

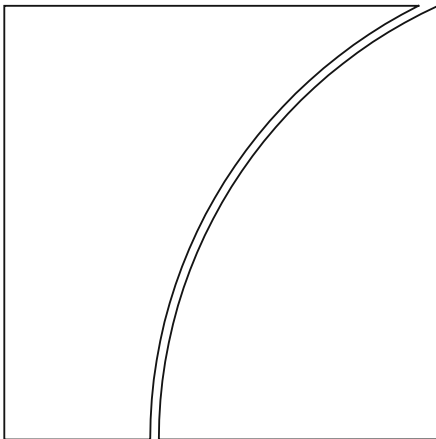
Basel Committee on Banking Supervision

Working Paper 43

Literature review on financial technology and competition for banking services

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7 June 2024



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ISSN 92-9131-870-1 (online)

ISBN 978-92-9259-759-7 (online)

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Literature review on financial technology and competition for banking services

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Executive Summary

The extent to which financial technology will shape the banking industry depends in part on the nature of competition for banking services that arises from innovation by incumbent banks and the entry of new players. This paper presents a review of the growing body of economic literature on financial technology and competition for banking services. The review highlights that fintech has spurred innovation and competition across banking services including in payments, lending, deposit taking and advisory services. Research finds that entry by new fintech-based service providers has expanded access to financial services and put pressure on the market share and pricing power of incumbent banks. The evidence also suggests that fintech-based firms that started out as lenders or payments providers have evolved to offer a broader range of services. We cannot fully know how ongoing innovation will affect business models, but so far, the literature highlights some enduring strengths for the model that bundles a variety of banking services in a single firm, ie, a bank.

¹ The work stream was led by Hein Bogaard. Comments by other members of the Research Group as well as from other Basel Committee groups are gratefully acknowledged.

1 Introduction and Overview

In recent years, technology has helped accelerate the pace of innovation in banking services. Financial technology (fintech) has been defined by the Financial Stability Board as “technology-enabled innovation in financial services that could result in new business models, applications, processes or products with an associated material effect on the provision of financial services” (Financial Stability Board 2017). This definition captures both the promise of better financial services, available to a greater number of clients (eg Philippon 2016), and the prospect that fintech could affect the viability of incumbents’ business models in financial and banking services.

The extent to which financial technology will shape the banking industry depends in part on the nature of competition for banking services that arises from innovation by incumbent banks and the entry of new players. In this context, a 2018 paper from the Basel Committee on Banking Supervision laid out several scenarios for the future structure of the banking sector (Basel Committee on Banking Supervision 2018). The scenarios are predicated on whether banks will continue to manage client relationships, the execution of transactions and risk taking, or whether these functions will be (partially) transferred to financial technology-based firms. As such, the scenarios describe a potential structure where financial technology has enabled firms to interact with clients without a dense branch network and made it easier to offer only a portion of the services that are available from vertically and horizontally integrated banks. Scenarios range from the “better bank” scenario in which incumbents innovate and continue to be dominant in providing banking services to a “disintermediated bank” scenario in which fintech-based firms manage both client relationships and the execution of services. In intermediate scenarios, incumbent banks are replaced by novel banks or operate alongside fintech-based firms dividing (in one way or another) client relationships, the execution of transaction services and risk taking among them.

This paper presents a review of the growing body of economic literature on financial technology and competition for banking services. The aim is to characterise this competition, its impact on banks’ business models and on the accessibility and price of services for customers.

The review highlights that fintech has spurred innovation and competition across banking services including in payments, lending, deposit taking and advisory services. Entry by new fintech-based service providers has expanded access to financial services and put pressure on the market share and pricing power of incumbent banks. Fintech-based firms have had some successes with business models that disintermediate banks such as peer-to-peer payments and lending. Yet, theoretical models and empirical evidence point to synergies between banking services and some fintech-based firms have evolved from being lenders or payments providers to offer a broader range of services. Future innovation may drive (further) unbundling or disintermediation, but thus far, the business model that bundles a variety of banking services in a single firm, such as a bank, has enduring strengths.

Consumers likely have benefitted from the entry of fintech-based firms through a further digitalisation of financial services, an expansion in the scope and reduction in the pricing of financial services. There is some evidence that the benefits are not equally shared by all consumers. For example, advances in data processing and machine learning enable lenders to more precisely discriminate between borrowers according to credit risk whereas some borrowers would be better off if credit risk were pooled (Fuster, Goldsmith Pinkham, Ramadorai and Ansgar 2022). Similarly, there are concerns about bias in algorithmic investment advice. However, biases also exist in advice or credit decisions by humans. On balance, the evidence appears to indicate that the improvements in efficiency and access that fintech affords are wealth improving.

Innovation in banking is not new and banks started introducing online services well before fintech-based firms were entering the market (eg Berger, Black, Bouwman and Dlugosz 2014, DeYoung 2005). Current research on financial technology builds upon this prior work. that finds a positive association between online banking and profitability. One important finding of this earlier literature is that technology adopters seem to be more profitable (see for example DeYoung, Lang and Nolle 2007 for the

US and, Hernando and Nieto 2007 for Spain). Another interesting finding is that competitive pressures induce the introduction of online services by even more banks, meaning that there is a feedback loop between competition and technology (Dandapani, Lawrence and Rodriguez 2018, Hernández-Murillo, Llobet and Fuentes 2010)

In addition to extending research on innovation, research with a focus on financial technology can build on a rich literature that studies competition in banking. One strand of this literature uses metrics of market structure or pricing power to study the determinants and effects of bank competition (eg Claessens and Laeven 2004). Other research has sought to understand how competition operates at the product level. There is a large literature on competition and asymmetric information in lending (Petersen and Rajan 1994, Sharpe 1990, von Thadden 2004). Theoretical models of network effects (Rochet and Tirole 2003) have been used to study competition in payments and empirical research on competition in deposit markets, payments, and increasingly lending markets has used discrete choice models to study what drives consumer preferences (Dick 2007, Kosse 2014).

The literature has also addressed more generally the cost and benefits of increased competition in banking services. For example, Drechsler, Savov and Schnabl (2017) find that greater competition for deposits increases rates paid to depositors, while Degryse and Ongena (2005) find that clients' cost of borrowing falls with the intensity of competition between banks.

There is also a substantial amount of research on potential adverse effects of competition in banking. Researchers have investigated concerns that information asymmetries may inhibit market entry (Dell'Ariccia, Friedman and Marquez 1999) and that competition could reduce information production and market efficiency (eg Hauswald and Marquez 2006). Considering the importance of information and information processing for the competitiveness of fintech-based firms, these concerns are quite relevant in the context of this literature review.

Another branch of the literature has investigated a potential link between competition and financial stability – driven by the concern that slimmer margins may encourage risk taking (see eg Vives 2016 for an overview). As pointed out in a meta-analysis by Zigraviova and Havranek (2016), there is no general consensus on the empirical significance of this mechanism (or indeed for the opposite conjecture that competition promotes stability). However, financial technology may introduce new channels of transmission from competition to financial stability. We still have much to learn about the bank failures in the US and Switzerland in the first half of 2023. The trajectory of these failures suggests that social media and online banking may accelerate the speed at which depositors and investors can withdraw their funding and support that no longer have the confidence of their clients. Furthermore, the process of innovation in banking services that financial technology enables will likely have winners and losers, which could lead to elevated levels of turnover in the future.

The sections of this literature review are organized along business lines considering that most researchers focus on a single line of business (payments, lending, funding or investment advice). However, financial technology in one line of business may also be a source of spillovers and synergies (Ghosh, Vallee and Zeng 2021, Stulz 2019, Vives 2019) and there are other issues that cut across business lines such as the role of the market environment in the development of financial technology products and the difficulties associated with measuring "innovativeness" of incumbent banks and potential entrants. We highlight these issues in the discussion and conclusion at the end of the paper.

The paper starts with a discussion of the literature on competition in payments. So far, financial technology has achieved most penetration in so-called account-based payment services, while the provision and adoption of token-based payment technologies (eg stablecoins) by businesses and consumers remains limited. The market for payment services is a two-sided market characterized by network externalities; successful service providers build a user base among both payers and payees (Baxter 1983, Rochet and Tirole). Empirical evidence on the growth of financial technology-based solutions in payments illustrates the importance of both accessibility to retail payment services and network effects. For example, mobile phone networks have been a "backbone" for the development of new payment

systems, especially in emerging markets, where fewer consumers and merchants have access to banks or card-based payments (Frost 2020, Jack and Suri 2014). Similarly, big tech companies have been successful in the introduction of payment or ancillary services in select markets; they have filled in gaps left by incumbents in emerging markets, engaged with incumbents to develop new services (often in advanced economies) or directly compete for clients (Brits, Cuijpers, Jonker, Lohuis, Roerink, ter Wal and Zwemstra 2021, Demircuc-Kunt, Klapper, Singer and Ansar 2022, OECD 2020). Public policy that requires acceptance of new fintech-based payments or provides fintech-based entrants access to retail payments markets promotes the adoption of new payment systems (Brits et al 2021, Duarte, Frost, Gambacorta, Wilkens and Shin 2022, Kukkola 2010). In addition, evidence from India and Brazil shows that an unanticipated drop in the availability of cash can lead to a lasting shift in the use of financial technology-based payments (Crouzet, Gupta and Mezzanotti 2023, Mariani, Ornelas and Ricca 2023).

There is some evidence that financial technology-based competition has reduced the cost of payments and put pressure on fees (BIS 2019, Jonker and Kosse 2022). This has contributed to greater access to payment services, although it remains unclear how this has affected incumbents; banks have engaged in innovation themselves and thus far, they also provide much of the underlying infrastructure for digital payments.

The literature on financial technology and competition in lending, which we turn to next, emphasizes the role of alternative data, information processing and regulatory burden. Fintech lenders usually do not take deposits and hence are subject to lighter regulation. This lighter burden allows fintech lenders to expand in both mortgage and small and medium-sized enterprise (SME) lending markets (Beaumont, Tang and Vansteenberghe 2022, Buchak, Matvos, Piskorski and Seru 2018, Di Maggio and Yao 2020). Moreover, improved access to data can spur the growth of FinTech lenders. Banks are able to gather information about borrowers from payments and deposit transactions, which confers a benefit of incumbency (Parlour, Rajan and Zhu 2022). Fintech-based entrants may be able to overcome a lack of access to banking data by exploiting data from other client interactions (fintech payments, or other businesses such as e-commerce or social media, Frost, Gambacorta, Huang, Shin and Zbinden 2019, Shin and Zbinden 2019, 2021). Similarly, FinTech-based firms tend to benefit from regulation that gives consumers more control of their financial data and enables them to share financial data with others than their bank, such as "Open Banking" rules (Babina, Buchak and Gornall 2022, Doerr, Gambacorta, Guiso and Sanchez del Villar 2022). Finally, FinTech-based firms have been shown to have superior information processing technology (Fuster et al 2022, Sadhwani, Giesecke and Sirignano 2020) which can lead to an improvement in the speed of decision-making and could improve default prediction (Berg, Fuster and Puri 2018). At the same time, there are some indications that the benefits of better information processing and open data rules may be greater for clients with good credit scores than those with weaker credit scores.

Beyond payments and lending, financial technology is also changing how banks compete for deposits and with whom. Online deposit-taking has the potential to increase the geographical reach of banks and therefore reduce market power that banks derive from having a physical presence in deposit markets (Abrams 2019). At the same time, some banks have gained access to new groups of depositors by partnering with fintech-based firms that seek to provide deposit services to their clients. Banks also face competition from providers of "deposit-like" products; the introduction of money market funds by big techs that are integrated with payments services in China has affected deposit growth among competing banks and appears to have increased the pass-through of policy rates into deposit rates (Zhu and Lu 2021). Finally, there is some emerging evidence that financial technology may affect the cost of liquidity for banks. Some issuers of asset-backed stable coins use safe assets to back up the coins. If these coins are issued on a large enough scale, prices of these assets may rise as a consequence, affecting the cost of these assets for banks and others that use safe assets to meet liquidity needs (Barthelemy, Gardin and Nguyen 2023, Garratt, Lee, Martin and Torregrossa 2022).

The final line of business that we discuss in the first part of the literature is investment advice. Even before the current wave of innovations, advisory services have evolved in ways that, generally, democratized access to these services and to investment options. This includes the development of

discount brokerage as a business model (such as Charles Schwab in the United States) and Exchange Traded Funds (ETFs) as investment products. Recent innovations have generally reinforced this trend. For example, “robo-advice” can be offered economically to smaller investment accounts than in-person advice (Abraham, Schmukler and Tessada 2019). In addition, trading algorithms can facilitate the implementation of investment strategies that are otherwise too costly to execute.

The literature provides limited insight into the impact of recent technological innovation on market power in the market for investment advice. Fintech firms are entering the market to offer services directly to investors and also with tools to implement specific investment strategies such as “tax-loss harvesting” in the US.² At the same time, incumbents are actively innovating as well; they benefit from access to a large pre-existing client base and cost advantages due to economies of scale.

Innovations in investment advice and wealth management provide greater access to various investment strategies and may help overcome biases in the recommendations from personal advisers (D’Acunto and Rossi 2021, Reher and Sokolinski 2022). The algorithms underlying robo-advice potentially have their own biases and could expose investors to unanticipated risks (Turner Lee, Resnick and Barton 2019). This suggests more research is needed to understand the risks for both consumers and the banks or firms offering automated investment advice.

So far, there is ample evidence that financial technology contributes to greater competition for banking services in individual lines of business, both among incumbents and with FinTech firms. In the second part of the review, we consider several topics that cut across lines of business. To begin with, there is emerging evidence on the spillovers of fintech innovation in one line of business to other parts of the banking business. Several papers have found that financial technology-based payment services can be a facilitator for lending or the provision of deposits, or deposit-like products (eg Buchak, Hu and Wei 2021, Frost et al 2019, Ghosh et al 2021). In addition, there is evidence of interaction between funding and lending. In a study of bank branching decisions, Jiang, Yang Yu and Zhang (2022) provide evidence that technology induced competition in the lending market can affect the viability of branches and the availability of deposit services. At the same time, fintech-based lenders often rely on a combination of warehouse lending from banks and off-balance sheet finance to fund loans. Perhaps unsurprisingly, the efficiency of markets for off-balance sheet finance benefits non-banks relative to banks (Jiang 2023). In addition, several papers show that peer-to-peer lending models where investors fund individual loans are less effective than models that rely on investors who “passively” invest in a portfolio of loans; passive investing enhances the efficiency of the screening and origination process for fintech-based lenders (Balyuk and Davydenko 2023, Vallée and Zeng 2019). This shows that FinTech-based firms can expand in scope to challenge incumbent banks but it also suggests that they do so by becoming more like banks, offering a bundle of services and broadening their role as an intermediary between borrowers and funding providers.

Competition with big tech firms is sometimes seen as especially challenging for banks. Big techs offering financial services can leverage pre-existing client networks and may have fewer financial constraints than dedicated Fintech-based firms that seek to enter the market for banking services. The literature studies big tech firms offering online or mobile payments services (eg OECD 2020) as well as deposit-like products and loans. To some extent, these services are offered to tie users to a big tech platform. Alternatively, interaction with users provides a big tech with unique information or exclusive benefits from a lending relationship that is not available to outside lenders (Chen, Huang, Lin and Sheng 2022, Li and Pegoraro 2022). It therefore remains an open question to what extent big techs are generally well-placed to provide financial services beyond their own platform.

A different way of approaching the question whether financial technology will challenge bank business models is to consider the market environment in which FinTech-based firms tend to be successful.

² This strategy involves selling securities that have incurred a loss and replacing them with similar securities in order to benefit from the tax deductibility of certain losses.

One of the most well-known fintech-based payments networks, M-Pesa, benefited from the growing penetration of mobile telecom in markets where services from regular banks were absent or inaccessible (Demirguc, 2022; Frost, 2020). Other research finds that financial, regulatory or supervisory constraints on banks provide opportunities for FinTech-based firms to provide substitute (Buchak et al 2021, Buchak et al 2018, Eca, Ferreira, Porras Prado and Rizzo 2022, Mariani et al 2023). Similarly, rules that require banks to share account data to payment service providers, or give consumers control over their banking data can promote entry by FinTech-based providers of banking services (Babina et al 2022). At the same time, some fintech-based services rely on partnerships with banks; this includes payment services offered by big tech firms and even partnerships to offer deposit and other services to M-Pesa clients. And even though there is some concern that these partnerships could erode banks' fee income and access to client information (Basel Committee on Banking Supervision 2018, European Banking Authority 2018), they also underline the importance of banks in financial intermediation.

On the flipside of the concern that financial-technology-based entrants and big tech firms challenge bank business models, is the concern that banks use the power of incumbency to stymie entry by potential competitors. For example, incumbents might seek to acquire FinTech firms in an effort to preempt a competitive challenge (Cunningham, Ederer and Ma 2021). So far, there is no evidence in support of this particular mechanism in the banking sector (Cornelli, Doerr, Franco and Frost 2021). However, in a study of competition in mortgage lending, Jiang (2023) finds that banks exploit market power in the funding market to limit competition from non-banks in the mortgage market.

The literature on financial technology and banking services is growing fast and evaluates developments in multiple countries and regions. The literature indicates that financial technology has often spurred competition in providing banking services and made them available to more clients. New entrants have leveraged technology to exploit gaps in the market and in some cases benefited from regulation that facilitated their entry. This has challenged banks to become more efficient. Thus far, there is no evidence that the business model of banks is no longer viable. The evolution of business models of fintech-based firm may bring new pressures for banks to adapt their business model or unbundle services in a way that challenges both the industry and individual banks.

As financial technology and regulation progresses, future research will further refine lessons learned so far. However, we would like to highlight two related areas where further research would be particularly useful. The first issue pertains to the measurement of innovation or innovativeness of banks and non-banks offering banking services. Chen, Wu and Yang (2019) show that patents are associated with higher market values for banks, but also that there are very few banks that actively pursue and obtain patents. Others have used information on employee skills or investment in Information Technology (IT) as a measure of innovation (He, Jiang, Xu and Yin 2022, Shen, Wang and Zheng 2023). While inventions, skilled personnel and IT investments are important technology inputs, banks will ultimately have to integrate new technologies in an effective business model (Brynjolfsson and Hitt 2003). This requires research into characteristics that are conducive to banks' ability to exploit innovation and investments in new technology. Second, much work has been focused on the role of non-banks or neo-banks leveraging technology to offer banking services. Less attention has been given to the characteristics of banks that might be more, or less, well-placed to address the competition from these new entrants. For example, does technology increase or reduce economies of scale in banking? Does it favour narrower or more diverse business models? And if so, under what conditions? Developing answers to these questions will provide a clearer picture on the future of the banking industry.

2 Payments

2.1 Introduction

Financial technology, and innovation by fintech-based firms and big techs have helped to rapidly expand the options available to make and process electronic retail payments. Such innovation in consumer-to-business and person-to-person payments includes the introduction of mobile payments as well as of cryptoassets as a means of payment. In this section, we review what drives the competitiveness of financial technology-based payments in an industry where the benefits of incumbency are perceived to be high.

Research on payments and electronic payment systems identifies several potential barriers to entry in payments. Brits and Winder (2005), Guibourg and Segendorf (2004), and Schmiedel, Kostova and Ruttenberg (2012) discuss how the complexity of infrastructure, high upfront and fixed operating cost, and relatively low variable communication and processing cost are a source of scale economies. In addition, once the payment infrastructure is in place, it can be used for processing transactions coming from different (electronic) payment instruments, and create economies of scope (Kokkola 2010).

Unlike most markets, the retail payments market is a so-called two-sided market: ie a market with two different user groups that interact with each other. The benefit that market participants receive depends on the size of the user group at the other side of the network and the value of the product/service. For a consumer, it is essential that enough merchants accept a payment method. For a merchant, the presence of a sizable consumer base makes it appealing to accept a specific payment method. To encourage the use of their networks by consumer banks and consumers, payment card networks generally charge an interchange fee to the merchant's bank ("acquiring" bank) and pass this fee on to the consumer's bank (the "issuing" bank) to compensate this bank for part of the costs associated with processing the payment. The acquiring bank passes the cost of the interchange fee on to the merchant. Issuing banks often use part of the interchange fee to issue rewards in the form of cash back or other card benefits to encourage the card holder to use the payment card. The rationale behind this pricing model is that merchants are perceived as less price elastic with respect to their decision to accept a certain payment method than consumers in their choice to use it (Baxter 1983, Rochet and Tirole 2003).³

Empirical research suggests a positive relationship between card acceptance by merchants and card usage by consumers (see eg Arango, Huynh and Sabetti 2015, Bagnall, Bounie, Huynh, Kosse, Schmidt, Schuh and Stix 2016) (Stavins 2001), a steering effect of prices and financial incentives on usage of payment instruments by consumers (Bolt, Jonker and van Renselaar 2010, Borzekowski, Kiser and Shaista 2008, Carbó-Valverde and Liñares-Zegarra 2011, Ching and Hayashi 2010) and the adoption of payment instruments by merchants (see eg Jonker 2011). The latter study also takes the role of competition among merchants into account. Merchants who face relatively strong competitive pressures are more likely to accept 'expensive' means of payments than other merchants; merchants who face relatively little competition are more likely to impose surcharges on customers for the acceptance of 'expensive' card payments than merchants who face moderate competition.

³ From 2005 on, interchange fees have become controversial and subject of regulatory and antitrust investigations, in Australia, the US, the UK, in the EU, and other countries. Competition authorities worldwide assessed the usage of interchange fees as anti-competitive behavior by card payment schemes and introduced regulation for interchange fee levels. For instance, the European Commission came up with the Interchange Fee Regulation for Card-based payments (2015/751), which entered into effect on June 2015, based on the Merchants 'Indifference Test between cash and card payments developed by (Rochet and Tirole 2011). Card companies, especially those operating in a duopoly market, raised interchange fees for card payments to attract issuers to their card platform, and to encourage their customers to use the card. Sometimes this resulted in negative transaction fees for card holders (cash back). By doing so they could increase card payment volume. One of the reasons why interchange fees could become so high is because of competition among merchants for customers. Merchants may feel obliged to accept card payments, because they may lose card-preferring customers to competitors if they do not accept card payments (Rochet and Tirole 2002). This is known as the 'must take card' concern (Vickers 2005). For an overview of the literature on interchange fees in card payments, see eg Borestan and Schmiedel (2011).

Competition between payment networks tends to reduce interchange fees as it increases merchants' price elasticity of demand for the services from each network (Rochet and Tirole 2003). This imposes some limitations on the market power of a network, but nevertheless, the combination of huge economies of scale and scope in retail payments in combination with strong network effects has driven market concentration in payments (Kokkola 2010).

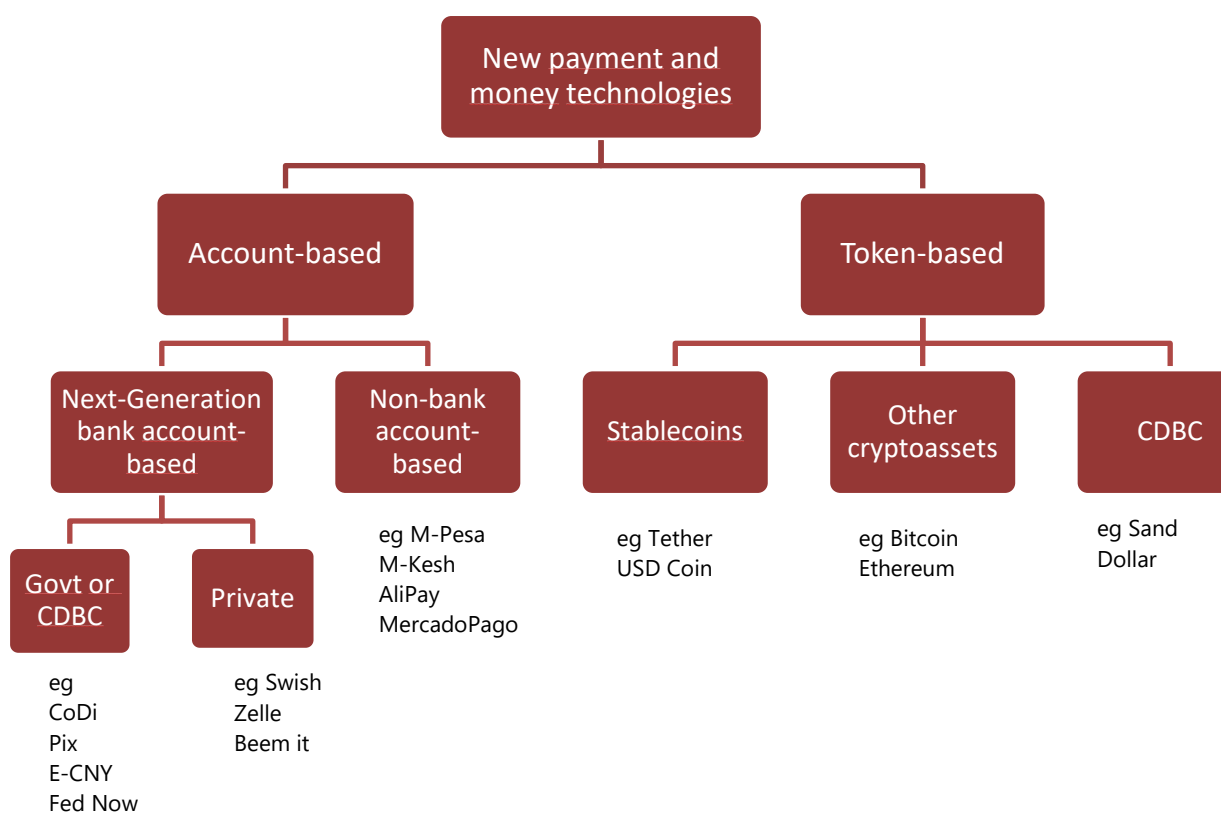
Other important factors explaining the adoption and usage of retail payment instruments are ease of use (see eg Arango and Taylor 2009, Jonker 2007), record keeping/budgeting (eg Fusaro 2013, Hernandez, Jonker and Kosse 2017, Schuh and Stavins 2016, von Kalckreuth, Schmidt and Stix 2014), safety (eg Bagnall et al 2016, Kosse 2013a, Kosse 2013b, van der Crujisen and Plooij 2018), and transaction speed of payment instruments (van der Crujisen and Plooij 2018). Social norms have also been found to have a role, ie people's choice of payment instrument in a specific situation depends on how other people pay in a similar situation (van der Crujisen and Knobens 2021).

2.2 Financial technology and payments

There are different ways of categorising financial technology-based innovations in payments (see Figure 1). One is to consider the nature of the transaction by which a payment is made (Bech and Garratt 2017, Duffie 2019). This can be token-based and involve the direct transfer of a token, such as a stablecoin or another cryptoasset, from the payer to the payee. Alternatively, payments can be account-based, where the party making the payment directly or indirectly transfers a claim on a bank or other financial institution to the recipient of the payment. Payment technologies involving cryptoassets are often designed to work outside of the traditional payment system although, as we will discuss below, these assets have so far not gained widespread acceptance and usage as a means of payment.

Classification new payment and money technologies

Figure 1



Account-based payments products can further be classified as bank-account or non-bank account-based payments. The bank-account based services can subsequently be divided in private and public services. Some fintech payment services have been introduced by public authorities. Examples include Mexico's CoDi and Brazil's Pix,⁴ which are available to payers and payees through local banks. Other authorities are piloting account-based central bank digital currencies (CBDC), like the e-CNY in some Chinese provinces and JAM-DEX in Jamaica.^{5 6} Networks of banks or private payment service providers have similarly introduced account-based fintech payments such as Swish in Sweden, Zelle in the US, and Beem It in Australia. In other cases, financial technology-based firms or big techs have introduced payments services that are independent of bank accounts, including M-Pesa (operating mostly in Africa), mKesh (operating in Mozambique), AliPay (from Alibaba in China) and MercadoPago (from Mercado Libre in Latin America). Furthermore, there are also services, such as Apple Pay and Google Pay (both worldwide), which are not independent from bank accounts and may not be considered as payment services, but rather as pass-through wallet services.

Whereas some firms offer payment services directly to end-users, other financial technology-based firms form partnerships with incumbent banks or payment providers, offer services such as payment processing of payments or help them with the digitalisation of payment services. Yet others essentially act as intermediary between consumers and merchants and take care of the acceptance of payments and their deposit in bank accounts. Fintech-based firms operating as an intermediary in this area compete for a share of the fees traditionally captured by banks or card networks. Their main business is payments. In contrast, fintech-based firms that run social media or ecommerce platforms and process the payments made on their platforms independently of banks, are engaged in a form of competition that could challenge the market power of existing payment networks. Banks who are affiliated with these networks in their role as issuer or acquirer may lose part of their fee income because of this competition (Brits et al 2021).

The literature suggests that the evolution of fintech-based payment services and their relationship with incumbent banks and payment firms has been driven by the market environment perhaps more so than by the nature of technology. Several papers have found that an unmet demand for electronic payment services is an important factor driving the adoption of fintech-based payment services (Frost et al 2019, Lashitew, van Tulder and Liasse 2019, Soutter, Ferguson and Neubert 2019). For example, Soutter et al (2019) point out that M-Pesa, which has flourished in several African countries including Kenya where bank penetration is low, failed to take off in South Africa where 80 percent of the population has a formal payment account. As such, fintech-payments help enhance financial inclusion among unbanked or underbanked people and small and medium enterprises (SMEs) (BIS 2019, Jonker and Kosse 2022).⁷ The existence of unmet demand is typically not sufficient for fintech payment services to emerge and

⁴ CoDi and Pix are fast retail payment systems that allow users to execute and finalise payments in real time and are available 24/7, through a platform operated by the respective central banks.

⁵ A CBDC is defined as central bank-issued digital money denominated in the national unit of account, and it represents a liability of the central bank. We can distinguish between retail CBDC and wholesale CBDC. CBDCs that are intended for storing value and making payments by citizens and businesses are referred to as a "general purpose" or "retail" CBDC. Retail CBDC represents a direct claim on a central bank rather than the liability of a private financial institution. Wholesale CBDC is intended to be used by financial institutions, and is similar to today's central bank reserves and settlement accounts in that it is intended for the settlement of large interbank payments or to provide central bank money to settle transactions of digital tokenized financial assets in new infrastructures (Bech, Hancock, Rice and Wadsworth 2020). There is discussion about the desirability of the usage of CBDC for saving or investment purposes, because of possible adverse effects on bank funding and financial stability, see eg Bank for International Settlements (2020), and European Central Bank (2022a). Especially in developed countries CBDCs designs are being considered that would limit CBDCs suitability as a large-scale store of value.

⁶ As with physical cash, CBDC is a form of public money ie money issued and backed by the state (ie the government and the central bank). Private money refers to money issued by private parties, such as bank deposits and e-money. These private money forms are not backed by the state, but by the parties that issued them. Holdings in public money and regulated traditional forms of private money (bank deposits and e-money) are in fiat sovereign currencies.

⁷ With global investments increased by 91 percent from 9 billion USD in 2010 to 98 billion USD in 2021, Fintech firms have closed the gap with traditional banks as prominent payment service providers in financial markets, see Statista (2022).

researchers point to several other factors that are conducive to their development including the characteristics of regulation, public infrastructure, mobile phone penetration, and the cost and availability of alternative payment technologies.

Regulation

Regulators in several jurisdictions, like the EU, have implemented rules specifically aimed at promoting competition and innovation in payments. For example, a series of EU rules opened the market to non-bank payment service providers and required that banks provide licensed service providers with access to account information if authorized by account holders.⁸ Thus far, hundreds of fintech companies and many big tech companies have received a license to provide specific e-money or payment services in the EU.⁹

Similar regulatory frameworks are being implemented in Australia, Japan, and the UK as well as in emerging market countries like Brazil, India and Indonesia, where banking regulators are issuing licences to new payment institutions. In other jurisdictions like the US and Switzerland, there is a market-led approach as banks recognise the potential of API-based collaboration and, even without regulatory enforcement, create their own data sharing rules. OECD (2023) cites survey evidence that data sharing enhances competition in payments, including by facilitating entry and the introduction of new business models.

While rules that promote the entry of non-bank payment service providers have facilitated competition in some jurisdictions, Frost et al (2019) find that less stringent regulation and a lack of competition from incumbents can facilitate the entry of big tech firms in finance. In their study of digital payments in Africa, Soutter et al (2019) argue that in addition to low bank penetration a light, sandbox like regulatory approach enabled M-Pesa to flourish in Kenya. Lashitew et al (2019) also note Kenyan regulation facilitated the growth of M-Pesa in the early stages of product development. Hence, both the extent and the nature of regulation matter for the development of fintech-based financial services.

Public infrastructure

Traditionally, many central banks have provided wholesale payment services that facilitate the settlement of electronic payments between financial institutions. Recently some central banks have also sought to facilitate retail payments to settle electronic payments between payers and payees and to leverage technology for near-instantaneous transfers. Examples include CoDi in Mexico and Pix in Brazil. Duarte et al (2022) analyse the rapid growth of Pix to identify the factors driving the adoption of fast public payment infrastructure. The first factor was that adoption of Pix was mandatory for large financial and payment institutions (above 500k accounts). This kick-started network effects and encouraged small institutions to participate in Pix even though this was not mandatory for them. The second factor is that the central bank used its dual role as infrastructure provider and rule setter to create an open and interoperable payment system, including through open APIs that facilitate integration into existing applications in financial institutions. This is in contrast to some private payment service providers in Brazil, who, according to Duarte et al (2022) sought to introduce a closed-loop system that required payer and payee to be part of the same network as traditional card schemes.

⁸ This includes the e-money directive (2000/46/EC), which regulated market access for issuers of electronic money, and the 2007 Payment Services Directive (EU 2007/64/EC PSD), which established the concept of nonbank 'payment institutions', licensed non-bank firms that could provide several payment services across the EU under a lighter regulatory regime than banks. In 2015, the revised Payment Services Directive (EU) 2015/2366/EC (PSD 2), further opened retail payments markets to two types of third-party service providers (TPSPs). PSD2 obliges banks to give these licensed TPSPs access to bank customers' payment account (after their explicit consent), in order provide them with account information services or payment initiation services.

⁹ These payment service providers are listed in the European Banking Authority (EBA)'s [Register of payment and electronic money institutions under PSD2](#) | European Banking Authority (europa.eu).

Legacy payment systems

Traditional banks and networks have legacy payment systems that were developed decades ago, (see eg Megargel, Shankararaman and Fan 2018, Stulz 2019). Implementing new services on top of these systems may be challenging, because there may be shortages of staff with the necessary IT skills to update legacy systems and develop new digital payment services (European Banking Authority 2018, Kornelakis, Kirov and Thill 2022). In developed countries, banks have therefore often worked together with fintech-based firms to modernise their payment systems and data storage systems and develop new digital (payment) services to anticipate (young and tech-savvy) bank customers' needs and expectations (Brits et al 2021). Examples of new digital payment services include mobile payment apps for point-of-sale payments, online payments and request to pay apps for peer-to-peer-payments. In addition, the challenges of modernizing bank technology enable fintech and big tech companies to compete with banks for offering payment services. Some of them also provide ancillary financial services, such as securities/investment services, insurances and credit lines.

Big techs and mobile phone networks

In countries with limited public or private payment infrastructure, or low penetration of bank accounts, operators of non-financial networks may have a competitive advantage in the introduction of new payment services. Arner, Auer and Frost (2020) find that especially in emerging economies, fintech and big tech companies are benefiting from the high share of consumers with mobile phones, which often exceeds those with payment accounts or credit cards, facilitating access to financial services to previously underbanked/unbanked people and SMEs. Others discuss how the introduction of smartphones and (mobile) broadband internet helped fintech and big tech firms reduce price, improve quality, and thus expand payment services (see eg Brits et al 2021, Financial Stability Board 2022, Philippon 2020).

An example is the mobile-based payment service M-Pesa in Kenya, operated by the telecom company Safaricom, in association with Vodafone. Suri and Jack (2016) claim that access to M-Pesa increased per capita consumption levels and lifted 2% of Kenyan households out of poverty. Like M-Pesa and Vodafone, big tech firms in other emerging markets have developed payments infrastructure independently from the core financial system. Examples include Ant Financial's Alipay, Tencent's WeChat Pay, and Mercado Libre's MercadoPago. Firms like Google, Apple, Amazon, and Samsung have also introduced wallet based pass-through services that are integrated with their core products, although these tend to rely on existing payment rails and collaborate with incumbent banks. At the same time, these big tech companies compete with incumbent banks in the front-end of the retail payment market for customers and they may have an advantage where incumbent banks face difficulties meeting the digital demand of young customers.

Beyond evidence on entry, data on market structure is somewhat limited. However, Financial Stability Board (2022) uses the monthly downloads of retail payment apps offered by big techs, FinTech-based firms and incumbent financial institutions to construct a Herfindahl-Hirschman Index (HHI). It turns out that in advanced economies, the HHI of payment app downloads had been falling just before the beginning of the Covid-19-pandemic, ie market concentration decreased at that point in time. But then the HHI slightly increased during 2020 and 2021 (ie market concentration increased). This was mainly due to a growing number of downloads of payment apps from big techs, although the number of payment app downloads of some larger FinTech-based firms and incumbent banks that had invested in digitalization also rose. Furthermore, the HHI is much higher in emerging and developing economies, where big techs have a much larger market share. Financial Stability Board (2022) concludes that the entrance of big techs and FinTech-based firms may add to diversity in the financial sector, but also signals that the increasing market share of the larger players could lead to greater concentration in some markets and other risks related to banking as a service.

Shortages in cash services

Physical cash shortages (in part caused by banks' shrinking of physical branch networks and ATM points) have the potential to boost digital payment adoption, and thus improve FinTech-based firms positioning in the competitive landscape. Using unexpected / unanticipated cash shortages can be a good empirical identification strategy to properly measure the effect on competition from payment digitalization.

Crouzet et al (2023) use the 2016 India's demonetization to study the use of mobile payments provided by a fintech. They find that individuals more exposed to the demonetization shock¹⁰ had a higher and persistent increase in both their usage and adoption of fintech mobile payment services in response to the temporary cash shortage. In the two months following demonetization, the growth rate of debit card transactions provided by incumbent banks also increased substantially, but later returned to the pre-shock levels. Unlike the uptake of the electronic wallet from FinTech-based firms, this was driven by the intensive margin, ie, there was an increase in the number of debit card transactions, but not in the number of households newly adopting debit cards. Therefore, in the long run, the demonetization shock was comparatively more beneficial to fintech-based payment services than to incumbent banks.

Mariani et al (2023) analyse temporary cash shortage shocks in Brazil caused by hit and run attacks to bank branches. After an attack, the usage of non-cash payments methods increased in affected municipalities when compared with matched unaffected municipalities, and this was especially strong for Pix, a type of instantaneous payment transaction. When analysing the intensity of the effects by type of institution, the authors suggest a stronger increase of Pix transactions provided by FinTech-based firms and digital banks, when compared to traditional banks.

Both studies shed light on the competitive advantages of FinTech-based firms when physical money is or becomes scarce. They may also indicate that as the non-cash payments trend intensifies, FinTech-based firms will gain further competitive strength, especially if incumbent banks are not able to meet the digital demand of their customers.

Crypto and token-based payments

The rapid growth in the market capitalization of cryptoassets has raised concerns about (potential) linkages with the regulated financial system (eg the use of safe assets to back stablecoins, the impact of cryptoasset prices on borrower creditworthiness, the traceability of payments). However, regulators have taken very different approaches to cryptoassets, ranging from outright prohibition to the adoption of cryptoassets as an official means of payment.

Notwithstanding the different approaches, the empirical literature provides some insight into the adoption of cryptoassets as a medium of exchange by households and businesses. Thus far the adoption rate of privately issued cryptoassets by households in North America and Europe is relatively low. It ranges between 1 and 8 percent, as can be seen, for instance, in Henry, Huynh and Nicholls (2018) for Canada, Jonker (2019) for the Netherlands, Bagnall et al (2016) for the US, and more recently European Central Bank (2022b) for the euro area. European Central Bank (2022b) shows that most of the households in the euro area who hold cryptoassets rarely use them for making payments, but rather as an investment vehicle. According to Graf von Luckner, Reinhart and Rogoff (2021) at least 7 percent of the bitcoin transactions reflect domestic and international payments.

The impact of cryptoassets on the retail payment market in EMDE countries seems to be different from their impact in advanced economies. According to the Statista Global Consumer Survey (2023) covering 56 countries worldwide, cryptoasset adoption rates in some African, Asian and South American countries are rather high and steadily rising. The following countries had crypto adoption rates above 20 percent in 2022: Nigeria (45 percent), Thailand (44 percent), Turkey (40 percent), Argentina (35 percent),

¹⁰ The exposition to the demonetization is measured by the importance of chest banks – local bank branches in charge of the distribution of new currency – in the district.

United Arab Emirates (34 percent), the Philippines (29 percent), Vietnam (27 percent), India (25 percent), Singapore (25 percent), Brazil (24 percent) and South Africa (24 percent). Shahzad, Xiu, Wang and Shahbaz (2018) study the adoption of cryptoassets among the people of mainland China and find that awareness, perceived trustworthiness of cryptoassets, perceived usefulness and perceived ease of use may drive consumers' intention to use Bitcoin. Saiedi, Broström and Ruiz (2021) document that perceived failings of the traditional financial system – reflected by low trust in banks and the financial system and high inflation – as well as their usage in illicit trade contribute to the adoption of cryptoassets. This corresponds with results by Alnasaa, Gueorguiev, Honda, Imamoglu, Mauro, Primus and Rozhkov (2022) who find that the usage of cryptoassets is significantly higher in countries with more intense capital controls and higher perceptions of corruption.

An often-mentioned barrier of privately issued cryptoassets as a means of payment concerns the volatility of its exchange rate vis-à-vis regular national currencies. According to Bolt and Van Oordt (2020) the exchange rate of cryptoassets is determined by three components, ie 1) the current value of transactions in cryptoassets which absorb part of the exchange rate risk, 2) the decisions and expectations of forward-looking investors to buy cryptoassets (thereby effectively regulating its supply) and 3) the factors that jointly drive future consumer adoption and merchant acceptance of cryptoassets. Once a privately issued cryptoasset becomes more established as a means of payment, its exchange rate will become less sensitive to speculation. Bolt and Van Oordt (2020) conclude that once this takes place the exchange rate will not act as a barrier for widespread use of cryptoassets as a medium of exchange any longer.

Gorton, Ross and Ross (2022) are less optimistic. They draw parallels between privately issued monies by banks in the US between the 1830s-1860s (Free Banking Era) and privately issued stablecoins by fintech-based firms during the 2020s. They conclude, as with private monies in the 19th century, stablecoins cannot be considered as money and used as a medium of exchange because they are not always accepted at par and because they are subject to runs.¹¹ They also show that individual stablecoins have not differentiated themselves from other stablecoins. The market essentially views stablecoins as a single coin, making them more vulnerable to runs since all stablecoins face large volume drops during stress. The authors conclude that, analogously to privately issued banknotes before them, stablecoins are not likely to become a widely used medium of exchange. Following their line of reasoning, it seems unlikely that the issuance of stablecoins and other cryptoassets will increase competition in the retail payments market, at least in the short run.

Some studies focus on the drivers of crypto adoption by merchants. Using a large representative sample of retailers active in Dutch e-commerce, Jonker (2019) finds that acceptance of cryptoassets as a means of payment is modest (2 percent). Lack of consumer demand for cryptoassets as a medium of exchange acts as a serious barrier for merchant acceptance. Other factors that influence merchant adoption intention include perceived net transactional benefits relative to other mediums of exchange and perceived accessibility of accepting cryptoassets. The Dutch findings also point at an important role of FinTech-based firms in facilitating competition and innovation in payments: they act as intermediaries in e-commerce between consumers and merchants, and by providing privately issued money (eg Bitcoin) as a possible means of payment, they increase the accessibility of these new ways of paying to large groups of consumers and merchants.

Overall, we conclude that thus far, cryptoassets are hardly used for retail payments in advanced economies in Europe and North America and neither altered competition in the retail payments market nor had an impact on banks' position in it. It remains to be seen whether this changes in case cryptoasset regulations become applicable. This may be different for emerging and developing economies, as the usage of cryptoassets for payments is larger in countries with high inflation or low trust in the government (Alnasaa et al 2022, Saiedi et al 2021). It is yet to be shown whether cryptoassets will act as a complement

¹¹ Aldasoro, Mehrling and Neilson (2023) and Garratt and Shin (2023) are also sceptical of stablecoins to maintain their peg.

to bank-provided payment instruments and saving accounts, or as a substitute. In the latter case, big techs and FinTech-based firms issuing cryptoassets could increase competition and may be challenging banks.

Central banks are also engaged with the development of digital currencies. The issuance of digital currencies by central banks, next to cash, has become a mainstream policy issue. According to a BIS survey carried out in 2021 among 81 central banks, 90 percent of them are actively engaged in some form of work on CBDC, and 26 percent of them are in advanced stages of exploring CBDC (Kosse and Mattei 2022). Most central banks work on retail CBDC, but some of them also on wholesale CBDC (Payments Canada 2022). Many central banks want to co-operate with the private sector, for instance for distributing CBDC (indirectly) to the public via trusted private sector intermediaries (two-tier model). Most central banks also explore interoperability with existing retail payment systems. For both central banks in advanced economies and in emerging and developing economies improving domestic payment efficiency, payments safety and financial stability are motivations to work on CBDC, but for central banks in the latter group financial-inclusion related motivations are also important, as well as improving the efficiency of cross-border payments.

As only a few central banks have so far launched a retail CBDC for usage, it is hard to draw any conclusions yet about the possible impact on competition in retail payments markets. It may also differ by jurisdiction, depending on the design choices made by central banks and the governments. Overall, it seems unlikely that central banks intend to compete with incumbent banks in the retail payments market, as they expressed the intention to use intermediaries for the distribution of CBDC to the public (see eg Bank of England 2023, European Central Bank 2022a). However, their choice for intermediaries may affect competition and have an impact on incumbent banks' position in the retail payments market. If central banks (also) choose FinTech-based firms and big techs to distribute CBDC to the public, competition in the retail payments market may increase, resulting in declining revenues and market share of incumbent banks. To what extent CBDC may influence competition in retail payments may also depend on the amount of CBDC in circulation (Burlon, Montes-Galdon, Munoz and Smets 2022) and whether NCBs will apply a remuneration policy (Bijlsma, van der Cruijssen, Jonker and Reijerink 2021). Several central banks and public authorities have expressed that they intend to minimize the impact of the introduction of CBDCs to financial intermediation and that they want to prevent an outflow of bank deposits to CBDC by imposing limits to CBDC holdings and by not paying interest on CBDC holdings (see Bank of England 2023, European Central Bank 2021, International Monetary Fund 2022). Regarding wholesale CBDC, central banks wish to explore the possibilities of CBDC as a way to increase efficiency of cross-border payments which are currently time-consuming and expensive for end-users and reduce risks as well in case of delivery vs payment solutions for DLT based securities settlement transactions. In that sense, the introduction of wholesale CBDC may increase competition in the market for cross-border payments and put downward pressure on banks' revenues on cross-border payments.

2.3 Concluding remarks and thoughts for future research

This chapter documents a large and increasingly prominent role for FinTech-based firms and big techs in the field of account-based payments in the past few decades. The way these (global) players have been acting is twofold. On the one hand they cooperate with - or even work for - more traditional, incumbent banks and other well established financial institutions (eg by forming partnerships with them). On the other hand, they also engaged in tough competition with these more conventional long-standing institutions, mostly through price incentives, easier and more user-friendly provision of digital mobile payment apps. It is difficult to assess whether these new companies have been more complementary or have been acting more as a substitute with respect to banks in the payment landscape. The outcome seems to differ by geographical region, with FinTech-based firms and big techs providing payment services complementary to the ones offered by banks in EMDE economies, while in advanced economies their payment services may also act as a substitute and compete with the payment services provided by banks. However, it is hard to draw firm conclusions on the precise nature of the impact of big tech and fintech

on competition and on banks' position in retail payments, due to lack of data on the absolute and relative usage of payment instruments provided by different types of payment service providers.

Research on the impact of fintech on competition in retail payments could be extended in several directions. International consumer surveys on consumers' usage of payment instruments provided by banks, FinTech-based firms and big techs and may shed light on the extent to which big tech and fintech affect competition in retail payments. Furthermore, close monitoring of the adoption of cryptoassets and stablecoins as well as their usage in making payments is also a natural step for future research. In this way it would be possible to assess whether it will remain a niche product or become more mainstream. In addition, the impact that CBDCs have on the role of banks, FinTech-based firms and big techs in payments needs to be investigated more in depth. In particular, the way central banks bring CBDC to the market, could play an important role for that impact. Finally, the value of information derived from payment transactions in other product markets, such as lending, is also worth further analysis.

3 Lending

The rapid growth of FinTech companies has significantly altered the lending landscape, presenting both challenges and opportunities for traditional banks. This section reviews the literature on the competition between banks and fintech lenders, focusing on markets for personal loans, small business loans and mortgages. It explores the factors driving competition, such as innovation, regulatory environment, changing consumer preferences and globalization, while also examining the strategies employed by both parties, including digital transformation, partnerships, and the development of tailored lending products.

There is a large literature on competition and asymmetric information in lending that helps inform research on financial technology and lending (Petersen and Rajan 1994, Sharpe 1990, von Thadden 2004). The literature investigates both the extent to which informed lenders exploit their market power (Rajan 1992) and how information asymmetries affect competition between lenders. For example, Dell'Ariccia et al (1999) focus on the possibility that the presence of well-informed lenders could inhibit market entry and Boot and Thakor (2000) study competition between relationship-based and transaction-based lending models. Other papers investigate whether competition reduces information production and market efficiency (Hauswald and Marquez 2006).

3.1 Personal and small business loans

An increasing number of FinTech companies explore opportunities in personal loans and small business lending. Traditional banks primarily serve to collect, distil, and transmit information (Holmstrom and Tirole 1997). Uninformed savers deposit funds with banks to earn interest, and banks subsequently lend to borrowers, including firms and households. Generally, FinTech lending can be classified into marketplace lending, in which FinTech-based firms act as a platform between investors and borrowers, and balance sheet lending, in which FinTech-based firms pool funds and make loans on the investors' behalf (Berg et al 2022). Most FinTech lenders do not take deposits. This raises their cost of funding relative to deposit-taking banks, but also tends to reduce regulatory burdens; a significant objective of banking regulation is to limit conflicts of interest between bank managers and uninformed depositors (Laeven and Levine 2009).

Banks typically combine hard information, such as credit scores, income, and educational background, with soft information obtained through broader relationships with borrowers. By offering multiple services, including deposits and payment services (Parlour et al 2022), banks can access a wealth of proprietary data to inform lending decisions and enhance credit scoring models. This information advantage partly explains why banks serve as a crucial financing source for small businesses, which are often opaque and information-sensitive. Banks have been avid investors in IT to enhance their ability to exploit data (Ahnert, Doerr, Pierri and Timmer 2022, He et al 2022). Still, a perceived advantage of FinTech

companies is that they can use advanced technology to gather and analyse both soft and hard data from non-traditional sources to overcome their informational deficit. An increasing number of studies investigates the extent to which FinTech services act as substitutes or complements to bank lending.

One area of research investigates the effects of data sharing policies on competition between banks and FinTech lenders. Nam (2022) provides evidence for Germany that open banking, a policy facilitating easier access to banks' data for FinTech companies, fosters financial inclusion by improving access to credit for riskier borrowers. He, Huang and Zhou (2023) develop a theoretical model to analyse the welfare consequences of open banking when FinTech lenders have superior personal data screening technology but inferior data access. Their findings indicate that open banking can result in both increased and decreased competition in lending markets, depending on FinTech lenders' screening abilities and consumers' privacy preferences. Babina et al (2022) provide empirical evidence that open banking can stimulate FinTech venture capital investments, increasing competitive pressure on banks. However, open banking may also discourage banks' data production, leading to potential negative welfare consequences. Doerr et al (2022) study the California Consumer Privacy Act privacy regulation designed to enhance consumer confidence in data security. These rules increase users' willingness to share data, particularly with FinTech-based firms that have no established relationship with consumers. This leads to a surge in loan applications with FinTech-based firms, allowing them to offer more attractive rates through improved credit scoring. These results suggest that privacy regulation granting users control over their data can improve welfare in credit markets and spur the growth of FinTech-based firms, which can enhance financial inclusion, but also increase competition for banks.

Related research explores how FinTech lenders can use payment data from other services to overcome their informational disadvantage and inform lending decisions. (Ghosh et al 2021) demonstrate that Indian FinTech lenders use payment data to obtain information about potential borrowers, compensating for the lack of existing lending relationships. Firms using cashless payments (ie producing information that FinTech-based firms can access) are more likely to receive loans at lower rates, especially those with higher credit quality. Firms that are more creditworthy therefore opt for cashless payments to benefit from cheaper FinTech loans, potentially leaving banks with a less desirable pool of clients. Parlour et al (2022) develop a theoretical model showing that FinTech competition for payments can disrupt information spillovers from banks' payment services to their lending services. This affects the market for loans and, in the model, produces ambiguous welfare outcomes.

Another strand of research highlights that FinTech platforms obtain a competitive advantage due to their diminished regulatory burden. Beaumont et al (2022) analyse French administrative data on small business lending, revealing that SMEs without tangible assets often opt for unsecured FinTech loans (beyond traditional regulatory frameworks) to procure assets, which they subsequently pledge as collateral to banks for obtaining conventional (collateralized) loans. Throughout the relatively stable period examined (2014-2019), acquiring a FinTech loan correlated with a higher default risk for borrowers possessing high ex-ante credit risk, yet it did not impact those with low ex-ante credit risk. Considering the post-financial crisis tightening of banking regulations (eg Basel III), FinTech lenders seem to complement banks by offering unsecured credit to SMEs. This observation is supported by similar conclusions drawn by Cornelli, Frost, Gambacorta and Jagtiani (2022b) for small businesses in the US; and by (Ornelas and Pecora 2022), who show that in Brazil online peer-to-peer lenders focus on smaller and riskier firms already served by banks. Relatedly, Gopal and Schnabl (2020) show that in the aftermath of the 2008 financial crisis, FinTech lenders offset some of the reduction in bank lending to small businesses that happened due to tightened regulation (see Eca et al 2022 who find a similar pattern of lending substitution). de Roure, Pelizzon and Thakor (2021) show that P2P lenders are bottom fishing (ie serve riskier clients), especially when regulatory shocks create a competitive disadvantage for some banks.

Other studies investigate the nature of FinTech lenders' advantages in information processing and analysis. Balyuk and Davydenko (2023) provide results that are consistent with the notion that fintech lenders are good at processing hard information, rather than from an ability to turn soft information into "hard" data informing credit decisions. Di Maggio and Yao (2020) used data on unsecured personal loans

by FinTech and traditional lenders to show that FinTech lenders initially targeted less creditworthy borrowers but expanded their market share over time by serving better borrowers. FinTech lenders primarily based their loan decisions on hard information, tending to lend to borrowers who already had access to other credit sources. Borrowers utilized FinTech loans for debt consolidation and increased consumption, resulting in higher default rates for FinTech loans compared to traditional loans, particularly among borrowers with low credit quality. The implications for banks remain unclear. If risky borrowers use FinTech loans to repay credit card debt, they reduce banks' income but also lower the risk of banks' loan portfolio. Generally, to what extent FinTech-based firms and banks are substitutes or complements can vary by context. For example, for Kenya, Suri, Bharadwaj and Jack (2021) show that the rapid uptake of digital loans did not replace credit by banks.

In addition to FinTech lenders, big techs – large technology companies primarily focused on digital services – are entering the lending business, potentially causing significant shifts in competition. Big tech firms often possess exclusive access to customer data from their telecommunications, e-commerce, or payment operations. Combined with machine learning methods, such big data can be utilized to assess borrowers' creditworthiness, which has been shown to outperform credit bureau data (Frost et al 2019). Gambacorta, Huang, Li, Qiu and Chen (2022) argue that improved credit scoring allows Chinese big techs to forgo the need for collateral in lending decisions, making big tech credit less susceptible to house price fluctuations. However, Liu, Lu and Xiong (2022) caution that the difference in behaviour could be explained by big tech lenders offering smaller loans at higher rates, addressing borrowers' short-term liquidity needs rather than long-term financing requirements. In the Chinese context, Hau, Huang, Lin, Shan, Sheng and Wei (2021) emphasize that big techs help mitigate financial frictions for online vendors located near state-owned banks and that big tech loans contribute to short-term sales growth for vendors. Hau et al (2021) demonstrate that big tech credit reduces firms' sales volatility following credit approval by enabling vendors to increase advertising expenses and to introduce new products. In conclusion, the literature suggests that big techs primarily compete with banks through better technology, privileged access to information through interactions with potential borrowers on the big tech platform and can enhance access to financial services.

Within the area of personal lending, so-called "Buy Now, Pay Later" (BNPL) services have received attention by both researchers and policy makers. BNPL offers an alternative to conventional credit products that is experiencing rapid growth globally (Cornelli, Gambacorta and Pancotto 2023). BNPL services are favoured by younger, less financially-mature demographics, as well as those with limited access to traditional banking services (Lusardi and Mitchell 2023), high debt levels, or with low credit scores (Consumer Financial Protection Bureau 2023). Traditional banks have incorporated BNPL services, albeit with different strategic approaches, considering their established customer base and regulatory constraints. The regulatory environment for BNPL is in flux, with countries adopting varied stances, from stringent credit law inclusion to self-regulation (Adams, Hermalin and Weisbach 2010, Consumer Financial Protection Bureau 2022, Consumer Financial Protection Bureau 2023, European Council 2023, Financial Consumer Agency of Canada 2021, HM Treasury 2023, Reserve Bank of India 2022, Singapore 2022, Svahn 2023). Despite the growing popularity of BNPL schemes, these platforms confront notable challenges, including balancing profitability with high operational costs, and managing increased delinquency rates (Consumer Financial Protection Bureau 2022).

3.2 Mortgage lending

Studies on FinTech lending within the mortgage market have primarily focused on the United States, where FinTech-based firms play a significant role in mortgage origination. This can be attributed to the excellent data availability through the Home Mortgage Disclosure Act (HMDA) and the unique regulatory environment of the US residential mortgage market. The majority of mortgage loans in the US are insured directly by the government, either through the Federal Housing Administration (FHA) or Veterans Affairs (VA), or indirectly through government-sponsored enterprises (GSEs). This leads to a deep, liquid secondary market for mortgages and lowers the funding requirements for originators. Non-bank

mortgage lenders in the US typically fund their originate-to-distribute business model with short-term warehouse lines of credit. This funding advantage, unique to US mortgage originators, has resulted in a strong FinTech lending presence in the country's mortgage market (Berg et al 2022), which underpins the subsequent US-centric FinTech mortgage research.

Current literature can be categorized into two areas. The first focuses on assessing the impact of new technologies on FinTech lenders and their customers. Fuster, Plosser, Schnabl and Vickery (2019) suggest that technological diffusion accelerates the mortgage origination process and reduces capacity constraints during peak demand periods. However, they find limited evidence that FinTech lending is more effective at allocating credit to constrained borrowers. Some studies emphasize the efficiency gains of adopting machine learning technology in credit screening for mortgage underwriting. Sadhwani et al (2020) demonstrate that many risk predictors have a highly nonlinear influence on borrower behaviour events that traditional statistical models fail to capture. They propose a deep neural network model, which they argue can significantly improve the accuracy of loan- and pool-level risk forecasts, mortgage trading strategies, and Mortgage-Backed Securities (MBS) valuation and hedging. Fuster et al (2022) use a theoretical framework to show that machine learning models predict defaults more accurately than simpler traditional models. Yet they also find that the benefits of improved technology can be unevenly distributed across categories like race, age or gender.

The second research area focuses on evaluating the impact of FinTech-based firms on their main competitors: traditional banks. Fuster et al (2019) suggest that the shift to online lending presents particular challenges for smaller lenders, given the economies of scale associated with developing and maintaining an online lending platform. Buchak et al (2018) test two competing hypotheses to explain the decline in traditional banking: increased regulatory burden on traditional banks and disruptive technology. They find that increasing regulatory burden accounts for about 60% of shadow bank growth during the 2008–2015 period, while advancements in online lending technology account for another 30%, and the remainder comes from other sources. Jiang (2023) examines the relationship between shadow banks and their upstream lenders of warehouse lines of credit, showing that shadow banks are primarily funded by traditional depository banks that originate the same types of loans in the same regions. The author argues that banks' upstream market power significantly reduces mortgage lending volume and consumer surplus, with these costs largely borne by consumers in more concentrated markets. This implies that shadow bank competition is least beneficial to consumers who need it most. Both Buchak et al (2018) and Jiang (2023) highlight the influence of regulatory interventions on downstream lending competition. For instance, Jiang (2023) suggests that a faster GSE loan purchase program would reduce shadow banks' reliance on their competitors, which could increase downstream competition and benefit consumers.

3.3 Taking stock

Overall, the question of how the rise of FinTech lenders affects traditional banks' lending business remains open. FinTech companies may have a competitive edge over traditional banks due to lower regulatory requirements. Technological advancements also play a role, as FinTech companies leverage alternative data sources and adopt machine learning techniques to speed up the credit decision process and enhance their screening capabilities. A number of studies find that increased competition from FinTech lenders negatively affects traditional banks, as they compete for the same customers. Yet other studies show that fintech lenders enable financial inclusion, serving individuals traditionally underserved by banks, or even facilitate borrowers' access to bank credit. In general, the extent to which FinTech loans complement or substitute for bank credit depends on the respective market and geography under study.

4 Funding

4.1 Introduction

While many firms, including fintech-based ones, provide banking services, the term “bank” is generally reserved for institutions taking deposits. Banks benefit from their access to deposits, which tend to have a lower marginal cost than other sources of funding due to deposit insurance, or market power (Drechsler et al 2017, Egan, Lewellen and Sunderam 2021, Hannan and Berger 1991).

In this section, we consider how financial technology affects competition for deposits, including deposit-like products. We also discuss evidence on fintech-based firms’ access to short term loans, equity funding and off-balance sheet funding. The availability and cost of these types of funding may affect the competitive position of fintech-based firms in lending and other markets (Jiang 2023).

In the market for deposits, competition (or a lack of it) is reflected in banks’ ability to attract deposits at interest rates below their opportunity cost. Much of the literature on competition for deposits is therefore focusing on the level of deposit rates, the spread between deposit rates and a benchmark such as a central bank policy rate or short-term money market rates, or the extent to which banks pass on changes in a benchmark rate to consumers. For example, Hannan and Berger (1991) show that deposit rates are more rigid in concentrated markets. And although there has been debate about whether rates are stickier upwards than downwards (Gerlach, Mora and Uysal 2018, Neumark and Sharpe 1992), the link between higher market concentration and lower deposit rates is well-established (eg Drechsler et al 2017, Driscoll and Judson 2013).¹² Indeed, Craig and Dinger (2013) simply use bank deposit rates as a measure of competition.

Building on developments in the industrial organization literature, researchers have increasingly been using discrete choice models to study competition for deposits (eg Dick 2007, Egan, Hortacsu and Matvos 2017). These models accommodate the inclusion of features other than deposit rates that may affect consumer choice such as location or other services offered by a bank. Although discrete choice models do not rely on market concentration as a metric of market structure, model estimation requires a clear definition of markets and market shares (Berry, Levinsohn and Pakes 1995, Berry 1994), a potential limitation in markets with both physical and online offerings. However, Honka, Hortaçsu and Vitorino (2017) present an extension in which the “market” is defined by consumers’ awareness and consideration of individual banks, which can be a function of location, advertising or other factors.

In addition, researchers have found indirect evidence of deposit competition on banks. Humphrey and Pulley (1997) and Koch (2015) show that US banks became more efficient after the phase-out of the interest rate ceiling on savings- and small-time deposits under the Federal Reserve’s regulation Q.

Bank deposits also compete with deposit-like products such as money market funds (MMFs) and potentially stablecoins (Gorton and Zhang 2022). Mertens (2008) and more recently Xiao (2020) provide evidence that competition from MMFs contributes to the disintermediation of bank deposits in rising rate environments because MMFs pass through higher policy rates faster than banks.

4.2 Deposits

In most jurisdictions, deposit-taking is a regulated activity that requires a banking licence in line with BCBS principles for effective banking supervision. This has kept many fintech-based firms from offering deposits

¹² Van Leuvensteijn, Sørensen, Bikker and van Rixtel (2013) find that higher competition among banks is associated with lower, instead of higher, deposit rates. However, their paper uses the Boone indicator to measure competition and does not distinguish between the level of competition in the loan- and deposit markets.

but incumbent banks have relied on technology to offer deposit services online.¹³ New, fully licensed, online-only banks have been established and some fintech-based firms that were established as non-banks subsequently sought a license or acquired a licensed bank to collect deposits (Zamil and Lawson 2022). S&P Global Analysis shows that even before the COVID pandemic growth in deposits of online banks in the United States outstripped growth in deposits of traditional banks.¹⁴ Online deposit-taking banks have also been successful in several European markets. In China and Hong Kong authorities have issued licenses to several online banks, including ones established by big-tech firms (Zamil and Lawson 2022). Analysing the impact of this growth on other banks can be challenging because online banks are not tied to a (local) market. Building on Honka et al (2017), Abrams (2019) proposes a discrete choice model in which consumers consider a subset of banks offering deposit services (“limited consideration”); online banks can increase the probability they are considered through advertising. Abrams analyses competition for deposits among banks with physical and online presence in the US. Results show that online banks have gained market power comparable to large mid-sized banks, thereby reducing the market power of other banks. Model simulations suggest that a big tech depository would further enhance competition for deposits (and thereby increase the welfare of consumers), under the assumption that the presence of such a depository would increase the share of consumers considering online banks.

More recently, Koont, Santos and Zingales (2023) show that the deposits of banks offering online services through a mobile app are more sensitive to changes in market interest rates. Hence, even though online deposit taking may economize on the cost of operating a branch, it may also reduce banks’ ability to acquire deposits at below-market rates.

Some banks have offered online deposits indirectly, through partnerships with fintech-based firms or have their products featured on product comparison websites. For example, a recent study from the Federal Reserve points out that community banks in the US are partnering with FinTech-based firms to explore online account opening tools or facilitate access to savings applications among other things (see Board of Governors Federal Reserve System 2021). An example for a product comparison website is the platform “Weltsparen” in Germany, where customers can contract fixed deposits with advantageous interest rates from banks all over Europe.¹⁵ The success of this fintech-based firm was based on the fact that interest rates in other European banks could be higher than in Germany, but European deposit insurance would still hold. While not formally studied by Abrams (2019), we can think of a comparison site as an application that increases competition by increasing the size of the consideration set for depositors.

4.3 Deposits versus deposit-like products

Some fintech-based firms have sought banking licenses to gain access to the market for (insured) deposits. Others have introduced products that are similar to deposits in terms of liquidity and stability of value even though they are not fully insured. For example, several papers analyse the introduction of a money market fund, Yu’ebao, by China’s Alipay in 2013 (eg, Buchak et al 2021, Zhu and Lu 2021). Yu’ebao enabled account holders to make instantaneous payments in cash or fund shares, both on and off Alipay’s platform. There are several things to note. First, Yu’ebao was integrated with Alipay’s payments network, and this arguably enabled Alipay to roll out Yu’ebao more quickly – showing once more that payments platforms can be a launching point for other fintech services. Second, the dynamics around the introduction of Yu’ebao and its impact on banks were remarkably similar to those around the introduction of money market funds in competition with deposits in the US. Yu’ebao was introduced in a regulatory environment

¹³ Separately, banks and regulators have been considering the possibility of tokenization of deposits.

¹⁴ See The Future Of Banking The Growth Of Technology | S&P Global (spglobal.com). S&P considers deposit growth between 2014 and 2018.

¹⁵ Weltsparen was first a fintech-based firm without a banking licence, but later obtained a banking license and changed its name to “raisin”. Raisin is now still offering deposits through the comparison platform, but expanded to offer other regulated banking services as well. In Germany it uses the old brand “Weltsparen” whereas in other countries it uses the new “raisin” brand

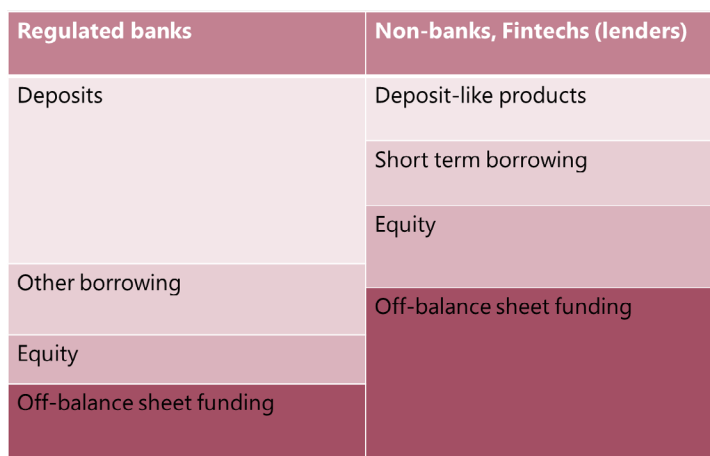
that included ceilings on deposit rates, limiting banks' ability to compete on rates. Following the introduction of Yu'eobao, the most exposed banks experienced lower deposit growth than other banks, but they responded in large part by offering competing products or innovating in other ways (and, after ceilings were relaxed in 2015, by offering higher deposit rates Buchak et al 2021, Zhu and Lu 2021). Finally, although they don't specifically analyse Yu'eobao and competing products, Hasan, Boreum and Li (2022) find that the introduction of fintech dulls the response of loan growth and real economic variables to monetary policy adoption in China. This is akin to Xiao (2020), who develops a model in which money market funds become more competitive with banks as interest rates rise. Xiao then shows that the transmission of monetary policy to rates offered by money market funds essentially limits the transmission to the dollar amount of credit.

Gorton and Zhang (2022) compare stablecoins to other forms of private money that have circulated in the past and argue that stablecoins have some features that are similar to both deposits and, in some designs, money market funds (see also Anadu, Azar, Cipriani, Eisenbach, Huang, Landoni, La Spada, Macchiavelli, Malfroy-Camine and Wang 2023). Unlike insured deposits and fiat currency, private money has generally failed to achieve or sustain "no-questions-asked" status, limiting their usefulness as a medium of exchange. Empirical evidence and theoretical arguments surrounding the stability of stablecoins suggest that (private) stablecoins are not currently a viable alternative for deposits (d'Avernas, Mauriny and Vandeweyer 2022, Gorton et al 2022). d'Avernas et al (2022) focus on algorithmic stablecoins, whose supply is governed by a smart contract that is designed to maintain a fixed exchange rate to a benchmark. They do not find a stable equilibrium that is robust to large negative demand shocks without collateralization. Asset-backed coins aim at overcoming this problem by creating price stability and trust through their underlying assets. However, Gorton et al (2022) point to historical evidence on (uninsured) deposits and money-market funds to note that even asset-backed stablecoins will likely be subject to runs; they also argue that any run-proof scheme that involves backing stablecoins with a money-like safe asset is uneconomical.

Meanwhile, several central banks are discussing the introduction of retail CBDCs which would be guaranteed by the central bank exactly like fiat currency. Concerns have been raised that stablecoins or central bank digital currencies (CBDC) could affect banks' funding cost by reducing consumers' interest in bank deposits (Burlon et al 2022, Liao and Caramichael 2022). Several central banks are experimenting with CBDCs, but as discussed in the payments section, they are looking for modalities that would avoid disintermediation of depositories (Burlon et al 2022, Liao and Caramichael 2022)

4.4 Equity, wholesale and other borrowing, off-balance sheet funding

We have not come across evidence of a direct relationship between financial technology and competition for other sources of funding such as short-term borrowing, equity, or off-balance sheet funding. The availability and cost of these types of funding clearly have an impact on the competitiveness of banks, and especially non-banks that do not have access to deposits (Egan et al 2021, Jiang 2023). Without deposits, other types of funding, including off-balance sheet, become relatively more important (Figure 2).



Note: the figure illustrates the relative importance of funding sources for typical banks and non-bank fintech firms; the size of the shaded areas is not intended to represent exact shares of funding sources.

Equity

As fintech-based startups need equity funding, several papers investigate the nature of venture capital (VC) investment in the sector. Cornelli et al (2021) and Haddad and Hornuf (2019) provide evidence that VC funding is more readily available in markets that are more developed across economic, financial and technological dimensions, even though fintech-based firms have been successful in less developed markets. Cornelli, Doerr, Gambacorta and Merrouche (2022a) additionally find evidence that firms participating in the UK’s regulatory sandbox for fintech firms gained better access to VC funding. This suggests that regulatory sandboxes, which have been introduced in more than 50 countries can provide investors with some certainty about regulatory treatment and the quality of firms admitted into the sandbox.

Venture funding is generally a temporary source of funding with investors seeking to exit via a public or private sale of a startup once it has reached a certain size. banks have steadily acquired fintech firms over the past decade; a concern that has been raised in other industries is that incumbents buy promising startups in order to pre-empt their growth into significant competitors (Cunningham et al 2021). However, Cornelli et al (2022a) find that fintech acquisitions are often motivated by banks’ desire to broaden or improve (online) services. There is insufficient evidence to determine if fintech acquisitions by incumbent banks have had a dampening effect on competition.

Short-term borrowing

With regard to short-term borrowing, Jiang (2023) shows that banks exercise market power over shadow banks (including fintech-based firms) that need lines of credit to warehouse newly originated mortgages before they are sold to investors. Banks use this market power to limit competition in markets where both the bank and the shadow bank borrower offer mortgages. Jiang suggests that banks’ market power could be constrained by speeding up the loan purchase process employed by the Freddy Mac and Fannie Mae and other US government sponsored enterprises (GSEs) that purchase mortgages.

While the total market capitalization of stablecoins remains modest for now, further growth could increase the demand for safe assets that back the stablecoins (Garratt et al 2022). This could affect the market for short term funding and the cost of holding safe assets for others, such as banks seeking to satisfy LCR requirements, but could also limit the viability of asset-backed stablecoins as they are more expensive to “produce” than insured deposits. Along similar lines, Barthelemy et al (2023) document a

relationship between the issuance of commercial paper (CP) in US markets and the circulation of stablecoins that use CP as reserve assets. The authors do not find an impact on CP yields, but that impact may be felt in other markets.

Off-balance sheet funding

The work by Jiang cited above underscores the importance of off-balance sheet funding for loans originated by fintech-lenders without access to deposits. From a different perspective, several authors have investigated the evolving nature of off-balance sheet funding for marketplace lending. Vallée and Zeng (2019) focus on Lending Club, which started as a P2P lender, but increasingly sought to attract institutional investors. The authors develop a model to show that it can be in the platform's interest to promote "passive" investing by reducing the amount of information available to sophisticated investors who could potentially outperform the portfolio. Focusing on Prosper, Balyuk and Davydenko (2023) document a similar transition from P2P to institutional funding and passive investing strategies. Along with Bertsch and Rosenvinge (2019), they also provide data showing that European lending platforms have moved to centralized screening and pricing and source most loan funding from institutional investors (this includes October in France, Bondora in Estonia, Linked Finance in Ireland, Funding Circle in the UK, and lenders in Sweden). Franks, Serrano-Velarde and Sussman (2020) dive deeper into Funding Circle and also argue that centralized loan screening was an efficient response to liquidity fluctuations associated with screening by investors.

4.5 Taking stock

The availability and cost of on- or off-balance sheet funding is an important driver of the competitiveness of fintech-based firms and business models. Similarly, licensed banks benefit from their ability to acquire deposits below cost. The evidence in this section shows that financial technology has limited banks' market power in deposit taking both through the growth of online deposits and the introduction of deposit-like products by financial technology firms. Historical experience and research on stablecoins also suggest that there are limitations to the substitutability between deposits and deposit-like products. The evolution of funding models for fintech-lenders will likely depend on their market environment and, for some, a trade-off between the cost of being a regulated bank and the benefit of having access to deposits.

5 Asset management and investment advice

5.1 Introduction

Asset management, brokerage, and investment advice are often part of the portfolio of services offered by banks and their affiliates, although this is an area where services from non-bank providers abound. These services have been subject of substantial innovation by both incumbents and new entrants. This has contributed to a democratization of access to investments and investment strategies (eg, through the introduction of exchange traded funds) and a reduction in the cost of access (eg, low-cost or zero-fee brokerage services). The advent of more recent innovations, such as robo-advice, appears to have extended the trend towards democratization of access.

We will not provide a full accounting of research on competition in asset management and related services, but one important line of work has studied the relationship between fund performance and fund flows. Higher performing funds attract more flows; the relationship is non-linear, intermediated by advertising and membership of "families" of funds (eg Gallaher, Kaniel and Starks 2015, Sirri and Tufano 1998). The link between performance and flows is perhaps unsurprising, but because historical performance does not guarantee future performance, it may not be in the best interest of investors. Another strand of the literature has focused on the role of financial advisors; this line of work finds that

advisors may provide advice that is biased against investors' best interest and steer consumers towards higher fee funds, which potentially dulls the impact of competition on fees (Mullainathan, Noeth and Schoar 2012, Sun 2021).

5.2 Robo advice

Providers of wealth management services are increasingly deploying sophisticated algorithms to deliver automated investment advice and portfolio management for individuals and firms, or robo advisors (D'Acunto and Rossi 2021).

Although the development of robo advisors can require significant investment, they enable firms to provide advice at low marginal cost as compared to a firm operating with human advisors only. Hence, robo-advice is economical for much smaller portfolios than traditional advice. Estimates from a sample of US-based investors find positive wealth effects for consumers that gain access to robo-advice (and who did not previously have access to in-person advice Reher and Sokolinski 2022). Reher and Sokolinski (2022) also find that the wealth effect is due to the fact that robo advisors offer access to more sophisticated investment strategies than provided by index funds (in different settings, Bianchi and Briere 2022 also find that robo advice contributes to improved portfolio allocation, especially for less sophisticated investors, D'Acunto, Prabhala and Rossi 2019, Loos, Previtero, Scheurle and Hackethal 2020). The findings also suggests that there might be complementarities between robo advisors and fintech tools designed to implement strategies such as tax-loss harvesting (Abraham et al 2019). In addition, there may be complementarities between in-person and robo advice, at least for certain segments. Because many customers value personal interaction with advisors, established firms may benefit from the ability to offer hybrid services that simultaneously employ traditional wealth management services and robo-advisors or that use robo-advisors as time-saving tools for financial advisors (Abraham et al 2019).

Several authors argue that robo advice should help address bias observed in recommendations from human advisors, or in individuals' investor behaviour. For example, Loos et al (2020) find that robo advisors are less likely to engage in returns chasing. However, potential bias among robo advisors and the appropriateness of their advice has also been of concern. For one, several papers that find welfare improvements from robo advice, also note that this is due to increased risk taking (even as risk-adjusted returns increase Bianchi and Briere 2022). This raises the question as to what level of risk-taking is appropriate and whether there is a need to focus on financial literacy to ensure users have the skills to tailorize the information from robo-advisors to their individual risk profiles (Van Rooij, 2014; Butler, 2007). In this context, it would also be useful to conduct more research into the impact of different designs of robo advisors. For example, some robo advisors make recommendations, while others also implement investment strategies (Bianchi and Briere 2022). Evidence in Hong, Lu and Pan (2019) suggests that it also matters how information is presented by advisors; they study flows into Chinese investment funds that are offered through online platforms. The platforms display fund in order of recent performance and the authors shows that returns chasing is much stronger for funds that are on a platform compared to those that are not. In addition, Hong et al (2019) find some preliminary evidence that fund managers compete to be at the top of the list by taking more risk. One could imagine fund managers trying to "game" more sophisticated advisory algorithms to attract flows with negative effects for the users of robo advice.

Researchers have found bias in algorithmic tools, including robo advisors. For example, robo advisors could be trained on data that reflects historical bias, or are designed to optimize fee income rather than investor return (Fein 2015, Turner Lee et al 2019). Researchers have also made some advancements in the area of algorithmic fairness (or algorithmic hygiene) (Vassilopoulou, Kyriakidou, Özbilgin and Groutsis 2022), pointing to a role for a human element in decision-making to address potential bias in design, testing, and implementation of algorithmic tools such as robo-advisors. To the extent that competition among firms induces bias in robo advice (eg, to increase fee income) or promotes unwarranted risk taking by investment managers (Hong et al 2019), this could limit the benefits of robo advice.

5.3 Taking stock

Innovations in investment advice and wealth management are expanding access to advisory services, especially among less wealthy investors. Research has found that, on balance, this is welfare improving. There are inherent risks associated with the algorithmic tools that have supported broader use of advisory services, although some of these risks, including various forms of bias in investment advice, are also present in investment recommendations of human advisors. It would be useful to investigate further if, and under what circumstances, competition on the market for investment advice limits or promotes the welfare improving elements of robo advisory services.

6 Discussion and conclusions

Evidence from a cross section of banking services shows that financial technology has had a meaningful impact on competition in the markets for those services. The impact of competition has been to make services more widely available as well as, to some extent, to put pressure on incumbents' market share and margins. In this section, we discuss the evidence in light of several themes that cut across payments, lending, funding, and investment management services. Themes include the role of the market environment, regulation, the evolution of financial technology-based firms, Big Tech, competition and stability, in conclusion, we also point to areas for further research.

In competition between incumbent banks and fintech-based non-banks, the latter have been especially successful where there were gaps in service delivery by the existing banking system. This is less tautological than it sounds; data processing and communications technologies that underlie financial technology are widely available and banks have used such technologies to introduce electronic banking and other services. The papers cited in this literature review point to a few reasons as to why fintech-based firms have been able to fill gaps in financial service delivery left by banks.

First, a payment service like M-Pesa was built on the backbone of a mobile telecoms network, ie a proprietary infrastructure that created a competitive advantage for the introduction of electronic retail payments (Jack and Suri 2014). Second, regulatory restrictions on banks can create opportunities for fintech-based firms as they make banking services more costly (Buchak et al 2018), or less appealing (Buchak et al 2021) for consumers. Finally, several authors have argued that banks, stuck with legacy technology and data infrastructure, are bound to lag new entrants in the introduction of innovation. The broader literature provides some support for this argument; startups may be more creative in their approach to innovation (Kolev, Haughey, Murray and Stern 2022), incumbents may have disincentives to innovate for fear of cannibalizing existing revenue streams (Christensen 1997, Igami 2017). In addition, it is difficult to adapt business processes to exploiting innovations (Brynjolfsson and Hitt 2000). However, firm-level evidence on the introduction of financial technology in banks (and their level of success compared to fintech-based firms) remains limited.

Regulation affects the growth of fintech-based banking services both through constraints on incumbent banks (as noted above) and by imposing limitations on non-banks. Most notably, deposit-taking is generally restricted to regulated banks and provides them with a funding cost advantage. Research cited in the review also points to more specific effects of regulation in facilitating or even promoting the development of markets for banking services. For example, by requiring that large banks accept payments through Pix, Brazilian regulators ensured that the system was widely accepted at launch, which facilitates adoption by users in a two-sided market like payments. Similarly, regulatory interventions to enhance the portability of banking data have facilitated the introduction of payment and lending services by non-banks (OECD 2023).

Banks offer a bundle of services that includes payments, deposit-taking, lending, and sometimes wealth management. An important question about the impact of financial technology on banking is

whether this business model remains viable. Jiang et al (2022) show that competition from fintech-based firms in one line of business (lending), can compel banks to close branches, limiting availability of services to customers with preference or in-person transactions. At the same time, several of the papers we cite point to synergies between payments, funding, and lending for fintech-based firms. This includes the use of information from payments, or sales, for lending decisions and the reliance on portfolio-based funding models rather than a peer-to-peer model in which investors participate in individual loans. Zamil and Lawson (2022) document that fintech-based firms have obtained banking licences in several countries. Examples include big tech firms in China (eg Tencent or Xiaomi) as well as fintech firms obtaining charters in the UK (eg Paypal Holdings or Revolut), the European Union, and the US. This seems to underscore the appeal of banks' business model for firms that provide banking services.

The entry of big techs firms in the market shows that banking services have synergies not only with each other, but also with other services such as online retail and telecoms. Big tech are often perceived as potentially strong competitors in banking services because they enter the market with established client relationship, infrastructure to support financial transactions, and substantial financial resources (de la Mano and Padilla 2018). There are limitations to these strengths, particularly beyond big techs' own platforms. Information on creditworthiness that is derived from sales or purchasing data is not available for potential borrowers that do not transact on a big tech's platform and while peer-to-peer payments can be executed without involvement of third parties on the platform, that is not the case if payments are made to accounts that are not associated with the big tech. Furthermore, in some jurisdictions, the regulatory requirements associated with, say, deposit-taking may make it challenging for big tech firms to offer a full suite of banking services.

Evidence on synergies between banking services and limitations to banking services provided by big techs suggests that financial technology will not lead to the obsolescence of a business model that involves the bundling of key banking services. However, competition between incumbent banks and fintech-based entrants that obtain banking licenses as well as between incumbents that are more or less successful as innovators might well lead to some turnover in the banking sector. This leads us back to the question of competition and stability.

As noted in the introduction, evidence on a link between competition and stability in banking is mixed at best (Zigraiova and Havranek 2016). Yet there are at least two reasons to consider how financial technology might intermediate a link between competition and stability. First, although we still have much to learn about the bank failures in the US and Switzerland in the first half of 2023, technology appears to have played a role. Online banking services facilitated the withdrawal of funds from banks at unprecedented speed, while information exchanged on social media may have helped coordinate a bank run (Cookson, Fox, Gil-Bazo, Imbet and Schiller 2023, Koont et al 2023).¹⁶ There is no evidence that underlying problems at the failed banks were induced by fintech. Still, the widespread adoption of online banking may have financial stability effects if it affects the likelihood and speed of runs. Second, shocks to the banking sector often have real effects, especially for bank-dependent borrowers (Khwaja and Mian 2008). Access to Fintech-based lenders, could substitute for access to banks and mitigate the real effects of shocks to banks (Eca et al 2022). Third, innovation is likely to be a source of competition between successful and unsuccessful innovators; this could be a source of turnover in the industry and, if some of the less successful innovators are large, instability. It is not clear from current research what firm characteristics are associated with innovative success might evolve (eg, whether there will be a gradual process or sudden changes in competitiveness).

There is much that remains to be explored in the area of financial technology. As banks and fintech-based firms continue to experiment with service delivery and regulatory regimes evolve, we will likely gain further insight in the relationship between financial technology and competition for banking services. To conclude, we would like to highlight several areas where further research would be particularly useful. The first issue pertains to the measurement of innovation or innovativeness of banks and non-

¹⁶ The fact that social media is not strictly "financial technology" is cold comfort to regulators.

banks offering banking services. Chen et al (2019) show that patents are associated with higher market values for banks but there are very few banks that actively pursue and obtain patents. Others have used information on employee skills or investment Information Technology (IT) as a measure of innovation (eg He et al 2022, 2023). While inventions, skilled personnel and IT investments are important technology inputs, banks will ultimately have to integrate new technologies in an effective business model (Brynjolfsson and Hitt 2003, Fasnacht 2018). This requires research into identifying characteristics that are conducive to banks' ability to exploit innovation and investments in new technology.

Second, two of the five scenarios in the 2018 paper from the BCBS envision a form of partnership between banks and non-banks in the delivery of financial services. One scenario sees banks as providers of transaction services with fintech-based firms managing client relationships and another scenario sees banks, fintech-based and big tech firms managing transaction services and client relationships in configurations that may differ by client or line of business. We have come across some examples of such partnerships, with, for example, banks providing the payment rails for mobile wallets offered by big tech firms, banks offering loans and deposits for clients of M-PESA (Cook and McKay 2015), or providing warehouse loans to fintech-lenders (Jiang 2023). The rationale for such partnerships can be that they make use of existing infrastructure, that they enable fintech-based firms to offer services that require a banking license, or that they enable smaller banks to leverage technological innovations developed by fintech-based forms (Board of Governors Federal Reserve System 2021). However, there is limited evidence on what motivates the choice of partnerships over other options (such as the acquisition of a bank, or a license), how partnerships might evolve, or how they affect the competitive position of the partners. Considering that partnerships are perceived as a potentially important part of the future banking landscape further research into these questions would be useful.

Third, much work has been focusing on the role of non-banks or neo-banks leveraging technology to offer banking services. Less attention has been given to the characteristics of banks that might be more, or less, well-placed to address the competition from these new entrants. For example, does technology increase or reduce economies of scale in banking? or does it favour narrower or more diverse business models? and under what conditions? Developing answers to these questions will provide a clearer picture of the future of the banking industry.

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