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Digital Disruption in Banking

Xavier Vives*

IESE Business School

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Abstract

This review surveys technological disruption in banking, examining its impact on competition and its potential to increase efficiency and customer welfare. It analyzes the possible strategies of the players involved—incumbents and FinTech and BigTech firms—and the role of regulation. The industry is facing radical transformation and restructuring, as well as a move toward a customer-centric platform-based model. Competition will increase as new players enter the industry, but the long-term impact is more open. Regulation will decisively influence to what extent BigTech will enter the industry and who the dominant players will be. The challenge for regulators will be to keep a level playing field that strikes the right balance between fostering innovation and preserving financial stability. Consumer protection concerns rise to the forefront.

Keywords: FinTech, BigTech, digital currencies, blockchain, big data, bank strategy, competition, regulation, financial stability

JEL codes: G21, 23, 28; L13, 17

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1. INTRODUCTION

Since the 2007–2009 financial crisis, the banking industry has been faced with low interest rates, deleveraging and/or low credit growth, increased regulation and compliance requirements, and a damaged reputation. Along with the appearance of these threats, major changes have taken place in the banking sector in recent years. A decade ago, the 10 largest banks by assets were based in Europe or the United States, whereas currently the top 10 are dominated by 6 Asia-based banks. The reason for this shift can be traced not only to the crisis and the rise of Asia; banks have had to deal with all the threats arising after the crisis, as well as digital disruption stemming from increased competition in retail from financial technology (FinTech) and platform-based competitors. The profitability of the sector has been threatened, with European and Japanese banks barely covering their cost of capital. A legitimate question is what the top 10 list will look like in a decade. I note that the capitalization of large technological companies such as Amazon or Google is more than double that of JP Morgan Chase.

Banking is undergoing a transformation from being based in physical branches to using information technology (IT) and big data, together with highly specialized human capital. Even before this transformation began, banks and markets had become intertwined, with a higher proportion of intermediary activities becoming market based. Banks face greater competition from other intermediaries, increasingly digital, in their core businesses, such as payment and advisory services. A change in the use of technology in developing new services and business models has been unfolding with the rise of the FinTech sector, which can be understood as the use of innovative information and automation technology in financial services. The speed of adoption of the different new digital technologies and of the acquisition of users associated to them has accelerated markedly. Indeed, the major change is now coming from digital disruption of the sector, which is leaving incumbents with potentially obsolete legacy technologies (e.g., mainframes) and overextended branch networks to serve the standards of service that new competitors can provide. Customers have new service expectations in terms of user-friendliness of the interface and transparency. In Asia and Africa, technological leapfrogging has extended banking services to previously unbanked segments of the population.

Digital technology may have a large impact in terms of increasing competition and contestability of banking markets. Banking will move toward a customer-centric platform-based model, and incumbents will have to restructure.[1]

[1]Traditionally, banks have focused on the provision of products, while digital companies have moved

This digital disruption offers the potential to improve efficiency with innovation, enhanced supply diversity, and a more competitive financial system that yields market extension augmenting financial inclusion. This disruption will put pressure on the margins of incumbents, perhaps leading to increased risk taking, and will start a competition to capture the rents in the sector. In order to achieve improved efficiency, the incumbents must restructure simultaneously with the entry of the new competitors, and new dominant positions should not become entrenched. The new entrants, FinTech and especially BigTech (i.e., large technology companies that expand toward the direct provision of financial services or products),[2] should gain market share because of efficiency gains rather than by bypassing regulation or monopolizing the interface with customers. Furthermore, regulators must strive to detect new threats to financial stability from the new forms of systemic risk derived.

The remainder of this review is organized as follows. Section 2 describes the technological disruption to the banking/financial sector. Section 3 deals with the interaction between the new entrants and incumbents. Section 4 considers the impact of regulation, and Section 5 focuses on financial stability implications. Section 6 presents conclusions, and Section 7 addresses open research issues.

2. TECHNOLOGICAL DISRUPTION AND EFFICIENCY

Banks perform several important functions in the economy. The core one consists of maturity transformation and liquidity provision: taking deposits short term and making loans long term. This function is accompanied by the monitoring of opaque loans that would have trouble being funded by the market. A second function consists of payment and transaction services. Both functions rely on information processing of both hard information, verifiable and codifiable, and soft information, based on relationship banking. The digital revolution has greatly increased the weight of codifiable information and the tools that are available to process it, artificial intelligence (AI) and machine learning (ML) using mainly big data. Therefore, the functions that are more exposed to information processing, such as payment and transaction services, will be more affected (see Vives 2016, sect. 3.1, for an overview of banks' functions).

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the business model toward a more holistic approach that aims to solve clients' problems and set up new standards of service and customer experience. According to Investopedia, customer-centric "is an approach to doing business that focuses on creating a positive experience for the customer by maximizing service and/or product offerings and building relationships" (https://www.investopedia.com/terms/c/client-centric.asp; see Vives 2016, 2019 for an overview of competition in banking, with attention to recent developments).

[2]Typically, BigTech firms are platform based (e.g., Amazon, Google, Apple).

This section addresses first the supply and demand drivers of digital disruption followed by the impact of FinTech on efficiency.

2.1. Supply and Demand Drivers of Digital Disruption

Digital disruption in the financial sector is driven by factors both on the supply side, mostly technological developments, and on the demand side, accompanied by changes in consumer expectations of service (Carstens 2018, FSB 2019). On the technological supply side, relevant factors are internet application programming interfaces (APIs),[3] cloud computing, smartphones, digital currencies, and blockchain technology.

APIs have enabled service improvements, especially faster payments, and have provided support for easier unbundling of services. They have become the standard for data sharing in so-called open banking applications.[4] Such applications allow third-party access to consumers' bank data (with the consumers' consent) and are becoming a fundamental tool of digital disruption. They enable software applications to share data and functionality and represent a remedy for markets with high switching costs, increasing contestability as they help consumers compare product and service offers (e.g., OECD 2018). Cloud computing refers to the practice of using a network of remote servers, typically accessed over the internet, for the provision of IT services and for the storage and sharing of data. It has the advantage of flexibility in delivering services and cost-effectiveness. It has been used for customer relationship management, human resources, and financial accounting and is being tested for use in consumer payments, credit scoring, statements, and billing. Both APIs and cloud computing, if not securely managed or properly monitored, can give rise to new risks, endangering market structure stability. In this respect, the EU, the United Kingdom, Singapore, Japan, and Hong Kong have been developing frameworks for the application of APIs.

Mobile devices have become indispensable in consumers' daily lives, expanded the availability of financial services, and become a platform for third-party developers. They capture the client interface with multiple functions including payments (i.e., digital wallets), money transfers, and online shopping. Digital wallets are among the fastest-growing technology markets. Their integration is highly advanced in Asia, where payment apps are

[3]An API is a set of rules and specifications that software programs follow to communicate with one another and exchange data directly without the need for human input, and an interface between different software programs that facilitates their interaction.

[4]Open banking yields a secure way for providers to collect customers' financial information pertaining to accounts at a financial institution. In this way it enables third parties to provide services to bank customers.

currently serving a billion users and are part of a bundle with e-commerce, chat, deliveries, food ordering, and ride hailing.[5] Even though the traditional or high-street banks Visa and MasterCard are still the leaders of the market for transaction payments, nonbanks such as PayPal, Apple, and Google and new entrants such as Revolut, N26, and TransferWise are often behind payment innovations. For example, mobile-based payment schemes have a considerable effect in jurisdictions where the share of the population owning a current account is low. This is often the case in African countries, where only one-quarter of the population has a bank account but many more people have access to a mobile phone (*The Economist* 2015).[6] New payment systems as well as loans targeted to consumers with short credit history are often tested in such geographical areas, which represents technological leapfrogging for people who do not have a bank account but have access to banking services through their mobile phones.

Traditional payment systems and banking may also be disrupted by digital currencies. Cash is being used less and less.[7] The traditional functions of money are as a medium of exchange, as a store of value, and as a unit of account. Many examples of digital currencies already exist, such as Alipay and WeChat Pay in China, M-Pesa in Kenya, the Libra project sponsored by Facebook, and cryptocurrencies and stablecoins.[8] There is no consensus on the definition of e-money, but basically it is akin to bank money (e.g., deposit or debit card) but, in principle, without the guarantee of the government[9] (see the sidebar titled Digital Currencies).

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[5]Examples are applications offered by firms such as Alibaba and Tencent in China (see the sidebar titled The Case of China) and Grab in Southeast Asia.

[6]M-Pesa, a mobile-payment service launched by telecom companies Safaricom and Vodafone in 2007, offers common financing and microfinancing services such as deposits and bill payments and, in partnership with Kenyan banks, interest-bearing accounts, loans, and insurance. It became popular for instant and cheap money transfers through airtime, that is, prepaid mobile-phone minutes that can serve as currency. Following the initial success in its home country—three-quarters of Kenya's people are registered users—M-Pesa expanded to Tanzania, South Africa, Afghanistan, India, and Romania (Cent. Bank Kenya, Kenya Natl. Bur. Stat.& FSD Kenya 2019, CGAP 2014).

[7]In the EU, as elsewhere, there is an increasing trend toward contactless payments (EBA 2019, ECB 2018).

[8]In cryptocurrency systems, encryption techniques control the generation of currency units with the use of blockchain technology, typically of the permissionless type. This distributed ledger technology allows peer-to-peer money transfers, with transactions authenticated by many computers (belonging to users around the world) without the need for an intermediary. It is a collective bookkeeping system consisting of a continuously growing list of tamperproof public transaction records (Nakamoto 2008, Casey et al. 2018, Fatás 2019). The Libra coin, proposed by Facebook and the Libra Association on June 18, 2019, would be denominated in a basket of currencies and backed by bank deposits and short-term government bonds. Libra could be exchanged into domestic currencies according to the value of the basket of currencies.

[9]According to the European Central Bank: "Electronic money (e-money) is broadly defined as an electronic store of monetary value on a technical device that may be widely used for making payments to entities other than the e-money issuer. The device acts as a prepaid bearer instrument which does not necessarily involve bank accounts in transactions."

DIGITAL CURRENCIES

Different means of payment can be classified as objects, such as cash, central bank digital currency, cryptocurrencies including bitcoin or other digital coins, or claims such as money issued by banks or other intermediaries (Alipay, WeChat Pay, M-Pesa, or blockchain-based monies such as Paxos or USD Coin) (Adrian & Mancini-Griffoli 2019). Claim-based monies can in turn be categorized according to whether their redemption is at fixed value (e.g., bank money or e-money) or at variable value (e.g., Libra, which may have exchange-rate risk when converted into domestic currency). Other important distinctions are whether the redemption is guaranteed by the government (e.g., bank money) or, in principle, not (e.g., e-money) and whether settlement is centralized (e.g., cash, bank money, e-money) or decentralized (e.g., cryptocurrencies).

A key issue for digital currencies is stability. For example, bitcoin's value has fluctuated wildly. Central bank digital money, by contrast, would be perfectly stable (in nominal terms). E-money is exposed to liquidity, default, and market risk (including foreign exchange risk), which can be minimized by the issuers with prudential measures. E-money issuers typically hold bank deposits that are not protected by deposit insurance because those deposits are wholesale. Despite these limitations, e-money may gain ground, as it has done in China and Kenya, because of its convenience, low transaction costs (in particular for cross-border payments), complementarity with blockchain technology, and the power of network effects.

Digital currencies may threaten the banking sector with disintermediation if substantial retail deposits were to move to e-money providers. In that case, a crucial issue will be whether e-money providers will have access to central bank reserves, deposit insurance, and/or the lender of last resort. Some central banks, such as those in India, Hong Kong, and Switzerland, allow e-money providers to hold central bank reserves under some conditions, and in China Alipay and WeChat must hold clients' funds as reserves in the central bank (Adrian & Mancini-Griffoli 2019). In an extreme case of disintermediation, deposits would go to e-money providers that invest in very safe short-term assets and may even have access to central bank reserves, thereby becoming narrow banks, and finance companies would give loans and finance themselves in the wholesale market. Such disintermediation would represent a radical change, ending the fractional system by unbundling the main banking functions, as in the so-called Chicago plan (Fisher 1936). A cohabitation scenario of banks and e-money providers is more likely. In this case, e-money providers would complement banks' offers, either because they would cater to geographical and/or population segments not covered by banks or because they would form partnerships with banks. An intermediate scenario would also involve cohabitation but with banks and e-money providers competing for funds and forcing banks to improve both terms and service to retain customers, for example, by making payments faster and cheaper or by offering higher interest rates on deposits.

Digital currencies such as bitcoin have inherent drawbacks (e.g., the time and cost of transactions, regulatory uncertainty due to their facility for criminal activity and money laundering) that make them a speculative investment instead of a store of value and/or means

(https://www.ecb.europa.eu/stats/money_credit_banking/electronic_money/html/index.en.html). The European Commission's Directive 2009 Article 2(2) (available at https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0110&from=EN) defines e-money as "a claim on the issuer which is issued on receipt of funds for the purpose of making payment transactions." Adrian & Mancini-Griffoli (2019) define e-money as "electronically stored monetary value denominated in, and pegged to, a common unit of account such as the euro, dollar, or renminbi, or a basket thereof." According to the 2015 EU Payment Services Directive II (PSD2), by becoming a payment services provider or an e-money institution a firm can offer payment services; the US counterpart in known as a money services business.

to transact (see Auer 2019 for a survey of the technical problems with the "proof-of-work" system in bitcoin). However, blockchain technology could enhance new entrants' disruptive effects, since FinTech platforms could better exploit the potential cost-saving innovations allowed by this technology. This technology provides a means to achieve a decentralized consensus and may enlarge the space of potential contracts with so-called smart contracts, which can be enforced without the need for a third party.[10] This disruptive impact is exacerbated by the fact that traditional banks have specialized in intermediation activities, the need for which may be reduced by the blockchain technology. Smart contracts can lower contracting and verification costs and reduce informational asymmetries. However, the information distribution they require to achieve consensus may induce collusion (Cong & He 2019). In addition, market structure and regulation considerations (discussed below in Sections 3 and 4, respectively) may favor disruption. These include concentration in banking product markets, attenuated competition, and uneven regulation.

Demand-side drivers are linked to the greater service expectations of the mobile generation. Higher customer expectations result from the digitization of commerce and the real-time transacting capability of internet-connected devices offering greater convenience, higher speed, and better user-friendliness of financial services employed by Uber, Amazon, and the like (see the sidebar on P2P lending and robo-advising). FinTech firms have taken advantage of unmet customer needs in payments and transfers (such as international remittances), credit, and investment advice. Demographic factors and the decline in the reputation of incumbents also play a role, as younger generations are more likely to adopt FinTech products from digital banks.[11] Furthermore, some consumers might perceive FinTech credit, and especially peer-to-peer (P2P) lending, as more socially responsible and of greater social value than conventional banking (e.g., Ernst & Young 2017, IMF 2017, FSB 2019).

The digital revolution has changed the demand for financial services and led the sector to become more customer-centric. On the supply side, it has left incumbents with obsolete

[10]According to Investopedia, "Smart contracts are self-executing contracts with the terms of the agreement between buyer and seller being directly written into lines of code. The code and the agreements contained therein exist across a distributed, decentralized blockchain network. Smart contracts permit trusted transactions and agreements to be carried out among disparate, anonymous parties without the need for a central authority, legal system, or external enforcement mechanism. They render transactions traceable, transparent, and irreversible" (https://www.investopedia.com/terms/s/smart-contracts.asp).

[11]According to Raddon Financial Group, 85% of millennials in the United States (e.g., people born between 1981 and 1996) use mobile banking, and the prediction is that the share will be higher for the generation born after 1996 (*The Economist* 2019).

technologies, such as an overreliance on rigid mainframes, and an overextended branch network, while younger generations want to bank with their mobile phones. The sector has overcapacity and, perhaps worse, the wrong kind of capacity. The industry is facing a deep restructuring in a context of low interest rates and profitability (in particular in the Eurozone and Japan).

FINTECH INNOVATIONS: P2P LENDING AND ROBO-ADVISING

P2P lending platforms, in which individuals and companies invest in small businesses, enable the provision of credit without bank intermediation. They match borrowers and lenders directly: Some allow the lenders to choose the borrowers, while others form packages of loans, and online auctions are often used for this purpose. These platforms frequently provide business risk rankings to borrowers, obtained by algorithms using big data. P2P lending is prominent in China and is growing fast in the United States (leaders include LendingClub and Prosper, which target both retail and institutional investors) and the United Kingdom (with Funding Circle as leader). Other European countries where P2P consumer lending is growing are Germany, France, and Finland. The number of crowdfunding platforms (a version of P2P lending that allows projects to raise capital from a large pool of investors through an online platform) has increased significantly in EU countries, with France, the Netherlands, Italy, and Germany taking the lead, although in general the role of P2P lending is limited in the EU.

Another example of FinTech innovation is provided by so-called robo-advisors, which are computer programs that generate investment advice according to customer data. Through the use of ML tools, robo-advisors represent a cheap alternative to human wealth advisors. If programmed properly, they may help alleviate the usual conflicts of interest that are widespread in the banking sector. Nevertheless, robo-advising is still a young technology and represents only a fraction of overall financial advising; this is particularly true in Europe, where assets under robo-management amount to much less than those in the United States.

2.2. FinTech and Efficiency

The use of new technology has important implications for the welfare of market participants that may lead to lower financial intermediation costs in lending, payment systems, financial advising, and insurance, along with better products for consumers (see Philippon 2018, who emphasizes that the unit cost of financial intermediation has not gone down until relatively recently despite technological progress, as well as Vives 2017). Through online origination technology, FinTech firms offer more convenience to their borrowers. FinTech drives efficiency in several ways:

1. It can more effectively screen candidate borrowers via statistical models based on big data, thereby overcoming the information asymmetries that are at the root of the banking business. Importantly, information may be a substitute for collateral; therefore,

FinTech-based entities may be able to provide loans to firms and households without posting collateral (often, real estate). Furthermore, FinTech entities may be able to approve loans immediately, as the Ant Financial MYbank 310 loan application app demonstrates.[12] FinTech lenders process mortgage applications 20% faster than other lenders with no higher defaults and adjust supply more elastically than do other lenders in response to exogenous mortgage demand shocks.[13] To predict consumer default, easily accessible variables from the digital footprint (such as accessing a website) are as good or better than the information content of credit bureau scores (Berg et al. 2018).

2. It reduces the need for personnel (e.g., loan officers and tellers) and for an extended branch network (since customers use their mobile phones for banking).

3. It allows much more targeted price discrimination. For example, FinTech lenders employ interest rate–setting models for mortgages with superior performance compared with those used by non-FinTech institutions, since more of the variation in prepayment outcomes across borrowers can be attributed to interest rates in the case of FinTech loans. Furthermore, the convenience of online origination allows FinTech firms to charge higher rates, especially to low-risk borrowers, who are more likely to be less price sensitive and more time sensitive. Moreover, refinances of mortgages are 7% to 10% more likely to originate from FinTech firms compared with traditional banks (Buchak et al. 2018).

4. FinTech firms can increase financial inclusion by opening the door to financial services for less developed countries as well as segments of the population[14] and small and medium-sized enterprises (SMEs) currently unserved or underserved by banks. In particular, many SMEs in developing markets typically cannot fulfill the requirements

[12]Launched in 2018, the MYbank 310 lending app enables borrowers to complete their online loan applications in three minutes and obtain approval in one second with zero human involvement. With borrowers' authorization, MYbank analyzes real-time transactions to gain insight into their creditworthiness. By leveraging massive data from 16 million small and medium-sized enterprises (SMEs) in China in its portfolio, MYbank has, over its four years of operation, lent approximately $290 billion almost instantly, with a stunning default rate of (so far) 1% (Bloomberg 2019).

[13] Just from 2010 to 2016 in the U.S. FinTech lenders increased from 2% to 8% their market share in mortgages. See Fuster et al. (2019).

[14]An example is the service offered by International Smart Card (ISC) in Iraq, one of the most financially underserved regions of the Middle East, where according to The Global Findex Database 2017 of the World Bank fewer than one-quarter of citizens held a bank account in 2017. ISC, partially owned by two public banks, began as an electronic payment system but is gaining momentum as a means of electronically disbursing government salaries and benefits through a debit card to some seven million Iraqis (Cornish 2019).

for a loan application (e.g., they do not have their accounts audited).

5. Finally, FinTech firms have no legacy technologies to deal with and are characterized by a culture of efficient operational design, which, along with their often-smaller size in the case of FinTech firms, allows them higher innovating capacity than traditional entities.

Cloud computing is another source of efficiency for new entrants. The adoption of cloud computing by financial incumbents has been slower than in other sectors, which can be attributed to high transition costs, security concerns, and regulatory compliance complexities. An advantage emerges for FinTech companies, which can benefit from designing systems in the cloud from scratch instead of having to work on top of legacy IT systems.

FinTech firms have changed the structure, provision, and consumption of financial services, but have not managed to acquire a dominant position in the market. For example, FinTech firms have not yet made important inroads in corporate lending to medium-large and large firms. Despite its continuous growth, FinTech credit still represents a small share of total credit, even in China (where it has the greatest share of total credit activity), where it accounted for only 3% of total credit outstanding to the nonbank sector in 2017. FinTech credit tends to be more important in countries with higher income per capita and a less competitive banking system. Total FinTech credit per capita is high in the United Kingdom, United States, South Korea, and China. In South Korea and Argentina, BigTech firms provide a majority of FinTech credit (Claessens et al. 2018, Frost et al. 2019).

Although they initially aimed to replace traditional banks as leaders in the market, many FinTech firms have settled on forming partnerships with incumbents when faced with difficulties in increasing scale and customer numbers. Even though they have successfully led innovation efforts and raised customer expectations via innovations such as rapid loan adjudication, customers' willingness to switch away from incumbents has not met expectations, as the costs of switching and consumer inertia are high and incumbents have been adapting to FinTech firms' innovations (McWaters & Galaski 2017).[15]

An exception holds for geographical locations where incumbent service providers were absent and with market segments where customer needs were not met. In these cases, new entrants have managed to attain significant scale. China (see the sidebar titled The Case of

[15]An example of incumbent adaptation is Bizum, a joint mobile payment venture used by most Spanish banks (with some exceptions, such as ING). It allows individuals to send and receive funds in real time, connecting customers' bank accounts by linking them to their mobile phone numbers without requiring the use of IBANs (international bank account numbers).

China) and Kenya are good examples.[16] Another challenge for FinTech firms has been the need to build new infrastructure and introduce new financial services ecosystems; they have, instead, built upon traditional ecosystems and infrastructure. Although FinTech firms have not managed to change the competitive landscape, they have made some steps toward future disruption. The accelerating pace of innovation implies that the agility of the business model and the ability to quickly form partnerships, an area in which traditional banks are weak, are key to a financial institution's success.

THE CASE OF CHINA

China exemplifies the large effect FinTech and especially BigTech firms can have on the banking sector. Its mobile-based connectivity ecosystem, along with the scarcity of consumer-targeted bank offerings and the innovation-friendly regulatory framework, has allowed large tech companies to seize large market shares. P2P lending and mobile payments are well developed in China.

BigTech firms' financial activities include mobile payments for consumer goods. Such payments have become increasingly popular and now constitute 16% of China's GDP (versus less than 1% of US and UK GDP). In 2003 and 2004, Alibaba, China's most prominent online commerce company, took advantage of the underdeveloped payment system by introducing Alipay as a third-party online payment platform. Alipay, as part of Ant Financial,has been instrumental in Alibaba's success. It now offers payments, wealth management, lending, insurance, and credit scoring services; has more than 520 million users; and manages money at the same level as China's big four traditional lenders. The platform has managed to cover more than 50% of the US$5.5 trillion Chinese mobile payments sector; its only major competitor is the tech giant Tencent (which owns the dominant messaging and social network app WeChat), and the two firms account for 94% of the market. WeChat is used to make payments both online and in physical stores (it is often the only form of payment offered) and to settle utility bills. The total value of e-money transactions in China exceeds that of Visa and MasterCard combined worldwide.

The Ant Financial online money market fund Yu'ebao, the largest money market fund in the world, commanded US$200 billion in assets as of September 2018. Ant Financial is also a key provider of insurance services, holding a majority stake in Cathay Insurance China and a founding stake in ZhongAn insurance, China's first online-only insurance firm with 535 million insured customers. China is the largest market for FinTech credit, with 2,525 FinTech credit platforms by the end of June 2017, and FinTech credit volumes have been steadily growing, with cumulative lending reaching RMB 1.359 trillion (US$215 billion) in the first half of 2017. The search engine Baidu has also moved into banking and financial services.

Overall, smartphones have evolved into a major platform for the provision of alternate services in China. Single platforms integrate online shopping with mobile phone wallet and money transfer capabilities (McWaters & Galaski 2017, Carstens 2018, FSB 2019).

The United Kingdom, the United States, Singapore, Germany, Australia, and Hong Kong are the leading FinTech hubs on the basis of talent, access to funding, government policies, and demand for FinTech services (Ernst & Young 2016). The impact of FinTech and BigTech has

[16]Other areas where expansion is significant are Southeast Asia and Latin America.

been more pronounced in China. Indeed, the Chinese BigTech giants (Alibaba, Baidu, and Tencent) are active in financial services provision (see the sidebar titled The Case of China).

Overall, the fundamental advantage of FinTech firms is that they operate as leaner businesses, benefiting from state-of-the-art technologies with no rigid legacy systems so as to allow a fast and flexible response to changing consumer preferences. FinTech is flexible enough to be able to work with legacy technologies. It allows the provision of a satisfactory mobile and digitally focused customer experience focusing on the banking activities with higher returns on equity (ROE) such as payments, advice, and distribution of financial products. At the same time, FinTech firms possess a regulatory advantage in that they are funded with much more equity than traditional banks. Last but not least, FinTech companies are able to attract talent from young, bright people (*The Economist* 2017). In contrast, the absence of an installed, loyal customer base; limited access to soft information about potential customers; a comparative lack of reputation and brand recognition; and a relatively high cost of capital are challenges that FinTech firms must try to overcome. Table 1 compares the advantages and disadvantages of FinTech firms.

Table 1 FinTech firms advantages and disadvantages

Advantages	**Disadvantages**
Superior technology free of legacy systems; leaner operation	Absence of an installed, loyal customer base
Friendly consumer interface and new standard of consumer experience	Limited access to soft information
Focus on activities/business segments with higher returns on investment	Lack of reputation and brand recognition
More equity funding	High cost of capital and small balance sheet
Ability to attract best talent	Lack of regulatory and risk management experience and expertise; lack of access to the central bank backstop without a banking license

BigTech platforms have most of the advantages of FinTech firms with practically none of the drawbacks (except for the last point of disadvantage). They have an established, loyal customer base and large quantities of customer data; a strong reputation and lobbying capacity; strong brand names; an ability to exploit network effects; and the capability to fund their activities with a low cost of capital. In particular, BigTech platforms have access to valuable business data and can benefit from their scale to provide financial services at a lower cost at

high volume. BigTech platforms with a focus on internet search (e.g., Google) gather information about customers from search activity; those with a focus on social media (e.g., Facebook) have direct personal data on users and their connections; and those with a focus on e-commerce (e.g., Amazon) have data on both sellers and buyers and their habits. The complementarities of BigTech business with financial services will depend on the type of data gathered. For social media and search companies, data will help with distributing and pricing financial services, while for e-commerce platforms, data will facilitate credit assessment (Freedman & Jin 2017 shows, for example, that data from social media need not replace the information contained in credit scores).

BigTech platforms already have a captive ecosystem, with high switching costs for customers, and can exploit economies of scope and efficient technologies to provide financial services. Therefore, BigTech companies are potentially much more disruptive to the traditional banking business burdened by legacy systems. In contrast to incumbents, which face stricter regulatory limits on activities and user data, BigTech companies can exploit the information collected in their platforms by nonfinancial activities to design new services in banking. BigTech platforms have penetrated more less-developed banking markets (in particular those with high mobile penetration) with payment services[17] and money market mutual funds (such as Yu'ebao for users of Alipay in China) and insurance offerings. With regard to lending, BigTech platforms tend to lend more in countries with a less competitive banking sector and less strict regulation. Furthermore, evidence from MercadoLibre in Argentina shows that BigTech lenders may have better predictive power for loan repayment prospects using big data ML and AI techniques (e.g., on platform transactions and reputation of sellers) compared with traditional methods using credit bureau information (Frost et al. 2019[18]).

However, both FinTech and BigTech firms are still lacking the extensive experience and expertise in risk management that represent one of the strengths of large banks. Indeed, incumbents already provide numerous financial products, some of them quite complex, and have access to cheaper funding due to their banking charters. Furthermore, they have accumulated information capital thanks to their long customer relationships and have a reputation for preserving customer privacy.

[17]In developed banking markets, Apple Pay, Google Pay, and PayPal rely on third-party infrastructures (e.g., retail payment systems or credit cards), while Alipay and M-Pesa rely on proprietary systems in less developed markets.

[18]As pointed out by these authors, however, this does not mean that this superior performance can be generalized, considering the soft information that banks use and looking at full business cycles and not only part of them.

The impact of both types of nonbanks is expected to be significant in terms of payment solutions and the provision of advisory services in capital markets, as well as in reshaping consumer expectations. In other retail banking markets, especially the origination and distribution of consumer and SME loans, the effect will be less clear cut. Digital technology transforms in general back office processing customer management, and data analytics.

FinTech will certainly increase the contestability of banking markets and increase competition in the short term. Whether the entry of BigTech platforms will entrench large players with dominant positions, and whether it may raise systemic risk concerns, is unknown.

3. NEW ENTRANTS AND INCUMBENTS: COMPETITION OR COOPERATION?

FinTech competitors are encroaching on the traditional business of banks, despite the efforts of the latter to adapt to the digital world. On the supply side, new competitors are able to use hard (codifiable) information to erode the relationship between bank and customer, which is commonly based on soft information (derived from the knowledge gained from the relationship between bank and customer). That is, technologically able entrants are able to process large quantities of consumer data (e.g., with ML techniques), while incumbents have been using these data, if at all, from personal contact and with idiosyncratic interpretation of their meaning. However, so far quite a few new competitors have refrained from seeking banking licenses so as to avoid compliance costs while attempting to skim profitable business from banks and profit from regulatory arbitrage (EBA 2019). On the demand side, new entrants try to profit from millennials' mistrust of banks by offering digital services (e.g., McWaters & Galaski 2017).

While banks have traditionally focused on the product, new entrants emphasize the customer, putting pressure on incumbents' traditional business model. Entrants must focus on the customer because clients are the very essence of their business, while incumbents come from a tradition in which the customers already had a relationship with the bank and were sold products. Indeed, a competitive advantage of retail banks, which may be eroded by the new entrants, is that they enjoy privileged access to a stable customer base who can be sold a range of products. The presence of deposit insurance may facilitate the entry of new competitors as digital banks, but in this case the entrants will have to pay the costs of bank compliance, which, together with banking licenses, will weigh heavily on smaller firms.

Notably, in the US mortgage market banks have a somewhat lower shadow cost of funding and provide higher-quality products than do shadow banks, but they have still lost market share because of their increased regulatory requirements (Buchak et al. 2018). FinTech outlets have

profited from this situation while relying on both explicit and implicit government guarantees (in this case, mortgage loans), since they have been able to unload their risk onto government-sponsored enterprises (GSEs), as discussed in Section 5, below.

Ultimately, new entry in the intermediation business will depend strongly on how regulation and government guarantees are applied. The United Kingdom has developed an environment to facilitate the entry of FinTech firms and mobile-only neobanks such as Monzo, Revolut, and Starling [with a single regulator, the Financial Conduct Authority (FCA), a sandbox,[19] and open banking]. In the United States, by contrast, there are many more barriers (fragmented regulators and rules that imply the need to have physical branches). Furthermore, strict regulations for banks (e.g., enhanced capital requirements) are moving activity to the shadow bank sector, and an increasing proportion of nonbanks are digital.

Crucial questions are whether and to what degree the emergence of new, nonbank competitors will intensify competition in retail banking. First, the lighter regulation of FinTech firms will play a central role in the competition between banks and new entrants. Second, exogenous and endogenous frictions and switching costs will affect online banking. For instance, institutions may respond to enhanced internet search facilities with obfuscation strategies, increasing friction in order to restore margins (Ellison & Ellison 2009). The result of such strategies may be loss-leader and bait-and-switch tactics. For example, online financial providers may try to attract customers by offering very low mortgage rates but with additional hidden, restrictive conditions, with the aim of persuading them to pay a higher rate with more lenient conditions.[20] In general, the enhanced price transparency made possible by the internet can have unclear dynamic pricing effects, as has often been observed in analyses of transparency.[21]

The strategies used by new entrants and by incumbent banks will depend on whether investment makes a firm tough or soft on the competition and on whether competition in the

[19]"A regulatory sandbox is a 'safe space' in which businesses can test innovative products, services, business models and delivery mechanisms without immediately incurring all the normal regulatory consequences of engaging in the activity in question" (Financial Conduct Authority, 2015).

[20]Sometimes these practices aim to exploit the behavioral biases of consumers who may be overoptimistic or pay little attention to contracts by offering, for example, attractive initial conditions such as teaser rates for credit card borrowing. Consumers may then sign a contract with an overvalued perception (see Vives 2016, sect. 4.3.2).

[21]Transparency from the point of view of the consumer tends to be procompetitive, but dynamic effects are ambiguous. While it is tempting to undercut a collusive agreement when there is more consumer transparency (because it increases the effective demand elasticity of the bank), more severe punishments for the deviants are also possible. Transparency from the point of view of banks is always good for collusion because it makes price cuts easier to detect (see Schultz 2005; Vives 2016, sect. 4).

marketplace involves strategic substitutes or complements—that is, whether an increase in the action of a rival (e.g., price) leads to a decrease or increase in the action of the firm. Thus, depending on the underlying industry characteristics, an incumbent may decide to accommodate or prevent entry (Fudenberg & Tirole 1984; Vives 1999, sect. 7.4). An entrant may accomplish accommodation through nonaggressive strategies, such as a commitment to remain small or form a partnership with the incumbent. For an incumbent, the best commitment not to be aggressive may be to have a large installed customer base. In other cases, incumbents may try to prevent entry by shutting out entrants from infrastructure. For instance, should new entrants need to rely on incumbents' payment infrastructure to offer services, the incumbents may choose not to offer access to their infrastructure.[22] Another way for traditional banks to prevent entry is to degrade the interconnection between the candidate entrants and their infrastructure, thus raising the costs for entrants (Salop & Scheffman 1987, Economides 1998). This strategy is analogous to what has been observed in the case of ATM networks, where large banks have chosen to limit compatibility.

Incumbents may also use bundling and tying strategies to respond to entry. A stylized representation has an incumbent present in adjacent market segments, holding substantial market power in segment A (e.g., personal accounts and mortgages) and facing competition in B (e.g., insurance products and credit cards) (see Rey & Tirole 2007 for the general framework). The bank may either integrate those activities or try to leverage its market power in segment A by tying product B. This strategy is not effective when the goods are independent and B is produced competitively at constant returns to scale, which is the classical Chicago School doctrine. Tying may serve as a deterrence strategy or as an accommodating strategy. As a deterrence strategy, it increases the aggressiveness of the incumbent and requires the entrant to succeed in both markets. Tying can be effective in foreclosing entry when it is irreversible and the degree of complementarity between A and B is not too high, when there are cost links between markets, or when entry in B is uncertain, since tying then makes entry more costly and uncertain given that the entrant has to succeed in both complementary markets (see Whinston 1990, Carlton & Waldman 2002, and Choi & Stefanadis 2001, respectively). As

[22]In relation to this issue, the UK Payment System Regulator, a subsidiary of the Financial Conduct Authority (FCA), may impose requirements regarding system rules and require operators to provide direct access to payment systems. An example of attempted foreclosure of entrants is the case brought by Brazil's competition authority, the Administrative Council for Economic Defense, against Banco Bradesco for restricting the financial management app GuiaBolso from accessing its customers' data. GuiaBolso allows the bank's customers to compare credit offers from several financial institutions (Richards 2019).

an accommodating strategy, it may serve as a price discrimination device among heterogeneous customers. Most often, tying by the incumbent will decrease innovation incentives of the rival but increase those of the incumbent. As stated above, innovations in payment systems are generated primarily by new entrants.

In summary, the incumbents may partner with the new entrants, buy them up partially or totally, or decide to fight them. The details of each segment of the market will matter for the decision, and so will the extent of legacy technologies in each institution. Indeed, the response of institutions is likely to be heterogeneous according to their specificity. The new entrants may decide to enter at a small scale and grow from there, or they (the internet giants in particular) may attempt large-scale entry by controlling the interface with customers. Indeed, BigTech may leverage its dominance in certain areas, such as search or online retail, by tying financial services to its core offer. In any case, banking is moving from being relationship based, where soft information is crucial, to market based and data driven, where hard information predominates.

3.1. Player Strategies: Incumbents and FinTech firms

Incumbents may accommodate entry in some market segments and try to prevent it in others. In the presence of high switching costs for customers, an incumbent bank will behave as a so-called fat cat to protect the profitability of its large customer base. This behavior may allow a new entity to enter and attract, for example, technology-savvy customers or even unbanked consumers. Banks may prefer to accommodate entry because they receive interchange fees from new service operators and because the cut in revenues to banks for each purchase may be more than compensated for by the increase in customers' aggregate transactions.

On occasion, an entrant may want to commit to remain small so as not to elicit an aggressive response from incumbents.[23] For instance, P2P lending is a way to perform small-scale entry if it caters mostly to unbanked segments of the population. Entrants and incumbents may form partnerships so that the incumbents would benefit from both IT knowledge and regulatory arbitrage, as the new entrants experience lighter regulation, or so that they can reach new customers.[24] At the same time, FinTech firms may benefit from incumbents' established

[23]This is the concept of judo economics developed by Gelman & Salop (1983) and corresponds to the "puppy-dog ploy," in the terminology of Fudenberg & Tirole (1984).

[24]Examples are LevelUp, Simple, and LendingClub. LevelUp, launched in 2001 in Boston, established a partnership with Bank of America to allow mobile phone payments at points of sale. There are no interchange fees, and LevelUp receives income when consumers see ads on their phones. Simple is a US nonbank entity offering online deposit services without physical branches, which used to split interchange fees and interest collected with Bancorp in exchange for deposit facilities. It was acquired

brands, economies of scale, and distribution channels, as is the case for ING and Scalable in Germany. In another example, TransferWise, a retail foreign exchange platform offering an alternative to high bank transaction fees, has recently begun operating with banks such as N26 in Germany, Starling in the United Kingdom, and LHV in Estonia in order to expand its customer base. However, the case of new (licensed) banks' entry may be less likely, given the high compliance costs involved.[25] Obviously, established banks may also launch their own fully online banks.[26] Table 2 compares the potential strategies of incumbents and FinTech firms.

Table 2 Strategies: incumbents and FinTech firms

Incumbents' strategies (discriminate by segment)	**FinTech firms' strategies**
Accommodate (fat cat) • In the presence of high switching costs • To gain interchange fees paid to them by new service operators	Commit to remain small (puppy-dog ploy) • No banking license (e.g., with person-to-person lending that serves unbanked segments of population) → Form partnership
Fight, prevent entry (top dog) • Shut down/degrade access to infrastructure	Entry as a (licensed) digital bank • Less likely given the high compliance costs involved
Launch their own fully online banks	→ Consolidate or sell to incumbents

In any case, the strategies of both incumbents and entrants will be conditioned by regulation. In the United Kingdom the FCA has facilitated entry to the market, while in Singapore the government has pushed incumbents to upgrade digitally.[27]

3.2. Player Strategies: Incumbents and BigTech Platforms

BigTech platforms' primary business is technology and data, and unlike small FinTech firms, they also have important scale and scope economies, large installed customer bases, established reputation and brands, deep pockets from retained earnings, and unfettered access to capital

by BBVA in 2014. LendingClub has collaborated with Citigroup on loan financing.

[25]An early example of a new entrant profiting from online banking was ING in the 1990s. An example of a new entrant in the United Kingdom using branches and outsourcing its IT platform to reduce costs is METRO Bank, but it has had trouble expanding and becoming profitable.

[26]Examples include Open Bank in Spain, owned by Santander, and Boursorama in France, owned by Société Générale.

[27]The largest Singapore bank, DBS, has moved more than 80% of its computer capacity from mainframes into the cloud, while FinTech firms in Singapore have transitioned from serving consumers to providing digital services to banks (*The Economist* 2019).

markets. Thus, in principle they can compete head-to-head with incumbent banks either (*a*) by becoming banks (intermediaries) and exploiting economies of scope, bundling their existing offerings with traditional banking products, or (*b*) as multisided platforms (marketplaces), focusing on the most profitable banking activities (McWaters & Galaski 2017, de la Mano & Padilla 2018).

Big Tech firms may become banks and leverage their superior information about consumer preferences, habits, and conduct; they can control the shopping experiences of many consumers and now the distribution and commercialization of many suppliers. They have not only superior big data but also an advantage in terms of the tools (e.g., AI algorithms) used to analyze them in order to understand customers' needs and influence them. BigTech firms may also be able to offer new services by bundling their existing services (e.g., e-commerce, online advertising) with traditional banking products. One of the first ways to compete for giant e-commerce platforms (e.g., Ant Financial and JD.com in China) that hold huge quantities of accurate data on customer spending habits would be the provision of small loans. Combined with strong financial positions and access to low-cost capital, BigTech firms could achieve scale and scope in financial services very quickly, especially in market segments where network effects are present, such as payments and settlements, lending, and insurance. However, BigTech platforms may opt not to accept deposits, as doing so would constrain their innovation capability by imposing the same regulatory obligations that the incumbents have to fulfill. Furthermore, by trying to establish banks, they may run afoul of the separation rules between banking and commerce/industry in several jurisdictions. [28]

Acting as marketplaces, platforms will offer the ability to deal with different financial institutions. Platform delivery of financial products may well become the dominant distribution model. As multisided platforms, BigTech firms can target incumbents' most profitable business segments. For example, according to a McKinsey report (as cited by de la Mano & Padilla 2018), they could claim a share of the banks' distribution business (which generates 47% of their revenues and 65% of their profits, with ROEs of up to 20% compared with average ROEs that may be below 10%).[29]

BigTech companies can use a so-called platform envelopment strategy to exclude other intermediaries by using their data superiority (since they have complementary sources of data

[28] In the US Walmart was refused twice a banking license.

[29] BigTech firms are already encroaching on the banking business: Amazon provides lending and factoring services for SMEs, and Rakuten issues credit cards and offers brokerage and mortgages. Amazon profits from its vast information on sellers, which allows it to cherry-pick the best borrowers.

about customers from other lines of business). This strategy is a version of the embrace and extend strategy initially used by Microsoft to control the web browser business by doing what its rival (Netscape) could do and more. The strategy is more likely to succeed when the platforms' users have a large overlap with the intermediary that wants to be excluded and when economies of scope are high. Note that consumers served by a specific platform, such as Android or iOS, are likely to use this platform for many of their banking needs. This means that the platform will be the gatekeeper of a fraction of customers and that banks will have to be present in the different competing platforms/ecosystems.[30] Furthermore, BigTech platforms may cross-subsidize financial and nonfinancial products and obtain a competitive advantage.

The source of the market power of BigTech platforms is a feedback loop that generates vast quantities of customer data with the activity of the platform, processes the data with AI and ML techniques, exploits network externalities, and in turn generates more activity and more data (with dynamic economies of scale, since more data lead to better algorithms and prediction capacity).[31] This feedback loop consolidates an ecosystem with high endogenous switching costs for customers to change platforms. Financial services may complement and reinforce the platform business model. A first natural step in this direction would be to offer payment services. This would come in the mature phase of the development of the BigTech business. [32] Table 3 displays the potential strategies of incumbents and BigTech platforms.

[30]According to Eisenmann, Parker & Van Alstyne (2011, p. 1270), "Through envelopment, a provider in one platform market can enter another platform market, and combine its own functionality with that of the target in a multi-platform bundle that leverages shared user relationships. Envelopers capture market share by foreclosing an incumbent's access to users; in doing so, they harness the network effects that previously had protected the incumbent." See de la Mano & Padilla (2018) for a forceful argument on how Big Tech may radically change the banking industry.

[31]See Brynjolfsson & McElheran (2016) for the importance of scale in scope in data-driven decision making. Bajari et al. (2019) study how big data help forecast retail demand at Amazon. In the digital environment, entrants that are more efficient at processing information will grow faster than incumbents, since the former have the incentive to produce more data for which they are better processors (Farboodi et al. 2019). Prat & Valletti (2019) point out that a monopolistic platform may have an incentive to create an attention bottleneck by reducing the supply of targeted advertising and capturing it

[32]Big Tech firms start by attracting a critical mass of users to the platform, usually with no charge for customers; add functionalities to enhance user experience; and create an ecosystem that will increase the costs of switching to other platforms. In the growth phase, they exploit economies of scale and network externalities to reach the tipping point. In the mature phase, they exploit economies of scope across products and services and make heavy use of big data analytics.

Table 3 Strategies: incumbents and BigTech firms

Incumbents	**BigTech firms**
Accommodate • Cooperate with partnerships • Provide specialized unique banking products and services	Accommodate • Partnerships
Fight/compete head-to-head by becoming platform/marketplace • Profit from superior trust (?) from customers and data security • Better regulatory navigation skills and similar lobby power than BigTech firms • Cannot match BigTech firms' bundling/cross-subsidization strategy with complementary financial and nonfinancial products (despite enjoying some network effects)	Compete head-to-head • Become banks/intermediaries bundling their offerings and exploiting economies of scope - Opt not to accept deposits to avoid regulation • Multisided platform (marketplace) - Platform envelopment - Gatekeeper: monopolize interface with customers

BigTech platforms, when dominant, have successfully discriminated in favor of their own upstream or downstream affiliates in their central platform (according to the European Commission, in a string of three antitrust cases against Google in the EU, because Google exploited its dominance to favor its own vertical business in two instances and tried to protect the dominance of its search engine by leveraging its dominance in operating systems with Android in a third instance).[33] It is not far-fetched to think, then, that through technology and their extended customer bases BigTech firms could monopolize the interface with customers by controlling loan origination and the distribution business, with the incumbents taking deposits and investing in products distributed by BigTech firms (see **Figure 1**). A related prospect is that a first mover and unregulated e-money provider, through the exploitation of

[33]All cases involved large fines. In 2017, Google was fined €2.42 billion by the European Commission for anticompetitive behavior by using its online search engine to give an illegal advantage to its own online shopping service. In 2018, a record fine of €4.3 billion was imposed on Google because its contracts forced manufacturers of Android devices and mobile network operators to preinstall the Google search engine as a condition of using the smartphone store app Google Play. In 2019, the European Commission (EC, 2019, Press release of Antitrust case AT.40411 Google Search (AdSense)) reported that Google had imposed a number of restrictive clauses in contracts with third-party websites across the European Economic Area between 2006 and 2016, and it fined the company €1.49 billion. Google's misconduct involved blocking rival online advertisers by exploiting its dominance in search through AdSense. The result of the misconduct also favored Google's vertical business versus its competitors' (see European Commission Cases AT.39740, AT.40099 and AT.40411).

network effects and the benefits derived from access to massive amounts of data, could monopolize digital payments by denying (or making difficult) interoperability with other e-money providers (Adrian & Mancini-Griffoli 2019).

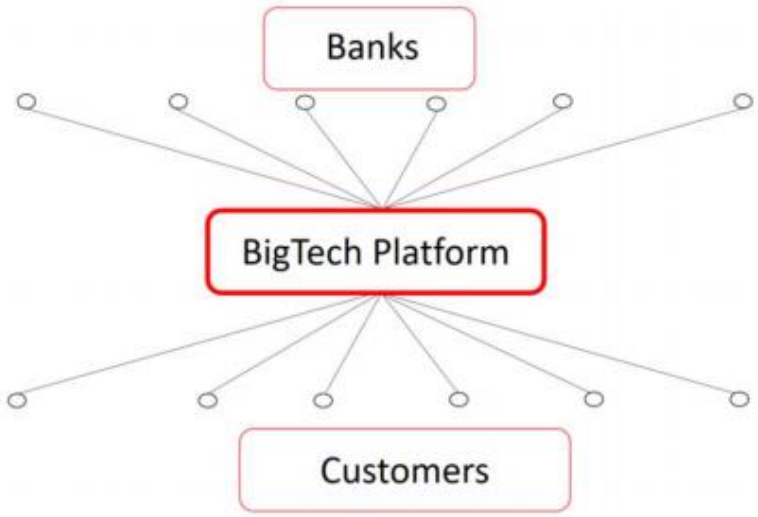

Figure 1. A world where a BigTech platform controls the interface of the customers in its ecosystem and where banks compete to supply products and services through this platform.

BigTech firms are likely to lead to increased competition, but in the long run this effect could be reversed if they dominate the customer interface. In markets with network externalities, once an operator has attained a critical market share—a tipping point—it may gain dominance. History has shown that when BigTech firms enter industries with long vertical value chains, they can use their comparative advantage to monopolize the segments where they operate and then expand their monopoly power to other layers of business through network effects, as the saga of abuse-of-dominance antitrust cases brought by competition authorities (mostly in the EU but also in the United States) against Microsoft, Google, and Apple has made clear. A greater market share of BigTech may be associated with unchanged or higher concentration, along with a change in composition away from traditional players. A striking example is the mobile payments market in China, where two firms account for approximately 94% of the overall market.

On the side of the incumbents' strategies, there are a couple of possibilities. Matching the BigTech firms' bundling strategy is not one of them, because it is very difficult to dispute the dominant position of BigTech firms in nonfinancial products and services that can be bundled with banking products and services. The alternative strategy is to cooperate with other third parties. Banks would have to transform their proprietary business into an open platform, shared

with other banks and financial intermediaries, to benefit from the coinvestments of all platform participants. Platforms may steer business away from some sellers (e.g., banks) to favor others that either are part of the same business group or may pay for prominence. As incumbents cannot directly imitate the bundling strategy of BigTech firms, they may develop into open platforms that also offer products of rivals. They may choose to compete head-to-head with BigTech firms (since they enjoy some limited network effects), or they may cooperate by forming partnerships. In the latter case, the question of who will control the interface with customers is crucial; if it is BigTech firms, then banks will experience reduced profit margins with their businesses commoditized, and they may opt to specialize in specific customer groups. Partnerships may be formed, as has been the case with Amazon and JPMorgan Chase, Apple and Goldman Sachs in the offering of credit cards, or Amazon and Bank of America in loan provision. Indeed, there are scenarios in which there may be no other viable option for traditional banks but to cooperate with BigTech platforms.

In any event, incumbents will have to restructure, and the current overcapacity, together with the need to invest heavily in IT in a low-profitability environment, will lead to consolidation. Small banks may be able to survive if they can outsource their IT needs by using cloud services, for example. Incumbents may benefit from new entrants' superior data security and better skills in navigating the regulatory maze.

3.3. Summary

An early effect of digital disruption will be the erosion of incumbents' margins and an increase in competitive pressure and contestability of banking markets. The long-run impact is not as clear cut, although in a likely scenario competition will also increase. The long-run impact will depend on the extent of BigTech firms' entry into the market and on whether several firms (perhaps including some platform-transformed incumbents) manage to monopolize the interface with customers and appropriate the rents in the business.

Incumbents have limited options for staying in business if BigTech firms enter the banking sector in full force. Either they can become platforms and compete directly with BigTech firms by trying to compensate for the latter's superior data capabilities, perhaps greater client trust and security (banks are good at keeping secrets), and better ability to navigate the regulatory maze, or they can become specialized in unique financial products that the BigTech firms cannot offer and therefore cannot commoditize. In any case, incumbents will have to restructure, and consolidation will occur.

FinTech firms will divide into (*a*) specialized service firms with no banking license and (*b*)

digital banks. The former will form partnerships with the incumbents, while the latter will consolidate or sell to the incumbents. BigTech will enter into banking services—it is already doing so—because of the high complementarity between the financial services and customer knowledge they have and the products they offer (this is the situation in China, which started from a much lower banked customer base). The question is how far they will go, which will depend largely on regulatory treatment.

4. COMPETITION AND THE ROLE OF REGULATION

What are the regulatory consequences of digital disruption? How should BigTech and FinTech firms be regulated? It is clear that regulation will influence the type of competition between incumbents and entrants. A main issue is whether regulation should aim at a level playing field or whether it should favor entrants in order to promote competition.

The 2007–2009 financial crisis has given rise to new approaches with respect to competition in the financial services sector. A case in point is the 2015 UK reform in which the FCA gained concurrent powers for enforcement of competition policy. Supervisory authorities of several countries now hold some competition-related powers.[34] Concurrent powers between supervisors and competition authorities introduce some complexity, but it is beneficial that consumer and investor protection in the financial sector are under the same roof as competition, since consumer protection and competition have a common goal: consumer welfare (Vives 2016, sect. 7.1).

Although most current supervisory frameworks predate the emergence of FinTech, several examples of post–financial crisis regulatory initiatives are worth mentioning (FSB 2019). The 2015 EU Payment Services Directive II (PSD2) is a regulation that aims to enhance competition by granting open access to certain types of customer banking data for nonbank licensed providers of payment initiation services and account information services.[35] The goals

[34]For example, the Irish Central Bank (the prudential supervisor) gained the power to introduce mortgage rate caps (Carletti & Smolenska 2017).

[35]Under PSD2, banks cannot refuse the providers of the latter access to information regarding personal online banking accounts if customers allow it. According to the frequently asked question nº 23 at the European Union Payment Service Directive (https://europa.eu/rapid/press-release_MEMO-15-5793_en.htm) concerning to what extent the providers will have access to information on a payment or bank account: "These new providers will only be allowed to provide the services the payer decides to make use of. In order to provide these services they will not have full access to the account of the payer. Those offering payment instruments or payment initiation services will only be able to receive information from the payer's bank on the availability of funds (a yes/no answer) on the account before initiating the payment (with the explicit consent of the payer). Account information service providers will receive the information explicitly agreed by the payer and only to the extent they are necessary for

of the initiative are to make the use of internet payment services safer and more convenient; safeguard customers against fraud, abuse, and payment issues; and promote innovative mobile and payment services. For instance, PSD2 mandates that customers be able to use one app to see a list of all their accounts, even those with other banks.

Such examples can be found outside the EU as well. In 2017, Japan revised its Banking Act, which now includes provisions encouraging banks to open their APIs and facilitating banks' acquisition of or collaboration with FinTech firms. The goal is to foster innovation and enhance banks' efficiency. Also in 2017, the Canadian Competition Bureau completed a review of the payment services, lending, crowdfunding, and investment dealing and advice sectors. In 2018, Mexico approved a FinTech law introducing novel models (e.g., a regulatory sandbox) to grant third parties access to data via APIs. Fees can be required for access, which financial authorities must first approve in order to prevent excessive fees (FSB 2019). Finally, the Australian government has declared its intention to enforce a consumer data rights initiative sector by sector, starting from banking, which will grant customers the right to ask that their data be shared with third parties they trust (see https://www.accc.gov.au/focus-areas/consumer-data-right-cdr-0).

All these regulation initiatives will influence the type of competition between incumbents and new entrants. If regulation manages to ensure a level playing field, then the likelihood of head-to-head competition potentially rises. In contrast, policies that imply asymmetric regulation between FinTech and BigTech companies on the one hand and traditional banks on the other could encourage entry, augment contestability through lower switching costs, and enhance market transparency. This increase in competition in the short term will need to be balanced given that there is a potential long-term risk of monopolization by BigTech firms (and even by platform-transformed incumbents). PSD2, discussed above, mandates that banks allow authorized third-party providers (TPPs) access to customer data; notably, banks are obliged to provide customer data to authorized competitors free of charge. A similar scheme has been developed under the UK Open Banking initiative. In contrast, under the EU's General Data Protection Regulation (GDPR), TPPs—including BigTech platforms—have to facilitate data portability only in cases where it is technically feasible. The GDPR aims to give customers control over their data and requires active consent for data sharing. These regulations may place

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the service provided to the payer. The security credentials of the payment service user shall not be accessible to other third parties and will have to be transmitted through safe and efficient channels to the bank servicing the account. A dynamically generated code only valid for that specific transaction (linked to the amount and recipient) will have to be used in the authentication process" (see also Ernst & Young 2018).

banks at a disadvantage relative to BigTech platforms, as the latter will benefit from nonreciprocal access to valuable data (this point is highlighted among the concerns of financial institutions in the EBA 2019 survey). Since BigTech firms are the ones that would gain the most from access to bank customers' data because of the economies of scale and scope of their existing large databases, they would be willing to pay more for these data and their dominance may be reinforced.[36]

The playing field could be made even more uneven to the extent that BigTech platforms would remain unrestricted by risk and compliance obligations as they enter retail banking. Regulatory authorities, in particular when there is cooperation between incumbents and new entrants, will have to determine who will bear the burden of operational and security risks, as well as regulatory compliance.

According to Andrea Enria, former head of the European Banking Authority (EBA), the policy debate on technological and financial innovation has commonly been led by two opposing views: "regulate and restrict," which often proves ineffective, versus "let things happen," which implies heightened risks in shadow banks (Enria 2018). The EBA has argued in favor of a combined approach in the supervision of FinTech firms. The pillar of this approach is a tiered regulatory structure in which each firm must fulfill different regulatory requirements on the basis of the risks it faces, who its customers are, and the state of the financial sector and the economy in general. This regulatory structure aims to impose the same rules on activities of similar levels of risk. It can be achieved through monitoring innovation, assessing risks in relation to the public interest, and making selective use of the existing rulebook. Doing so can be a challenge for regulators, since it implies a higher degree of complexity in regulatory operations and a higher level of commitment from the authorities, as well as extensive dialogue with firms and integrated approaches within the EU single market. However, this approach has advantages in that it aims to control specific risks in a flexible way and, hopefully, may be better suited to changing financial markets.

The EBA's main recommendations for FinTech regulation out of a general consultation are to follow a pan-European approach to ensure equal treatment and to allow a large domestic

[36]Competition authorities are starting to worry about data as a source of market power. For example, in February 2019 Bundeskartellamt (the Federal Cartel Office of Germany) prohibited Facebook from combining user data from WhatsApp and Instagram. An important general issue is who has ownership of customer data. If left undefined, BigTech firms will have control over personal data even if they do not own them. In principle, the welfare-optimal solution, according to Coase (1960), is to give property rights to customers and let them trade in a competitive data market. Obviously, things are more complicated in practice, since the market need not be competitive.

market for FinTech firms to achieve scale and be able to compete globally. In an EBA consultation (EBA, 2018), more than 30% of these firms were reported to be unregulated, and incumbents in the consultation would argue that financial institutions offering the same type of services and being exposed to the same risks should have the same regulatory and supervisory requirements.

The policy tension is between extending the perimeter of bank regulation to all financial service providers and thus constraining financial innovation (and implicitly extending a state protection umbrella to the new entrants), on the one hand, and keeping the new entrants out of the perimeter completely and tilting the playing field in their favor, on the other hand. A balance must be found to allow the regulatory perimeter to cover all activities that have systemic risk potential, while being more lenient otherwise. Note also that it is entities, not activities, that are subject to failure and may generate systemic risk. There is a trade-off between regulation by activity, which fosters a level playing field, and protection against systemic risk of failed entities. The focus of the regulatory perimeter should be on the institutions that provide the core banking activity of the joint provision of deposits and loans.

The European approach tends to impose the same rules and supervision on the same services, regardless of the institution offering them (EBA 2017, Demertzis, Merler & Wolff 2018). However, this approach is difficult to implement, as regulation and supervision focus mostly on institutions rather than products and services. So far, regulators of FinTech services have tended to offer a regulatory sandbox that gives firms the opportunity to experiment without the regulatory burden faced by the traditional banking sector. The sandbox also gives regulators the chance to look for the most effective ways to safeguard stability while encouraging innovation.[37] The United Kingdom's pioneering experience in this area is considered positive for both the FCA and the firms because it has shown that the regulator can have a role in fostering innovation (Deloitte 2018).

Furthermore, regulation needs to account for interconnectedness and so-called step-in risk arising, for example, from activities seemingly outside of the traditional banking model but connected to banks through ownership, partnership, or sponsorship, which may imply guarantees. Step-in-risk may apply to the new partnerships between incumbents and entrants. Also, regulations should be technologically neutral, which will enable substitutability of

[37]The FCA has been a pioneer in the development of sandboxes, with three main objectives: (*a*) reduce the time to market of a new product, (*b*) improve access to finance, and (*c*) encourage innovation. The FCA has offered four different ways to engage consumers in the sandbox (Arner, Barberis & Buckley 2017).

technology as opposed to restricting firms to vertically integrated technology monopolies. A challenge will be to develop standards to favor market integration without imposing a specific technology.

Consumer protection is paramount in an open banking environment, since consumers should be assured of the integrity of the process. This requires that their transactions be traceable so that liability can be assigned if there is any breach. The enhanced ability to target customers for price discrimination purposes may exacerbate behavioral biases of the consumers who are more easily exploitable (see Shoar 2019 for credit card evidence). Consumer welfare needs to be protected or enhanced, which will result in a wider spectrum of providers to choose from, better accessibility and quality, and respect for data privacy, while mitigating risks of confusion and cyberattacks.[38]

Regulatory authorities must also consider that cross-border asymmetries in data protection regimes may lead to market fragmentation and impede international business operations. Specifically, there is a risk that firms based in countries with restrictive data protection regimes may be denied operation in other jurisdictions on the grounds of the firms' inability to undergo effective supervision from those foreign countries' regulatory agencies. The desiderata of supranational regulation and supervision are not foreseeable, given ring-fencing and security concerns, but it is worth investigating in international fora. The money laundering concern with FinTech is paramount and will drive regulatory international cooperation.[39]

Digital technologies can also answer regulatory authorities' questions, improve both regulation and supervision, and help both regulators and firms decrease the costs of compliance. New technology can be utilized to achieve more efficient delivery of regulatory and compliance requirements. This approach is known as RegTech, which the Institute of International Finance defines as "the use of new technologies to solve regulatory and compliance requirements more effectively and efficiently." (IIF 2016 page 2) RegTech has to come to terms with the supervision of data sharing starting from who owns the data to the operation of FinTech algorithms (e.g., robo-advisors) for consumer protection and market integrity purposes.

[38]Regulatory authorities are taking data privacy issues seriously. Witness the fine of US$5 billion imposed on Facebook by the Federal Trade Commission for data privacy violations for commercial gain (related to the Cambridge Analytica affair), as well as the requirement to follow stricter rules in the management of its users' data.

[39]This will be particularly true in KYC (know your client) provisions.

Competition Bureau Canada has recently provided an assessment of the FinTech phenomenon and proposed key policy recommendations (Compet. Bur. Can. 2017). They are a good example of how regulators are anticipating change in the banking sector (see sidebar titled Competition Bureau Canada's Assessment of FinTech).

COMPETITION BUREAU CANADA'S ASSESSMENT OF FINTECH

According to Competition Bureau Canada regulation should achieve the following:

1. Be technology neutral and device agnostic. Rules that a financial entity must comply with often refer to the technology used at the time of the development of the rules (e.g., a requirement for a so-called wet signature, or in-person collection of information). Although such regulation may have been effective in the past, rules that can foster innovation and the development of yet-to-be developed technologies are necessary.

2. Be principles based. That is, regulation should be based on expected outcomes and not on specific procedures to achieve those outcomes. For example, instead of prescribing the exact method of identification verification, regulation can simply require that the service provider verify identity, so that it allows for new and more effective ways of doing so.

3. Be function based. All firms should face the same regulatory burden, and consumers should have the same protections when dealing with competing service providers.

4. Be proportional to the risks that need to be mitigated. Nonbank entrants will thus compete on a level playing field, with incumbents providing similar types of services, and the risk of regulatory arbitrage will be limited.

5. Be harmonized across geographic boundaries. Differences in regulation across geographical areas can increase the compliance burden, impeding FinTech development.

6. Encourage collaboration. More effective collaboration among regulators will allow for a clear and unified approach to risk, innovation, and competition.

7. Introduce a specialized body that other agencies can refer to. This body would also serve as a one-stop resource for information and would promote investment in innovative businesses and technologies in the financial sector.

8. Facilitate access to core infrastructure and services. For instance, access to payment systems would allow new entrants to deliver new overlay services such as bill payment and foreign exchange services.

9. Promote open access to systems and data through APIs. Such access would allow FinTech firms to innovate, leading to the creation of applications that facilitate competitive switching.

10. Consider the potential of digital identification verification. This can reduce the cost of customer acquisition for new entrants (and incumbents) and customers' switching costs, as well as facilitate regulatory compliance where identity verification is required.

11. Continue to review their regulatory frameworks, ensuring that they remain effective in endorsing competition as new technologies emerge.

5. FINANCIAL STABILITY IMPLICATIONS OF DIGITAL DISRUPTION

Several sources of risk have emerged with the entry of FinTech and BigTech firms into the banking sector. To the extent that the entry of these firms reduces the profitability of the incumbents, the latter may take excessive risks in an effort to counterbalance the downward pressure on their profits.[40] In fact, the response of regulators to the rise in contestability and enhanced risk taking may be to raise banks' prudential requirements, which in turn may raise the incentives to bypass regulation and foster an increase in shadow bank activity. The result would be a self-feeding increase in shadow bank activity outside the regulatory perimeter. For example, macroprudential regulation tries to limit systemic risk, but the limits to leveraged lending imposed to banks may increase nonbank leveraged lending. This is exactly what happened in the United States with the leverage guidance provided by the Financial Stability Oversight Council (Kim et al. 2017).

The danger that heightened regulatory pressure will cause a rise in shadow banking activities is always present, as exemplified by the mortgage market in the United States postcrisis (see Plantin 2015 on how capital regulation should be designed under regulatory arbitrage). The postsubprime crisis tightened regulatory scrutiny in the United States, which led to a fast expansion of shadow banking. The market share of shadow banks in mortgages has nearly tripled in the eight-year period after the crisis, with the rise in shadow banking accompanied by a change of origination from physical stores to online intermediaries. For example, while FinTech lenders originated fewer than 5% of residential loans in 2007, by 2015 this share had climbed to more than 12%. The increased regulatory burden on traditional banks can explain approximately 55% of shadow banking growth in the examined period, whereas the remaining 35% can be attributed to the use of FinTech (Buchak et al. 2018). Furthermore, shadow bank lenders, of which FinTech firms represent more than a third of loan originators, have prospered, particularly in borrower segments and areas where regulation made the activities of traditional, deposit-taking banks more difficult. These borrower segments include the Federal Housing Administration ones characterized by high risk and low creditworthiness, as well as areas with low average income and significant minority populations. Importantly,

[40]Banks have excessive incentives to take risk in the presence of limited liability and moral hazard on the investment side. The effect is reinforced by deposit insurance (with premia not sensitive to risk) or implicit insurance with bailouts and too-big-to-fail policies. Strong competition may worsen the problem of excessive risk taking, because profits provide a buffer and increase the bank's charter or franchise value. In a nutshell, a bank with more market power enjoys higher profits and has more to lose if it takes more risk and fails and its charter is revoked (Keeley 1990, Matutes & Vives 2000). Similarly, banking competition erodes the rents of relationship banking (Besanko & Thakor 1993).

shadow/FinTech banks rely on guarantees provided by GSEs by unloading the loans they originate onto the GSEs. The composition of shadow bank funding has shifted from bank, insurance company (FinTech in particular), and other capital in 2007 to 85% of mortgages sold to GSEs after origination in 2015. As a result, the United States has gone from providing a housing subsidy via cheap deposits and private-label securitization to providing a subsidy to shadow/FinTech banks by allowing the latter to unload the loans they originate onto the GSEs, thus relying on guarantees provided by them.

The extent of the regulatory burden imposed on new entrants and the guarantees that the public sector offers to them will be crucial for their competitiveness vis-à-vis established incumbents. For example, if e-money providers have access to central bank reserves, then they would not suffer from market and liquidity risk and would become de facto narrow banks, presenting a formidable challenge to banks in terms of competition to attract funds (see Vives 2016, sect. 5.4, for an assessment of the consequences of narrow banking). This competition may have advantages such as fostering innovation, facilitating cross-border payments, avoiding potential monopolization of e-money provision, and making monetary policy transmission more effective,[41] but it would hurt banks and make their deposit base less stable. Banks should respond by improving customer service and increasing interest on deposits in order to retain customers, which would diminish their profitability. The erosion of the franchise value of deposits (as may have been the case with money market mutual funds) would limit their value as hedge for interest rate risk and therefore the ability of banks to provide credit.[42] Furthermore, in a crisis, the full insurance of e-money providers may induce a flight to safety of bank deposits above the deposit insurance limit.

If e-money providers do not have access to central bank reserves, then they would be subject to market and liquidity risk even if they deposit client funds as wholesale deposits. This would make the system less stable, since e-money holders would have an incentive to run to obtain the deposit insurance offered by banks if they fear instability of the e-money providers'

[41] Adrian & Mancini-Griffoli (2019) discuss those potential advantages and note that e-money providers' access to central bank reserves implies the creation of central bank digital currency (CBDC), which they call "synthetic" because the central bank would offer only settlement services to e-money providers. Keister & Sanches (2019) show that CBDC promotes efficiency in exchange but crowds out bank deposits, raising the cost of funding for banks. Brunnermeier & Niepelt (2019) show that the introduction of a CBDC need not alter allocations, credit, or the price system, provided that a pass-through mechanism is in place; according to this mechanism the "reserves for all" principle affects the composition of bank funding but does not reduce it (see also Fatás 2019).

[42] Market power on the deposit side allows banks to pay low deposit rates, which do not increase very much when interest rates go up. This hedging value has been checked empirically by Drechsler, Savov & Schnabl (2018).

investments. Furthermore, banks' funding may also become less stable, since the banks would have a greater proportion of volatile wholesale deposits (see Skeie 2019 for a model-based discussion of runs in a digital currency environment).

Other sources of risk associated with the new entrants involve the implications of digital disruption for information asymmetries and the potential impact on systemic risk. Regarding asymmetric information problems, platforms have a potentially ambiguous impact on moral hazard and adverse selection problems and therefore on financial stability. To the extent that FinTech platforms have low stakes in the loans they help to originate but not retain, moral hazard problems may arise. As platforms take a central role, mostly in the screening process for loans, as their main goal is to maximize loan volume and fee revenue, they may choose to let the quality of the loans decrease. This effect can be exacerbated by the fact that these platforms have little soft information, an area in which traditional banks have the advantage (Vallée & Zeng 2019). Moral hazard may also increase even when the platforms fund the loans they originate (as BigTech firms may do), since they will have incentives to expand credit in order to bolster their other platform businesses—that is, to sell additional products or services on their e-commerce platforms or to acquire complementary data to monetize through advertising.

Adverse selection issues also emerge. The double-blind nature of P2P lending renders adverse selection by borrowers more likely in online lending. Among consumers of comparable credit scores, default rates on P2P loans are higher relative to those on other types of credit (Balyuk & Davydenko 2018). Nevertheless, there may also be self-selection of less trustworthy borrowers in P2P lending, with credit scores imperfectly measuring trustworthiness. Furthermore, BigTech platforms may use their superior customer data and technology to engage in so-called cream-skimming, which allows them to screen out low-quality loans more effectively than both FinTech start-ups and traditional banks. As a result, traditional banks might end up bearing increased credit risk and adverse selection problems. The increase in competitive pressure may lead banks to take on even more risk in an attempt to recover profitability.

In short, it is possible that the development of FinTech and BigTech, despite their potential to reduce information asymmetries, will exacerbate informational differences between informed and uninformed investors, since the firms that can accumulate massive amounts of data and possess the technical ability to interpret and analyze them will come out ahead and may induce other lenders to be passive. Consistent with this hypothesis, there is evidence of a reintermediation process of P2P lending marketplaces because of their accumulation of

information advantage.[43]

Note also that asymmetric regulation may limit information sharing among financial service suppliers (e.g., on credit records) and consequently the efficiency of credit markets may be compromised given that consumers and firms can borrow from both banks and platforms.

With regard to potential impacts on systemic risk, there are several sources of concern. First, there is the possibility of development of a parallel payment system not adequately monitored by central banks, which could take place if BigTech firms deposit customer funds directly with banks, as is the case in China.[44] Second, a proportion of financial institutions may rely on a BigTech firm (or a few of them) that provides third-party services (e.g., data storage, transmission, or analytics), some of them in the cloud. In this case, a cyberattack or operational failure may pose a systemic risk. Third, the very existence of large online money market funds, such as Yu'ebao in China, which are not in principle insured, leaves them vulnerable to runs (which are possible, as we learned in the United States during the 2007–2009 financial crisis).[45] On the bright side, FinTech start-ups may manage to operate with less leverage than traditional banks (Philippon 2018). Fourth, if BigTech enters the core of banking, then systemic concerns will increase, since trouble in the nonbank business of the firm may contaminate the bank and would be very likely to be systemic. The prudential principles that call for separation of banking from commerce and industry apply here.

Regulators have to come to terms with a complex environment in which incumbent banks compete with nimble FinTech and established BigTech, and where new forms of systemic risk may arise. A key to prevention is early detection, and new technology should develop continuous monitoring tools that take advantage of big data to serve as early indicators of risk. These tools should be added to the developing ways to measure systemic risk based on market

[43] Balyuk & Davydenko (2018, from Abstract) state that "the peer-to-peer loan market was designed to allow borrowers and lenders to interact online without banks as middlemen. Yet we document that, in contrast to other trading venues, P2P lending platforms over time have become new intermediaries, and now perform essentially all tasks related to loan evaluation. By contrast, lenders are overwhelmingly passive and automatically fund almost all loans offered by the platform, forgoing potential benefits of active loan selection. The dominant role of lending platforms with little skin in the game makes the market vulnerable to moral hazard, checked by the threat of institutional investors' withdrawal. Our findings suggest that in markets without private information reintermediation may arise naturally as the platform's expertise in data analysis crowds out that of investors." This reintermediation process may increase the chances that P2P lending platforms end up tapping the safety net when they get into trouble.

[44] This can not only compromise financial stability but also render prevention of illegal activities such as money laundering more difficult to achieve. BigTech firms in China have to clear payments on a state-owned clearinghouse and must keep customer balances in a reserve account with the central bank (see the sidebar titled Digital Currencies).

[45] Chinese authorities have introduced a cap on instant redemptions for money market funds and have restricted BigTech firms to finance them to limit the risk of runs.

data and the network structure of links between financial intermediaries (see Vives 2016, sect. 3.1.2).

6. SUMMARY AND CONCLUSION

The digital disruption of banking promises to lead to a general increase in efficiency and service by helping to overcome information asymmetries (using big data and AI/ML techniques and blockchain technology), providing a user-friendly consumer interface and a higher standard of service, and ultimately replacing obsolete technology. Banking will thus move to a customer-centric platform-based model. All these changes present formidable challenges to incumbents, since they will have to update their technological platforms (moving from relatively rigid mainframes to the more flexible cloud), reduce branch overcapacity in the current low-profitability environment (particularly in Europe and Japan, where there are still legacy assets to dispose of), and try to reach the new standard of service by competing with the new entrants that are encroaching on the most profitable lines of business. Incumbents will have to restructure, and consolidation will occur. Incumbents will also face heavy regulatory scrutiny and compliance duties and will have to overcome the tremendous damage to their reputation caused by the 2007–2009 financial crisis. They will face the dilemma of whether to compete head-to-head or cooperate with entrants. In the case of FinTech, this dilemma will be resolved by acquisition or partnership.

With BigTech firms, however, the challenge posed for incumbents is greater. The main threat to incumbents is that BigTech firms will try to control the consumer interface by using their superior data, acting as gatekeepers to the distribution of financial products. If this were to happen, incumbent banks would be relegated to product providers on platforms they do not control: Their businesses would be commoditized. Some banks have already perceived this threat and either are offering open platforms that may incorporate products from other financial providers or are forming partnerships with BigTech firms. In any case, incumbents have some strengths that they can leverage, such as customers' trust that their data will be kept secure as well as accumulated knowledge on how to deal with complexity and intrusive regulatory environments. Incumbents that will perform well will have managed to transition from the mainframe to the cloud, be lean in bricks but heavy on human capital, and either become digital platforms to keep the interface with the client or have unique products to feed the platforms that will distribute the products to the customers.

BigTech companies will enter into financial services because of the complementarities of

those services with the customer data they possess and the products they offer, as the China example above shows. The extent of their entry will depend very much on regulatory treatment. Indeed, prudential regulators may not allow BigTech firms to acquire full banking licenses because of the possible contamination between bank and nonbank activities, generating systemic risk. In general, most new entrants are reluctant to ask for a banking license because of the compliance costs it entails. Banks have access to cheaper funds, because they can take deposits under the umbrella of explicit or implicit public insurance schemes, but they are subject to tight scrutiny.

There is no doubt that the short-run impact of the digital disruption will be to erode the margins of incumbents and increase the contestability of banking markets. The long-run impact will depend on what market structure ultimately prevails. Banking could move from the traditional oligopoly to a new form in which a few dominant platforms control access to a fragmented customer base if a few BigTech firms, together with some platform-transformed incumbents, monopolize the interface with customers and appropriate rents. To keep the market sufficiently competitive, it will be crucial to have data ownership and portability for individuals and data interoperability between platforms so that switching costs for customers are minimized.

As long as efficiency advantages such as superior information and screening technologies, leaner operation, and less leverage are what drive the entry of BigTech into banking, the financial sector can become more efficient and feature greater financial inclusion. This effect will be especially pronounced if, as a response to BigTech firms' entry, incumbents become more efficient by restructuring and adopting more-advanced technologies. Nonetheless, if the forces behind BigTech entry involve market power, taking advantage of regulatory loopholes, and bandwagon effects of network externalities for exclusionary purposes, then the efficiency of the banking system could suffer in the long run.

Digital disruption also poses a formidable challenge to regulators, which must adapt by facilitating competition and allowing the benefits of innovation to permeate the system while protecting financial stability. Regulators must coordinate prudential regulation and competition policy so that compliance does not become a barrier to entry and entry does not become destabilizing. Light regulation of entrants into the industry may foster competition, but at the potential cost of destabilizing incumbents by decreasing their profitability, increasing their risk-taking incentives, and transferring the generation of systemic risk to nonbank entities. As we have seen in the United States, for example, shadow banks (including FinTech firms) are already taking the lion's share of mortgage loan originations. We know that for most financial

crises, from the Panic of 1907 in the United States to the global crisis in 2007–2009, a shadow banking system was at their origin.

Regulators must ensure a level playing field that fosters innovation and maintains stability. However, to do so, they must treat dominant players (be they incumbents or BigTech firms) differently that small entrants in terms of regulatory compliance requirements. Lighter requirements for small, nonsystemic institutions will foster competition and innovation without endangering stability, as long as those entities do not correlate their strategies. Furthermore, maintaining a level playing field is easier said than done, considering, for example, the asymmetry in customer information sharing requirements in open banking in the EU between PSD2 (which applies to incumbents) and the GDPR (which applies to nonbank entrants). To maintain a level playing field, it will be crucial to allow data interoperability between product and service providers.

Regulators must be alert also to new forms of systemic risk. For example, if banking moves toward a platform-based system, the risk of systemic problems deriving from cyberattacks and massive data leaks will be prominent. Furthermore, the possibility of contamination of bank and nonbank activities in generating systemic risk will increase, as will the risk of failure of TPPs. The decision regarding what activities to keep inside the banking regulatory perimeter will have consequences, since regulating according to activities may foster innovation and a level playing field, but entities, not activities, are what may fail and generate systemic risk. Regulatory sandboxes may help at the small FinTech scale, but it is not obvious that they will work at the large BigTech or incumbent scale.

Consumer protection concerns come to the forefront. Regulators must, for example, establish who controls the data (in this area, the EU seems to be in the lead) and ensure security when transacting in platforms. They must also account for the fact that digital technology allows a greater degree of price discrimination, which calls for enhanced consumer protection. Regulators must take special care to foster the use of digital technology in a transparent way that minimizes the possible behavioral biases of consumers and investors. When dealing with customers, transparency is and will be a competitive advantage of digital banks that should permeate the whole sector. The cooperation of competition and prudential authorities should be extended to encompass the units responsible for consumer protection and data management.

In short, regulation needs to rise to the challenge of ensuring that the welfare-enhancing disruptive capability of new technology and platforms materializes, by delivering benefits to consumers and firms without endangering financial stability.

7. SOME OPEN ISSUES

The new digital world leaves many issues open for research. A fundamental one is: What is a bank today? Can the core bank functions of handling both deposits and loans be unbundled? What is the optimal policy of central banks with respect to digital currencies? Should central banks supply their own digital currency or allow private digital currency providers to access reserves? Will the new digital world attenuate or exacerbate the asymmetric information problems at the root of financial intermediation? How will blockchain technology and smart contracts change financial contracting and impact competition? How will the new digital marketing and price discrimination techniques interact with the behavioral biases of consumers and investors? What role will new entrants play in providing credit to people and firms that cannot post collateral? Will innovation be favored? How do we avoid the entrenchment of dominant positions in a platform-based banking world? To what extent will dynamic economies of scale and scope lead to a natural oligopoly structure in banking? How do we assign property rights on data and data portability rules to maximize welfare? How do we design systemic risk indicators for cyber-exposure?

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