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# Fintech: Is This Time Different? A Framework for Assessing Risks and Opportunities for Central Banks

**by**

**Meyer Aaron,[1] Francisco Rivadeneyra[1] and Samantha Sohal[2]**

[1]Funds Management and Banking Department
[2]Financial Markets Department
Bank of Canada
Ottawa, Ontario, Canada K1A 0G9
maaron@bankofcanada.ca
frivadeneyra@bankofcanada.ca
ssohal@bankofcanada.ca

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# Abstract

We investigate the risks and opportunities to the mandates of central banks arising from fintech developments. Fintech may affect the different areas of responsibility of central banks—mainly monetary policy and financial stability—by changing money demand and by changing the industrial organization of the financial system. We present a competitive strategy framework to help evaluate the likelihood of these changes.



*Bank topics: Central bank research; Digital currencies; Financial institutions; Payment clearing and settlement systems*
*JEL codes: G1, G2, L1, E42*



# Résumé

Nous nous penchons sur l'évolution des technologies financières et analysons en quoi elle est porteuse de risques et de possibilités pour les missions des banques centrales. Parce qu'elles impliquent une modification de la demande de monnaie et du modèle d'organisation industrielle du système financier, ces technologies pourraient transformer les diverses sphères de responsabilité des banques centrales – en particulier la politique monétaire et la stabilité financière. Nous présentons un modèle de stratégie concurrentielle qui nous aide à évaluer la probabilité de voir ces mutations s'opérer.



*Sujets : Recherches menées par les banques centrales ; Monnaies numériques ; Institutions financières ; Systèmes de compensation et de règlement des paiements*
*Codes JEL : G1, G2, L1, E42*

# 1. Introduction

Innovation in financial services is not new. Advances in financial infrastructures and instruments have been ongoing for centuries—from Babylonian loan tablets, to double-entry bookkeeping in the 1400s, to the ATM and many more. Recently, however, financial innovations widely referred to as fintech are riding a flurry of new interest, as evidenced by the amount of investment dollars, product offerings, start-ups and media coverage.[1] The potential benefits of fintech for society seem large when compared with the historical cost of financial intermediation. By some measures, the cost of intermediation is close to 2 per cent of GDP in certain advanced economies.[2] Touted benefits of fintech include broadening financial inclusion and new financial intermediation applications, such as smart contracts.

In this paper we investigate the risks to and the opportunities for the mandates of central banks arising from fintech developments. If these developments change the relationships that underpin the traditional tool kit of policy making, central banks will need to develop new models and operational frameworks. To continue carrying out their mandates effectively, central banks must form an opinion on the following two questions: When should a central bank be concerned about developments in fintech? If there is a concern, what should the policy response be? This paper attempts to answer the first question in the context of the current mandates and leaves the second for future research, particularly if new mandates should be adopted.

The expected impact of technological change tends to be overestimated in the short run but underestimated in the long run.[3] Therefore, we attempt to take a long view of the risks and opportunities fintech presents. Our premise is that in the long run, fintech may affect the different areas of responsibility of central banks in two main ways: by changing money demand and by changing the industrial organization of the financial system. Both could directly affect the conduct of monetary policy, currency demand, financial stability and the need for a lender of last resort. Fintech could also have broader effects on employment and productivity as part of the digitalization of the economy. This in turn could affect the reaction functions of central banks. In this paper we focus on the direct effects.

We define fintech as applications of digital technology to financial intermediation problems. This covers a vast array of technologies, from mobile computing to distributed ledger technology

[1] Goetzmann and Rouwenhorst (2005) survey the history of financial innovation. For information on global financing trends, see KPMG and CB Insights (2016). **Table 4** in the appendix highlights that most fintech activity is focused on the retail-banking, asset-management and back-office functions of financial institutions.

[2] Philippon (2016) calculates that the unit cost of intermediation is close to 2 per cent of the value added in the US economy. Bazot (2014) finds similar estimates for France, Germany and the United Kingdom.

[3] This mantra among technologists, Silicon Valley entrepreneurs and economic historians is based on the observation that the most transformative applications of new technologies are implemented only after much trial and error.

(DLT) to artificial intelligence. The applications range from mobile retail banking, to digital currencies, to anti-money laundering. Throughout the paper we distinguish between the fintech technologies and the fintech business models, i.e., the core technologies and their applications. We present an analysis framework that focuses on the economics of fintech solutions. Since there is no unified theory of financial intermediation, we use the Porter (1980) competitive analysis framework to help us organize the banking and monetary theories that explain the different parts of the industrial organization of financial intermediation.[4] We use this framework to analyze which financial intermediation problems are the ripest for disruption by fintech and to understand where fintech could impact the mandates of central banks.

The main theme of our conclusions is that fintech is more likely to bring change by creating new financial intermediation applications rather than by changing the ones that exist today. Therefore, at this moment the best response of central banks is to monitor fintech to form a view on its risks and opportunities, by providing access to the infrastructures central banks control and to encourage the testing of new business models with the new technology.

Arguably, the most important responsibility of a central bank is conducting monetary policy. The advent and widespread adoption of new forms of electronic means of payment and stores of value may fundamentally affect money demand, and thus how central banks achieve low and stable inflation. However, electronic money is not new. It simply has received renewed interest following the introduction of Bitcoin in 2008.[5] A rapid and widespread substitution away from central bank reserves and notes seems unlikely at this point, at least when seen through the lens of past innovations such as credit cards and stored-value cards. Moreover, even in that event, central banks could still conduct monetary policy as long as they have control over a short-term interest rate.[6]

A second traditional area of responsibility of many central banks is the design and distribution of currency. Although this is not essential to the conduct of monetary policy, central banks around the world manufacture and distribute bank notes. Fintech could affect this function of central banks if there is a widespread substitution away from bank notes for retail transactions. Its main impact would be to drastically change the composition of the balance sheet of central banks. As mentioned above, this change seems unlikely, especially in countries with a credible

[4] The Porter (1980) competitive analysis, also known as the five forces analysis, is in fact rooted in industrial organization. It helps determine the competitive intensity of an industry by analyzing (i) threat of entry, (ii) threat of substitutes, (iii) the bargaining power of customers, (iv) the bargaining power of suppliers and (v) competition among rivals.

[5] Electronic means of payment, or e-money, have been a reality since at least the early days of the Internet and a theoretical concept of monetary economists long before (see Woodford 2000). The issue emerged as a research topic at the Bank of Canada in the mid-1990s with the advent of electronic stored-value cards and the Internet. More recently, e-money has been an active area of research at the Bank since 2013. For the recent research on this specific topic, see the dedicated website http://www.bankofcanada.ca/research/e-money/.

[6] See Woodford (2000) and Zhu and Hendry (2017).

monetary policy. On the other hand, central banks might still choose to issue their own digital alternative to bank notes for retail transactions.[7]

With respect to the financial sector, central banks have several responsibilities. One is to maintain a safe and efficient financial system by overseeing financial system infrastructures. Some fintech start-ups are investigating applications of DLT to create alternative clearing and settlement systems. Some central banks are also investigating applications to create settlement systems based on a central bank digital asset. We will argue that the current tiered payment structures seem to have a strong competitive advantage compared with the proposed decentralized systems, and that the biggest risks to central banks will likely come from new applications of DLT, such as smart contracts.

Recently, central banks have taken charge of macroprudential regulation and, in some jurisdictions, also oversee financial institutions. How central banks continue performing these duties will depend on the effects of fintech on the makeup of the financial system. The makeup of the financial system may change in two ways: at the industry level through the accommodation of new, differentiated entrants, or at the firm level by incumbents changing their organizational boundaries. Fintech affects the entrance decision and the boundaries of intermediation activities because it allows new firms to source deposits and create loans. This poses a challenge to regulators because the typical regulatory model assumes well-defined institutions. For example, the usual definition of a bank is an institution that takes deposits from the public and makes loans. Regulation based on the institution and not on the activity will be challenged by the blurring of the distinction between banks, non-bank credit providers and financial markets. Fintech presents opportunities for improved regulation in the access to data from DLT applications such as securities settlement. However, risk in this area may come from the complexity of these new applications.

One particular challenge retail banks could face is a threat to demand deposits. Many fintech firms are exploring mobile technology to test business models that create platforms for retail payments and cross-border transfers. In retail banking, the technology used by fintech firms will reduce the barriers to entry for new firms and will lower the switching costs of customers. On the demand side, the experience of mobile applications in other industries is changing the expectations and loyalties of customers in banking. Incumbents might choose to respond with predatory acquisitions or predatory pricing, or by lobbying for new regulation. Incumbents might also adopt the new technologies within their own business models through proprietary technology or partnerships with existing fintech firms. However, it seems unlikely that incumbents could adopt completely new business models within their organizations.

[7] Fung and Halaburda (2016) discuss a framework to analyze this possibility.

This paper is organized as follows. Section 2 reviews the basic banking and monetary theory necessary to understand the frictions underlying financial intermediation. To speculate about the potential impact of fintech, we describe how the current financial technology solves fundamental economic frictions. Section 3 goes deeper into distributed ledger technologies. We discuss the trade-offs in token- and account-based record-keeping systems. This distinction is important to understand the viability and implications of a widely held central bank digital liability. We also discuss whether DLT might be used to replace wholesale payment infrastructures. Section 4 presents our analysis framework based on the Porter (1980) five forces analysis.

Section 5 discusses the main implications of our analysis. We conclude that fintech does not seem to be an immediate threat to the conduct of monetary policy. As the technology is still evolving, it is important to note that it is too early to judge the effect of fintech on the financial sector mandates of central banks. We have, however, two conjectures about the potential changes to the industrial organization of the financial system. Our analysis suggests that fintech entrants will have incentives to become regulated entities to be able to exploit the traditional economies of scope of banks. Conversely, banks will have incentives to acquire the new entrants or to copy their technology. Section 6 provides some concluding remarks and suggests future research questions on regulation.

## 2. Financial Intermediation and Fintech

In this section we review some standard monetary and banking theories that are helpful to explain aspects of financial intermediation. We describe the fundamental economic frictions that financial intermediation tries to solve, and explain the different functions of banks and financial infrastructures. We then dive deeper into each of those functions and put them in the context of what fintech start-ups and technology companies are doing in terms of economies of scale, economies of scope and platforms.[8]

The fundamental economic frictions that give rise to financial intermediation can be grouped as follows: (i) incomplete information, (ii) lack of commitment and limited enforceability of contracts, (iii) transaction costs and (iv) the lack of coincidence in the timing of production and consumption. Obviously, all of these are frequently interrelated. For example, financial contracts are designed to transfer value intertemporally because of the lack of coincidence in the timing of production and consumption, which in turn raises the problem of the cost of enforcing contracts because of the lack of commitment and the difficulty of contracting on uncertain

[8] See Freixas and Rochet (2008) for a formal introduction to banking theory. Also see Varian, Farrell and Shapiro (2004) for a similar treatment of the expected effects of the information economy back in the 2000s.

outcomes (because they may be hard to verify). However, it is helpful to understand each of these frictions separately. These four types of frictions are fundamental, meaning that financial contracts can help alleviate them but will not remove them. This is because agents are heterogeneous in their preferences and sources of shocks, and both trade and contracting are inherently costly.

These frictions determine why financial intermediation and financial infrastructures are necessary. Banks in particular alleviate the frictions mentioned above by

(i) providing liquidity and means of payments;
(ii) transforming assets (in their maturity, credit or liquidity quality, or denomination);
(iii) managing and processing information (by keeping records, monitoring clients and markets, etc.);
(iv) being specialists in managing risks (like credit or liquidity risk); and
(v) providing access to markets.

Banks bundle more than one of these functions because they enjoy economies of scope and scale. Economies of scope occur when at the margin the cost of providing one type of service falls by increasing the provision of another. A typical example is when banks find synergies in selling mortgages to retail depositors. Among other factors, the economies of scope will determine the ability of incumbents to defend their competitive position from fintech entrants.

Some of the services mentioned above are also provided by other institutions, such as brokers and financial market infrastructures (FMIs), in particular the risk management and information processing functions and market access. We mention them separately from banks because some fintech start-ups are attempting to enter the brokerage and FMI businesses. In addition, some of these functions are fulfilled by financial markets, and they are indeed competitors to banks in that respect. We now turn to each of these functions and go a bit deeper into the economic frictions in relation to the technologies that fintech start-ups are using to solve those frictions. We mention the instances in which banks or financial markets are threatened by fintech.

### Liquidity and means of payments

Payments is probably the area that has attracted the most investment and experimentation by fintech start-ups and established technology companies. This is no coincidence, since although payments is a traditional area of expertise of commercial banks, it is rife with inefficiencies. Fintech start-ups are exploring several technologies to compete in the provision of means of payments. DLT is the technology behind most cryptocurrencies attempting to create digital payment alternatives. However, the most relevant developments are not in the alternative means of payment but in the access to established ones. Many firms are attempting to create new

payment platforms or to compete in the provision of *access* to established payment systems with new infrastructure at the point of sale.[9]

When providing means of payment, banks solve a lack of coincidence of wants, or a lack of coincidence in the timing of consumption and production. A necessary condition for this function is the creation of liquid bank deposits. Bank deposits are special to the economy because in the case of fractional reserve banking, they allow banks to create illiquid loans. An important implication of the competition from fintech in the provision of means of payment is that banks could reduce the amount of bank deposits and their credit to the economy.[10] The potential effect of such a scenario would depend on the starting level of credit provided by banks and the prevalence of alternative lending channels such as mutual funds and the stock market. However, the likelihood will depend on the rate of adoption of the alternative means of payment and the response of banks. The rate of adoption of clearly superior and newer technologies may be thwarted or delayed by the fact that payment platforms require acceptance by both customers and merchants, a problem that has received attention in the literature on two-sided platforms.[11]

Because of the economies of scope that banks exploit, it is safe to assume that they will respond vigorously. It is useful to remember that in past decades, banks faced new competition to their lending business from mutual funds. As a response, banks added a mutual fund business line. Therefore, the response of banks this time around might be to acquire the entrants or to adopt the technology if it is not proprietary. We discuss this in Section 5.

### Asset transformation

Banks, and other intermediaries, transform assets in their denomination, risk and maturity. Take again the example of bank deposits: by collecting deposits of small denomination across a large number of customers, banks are able to provide loans to firms and, in the process, modify the duration and risk of the deposits. This applies to currency denomination as well. Any type of transformation requires risk taking from the intermediary: liquidity risk in the case of deposits, credit risk in the case of loans, and exchange rate risk in the case of currency transactions.

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[9] Stripe and Square are recent and already large technology companies competing in the payment processing business. Apple and Google, to name two, are older and established companies also trying to firm up their interface between customers and their established means of payment.

[10] This statement assumes that banks would not adapt to fintech entrants. In reality, they could take advantage of fintech to reduce their cost of lending (even if borrowing through deposits becomes costlier because of competition). Thus, as long as net interest margin (the spread between lending and borrowing) is preserved, banks may continue to be significant providers of credit to the economy.

[11] Arifovic, Duffy and Jiang (2017) show experimental evidence that under some conditions superior means of payments will be adopted over time when fixed costs to merchants are relatively small, but may not otherwise.

An important fintech application in this area is peer-to-peer lending (P2P) and newer variants like investor-to-peer (I2P). The objective of these lending platforms is to channel savings from individuals directly to borrowers. The P2P model is similar to banks in attracting small-denomination amounts but different in that the lending can also be in small amounts. The advantage of these platforms is that they reduce the problem of fixed costs that banks traditionally solve by bundling deposits. The I2P model can be seen as the reverse of the small deposits–large loans model of banks. This model takes large amounts from institutional investors and distributes small loans to peers, individuals and small businesses. The technologies in these business models are in fact a combination of the asset-transformation, risk-management and information-processing functions of banks.

### Information processing

Banks specialize in a particular type of lending called "information-intensive" lending. Banks solve the informational frictions and the lack of commitment of borrowers either by partly demanding collateral or by screening and monitoring borrowers. Banks and borrowers have the incentive to build relationships to reduce the informational problems, for example, from screening that a loan applicant is truthful or the ongoing monitoring of a firm's project. This is in contrast to the arm's-length lending usually done by financial markets, where the securities issued should reflect the credit risks. One clear example is securitization.

The informational frictions are also present when a bank is performing duties on behalf of clients—for example, with international money transfers. Some regulated financial institutions are held accountable for due diligence in many jurisdictions, particularly banks and other lenders that must comply with know-your-client (KYC) and anti-money laundering (AML) requirements.

Many fintech firms are active in these two aspects of information processing, exploiting the plethora of information available. These business models usually exploit technology like big data and machine learning. As mentioned above, the peer-to-peer lending model focuses on creating new channels for intermediating savings to loans. This model relies on platforms that gather the information of borrowers, and assesses a credit risk profile that the lender can use in a lending decision. Therefore, this model has more in common with arm's-length lending since there is no relationship or monitoring by the platform or lender. If the risk is priced appropriately, the incentives of lenders will be aligned when they understand the risks—for example, from misrepresentation or cheating on the outcome of a project. By creating bundles of risk profiles for lenders to choose from, platforms reduce the problem of fixed costs of intermediating, which banks traditionally solve by bundling deposits. Other start-ups are narrowly focusing on developing technologies that reduce the cost of compliance and selling them as services to other intermediaries.

### Risk management

As a result of the functions mentioned above, intermediaries specialize in risk management and are compensated for doing so. Banks and other lenders have technology that helps them forecast liquidity demands and individual credit risk, which they bundle with the objective of diversifying those risks. Insurance companies, on the other hand, specialize in the evaluation and diversification of idiosyncratic risks as their main objective.

Some examples of component technologies that fintechs are using in this function are machine learning and big data.[12] Most of the new lending platforms use these techniques to predict default risk and speed up the credit approval process. Some insurance companies use wearable devices that aid in the tracking of behaviour to define risk profiles. As with the information-processing function, some start-ups are also focusing on developing and selling risk-management services to other intermediaries. It is not yet clear what barrier stand-alone fintech start-ups will develop to prevent established lenders from adopting these technologies.

The aggregate effect of better risk management on lending is likely to be positive. Some of the standalone P2P and I2P platforms attempt to service credit risks that were uneconomical for standard lenders.[13] On the other hand, the distributional effects and aggregate risk implications are not yet very clear. In the particular case of peer lending, the model has some economic similarities to the originate-and-distribute model of securitization because the platform typically has no direct stake in monitoring the performance of loans.

### Provide access

A consequence of transaction and information acquisition costs is specialization in intermediation. One way this manifests is in how customers access most organized financial markets (equities, bonds, etc.). In the current model, retail and institutional investors require brokers and dealers to provide access to the platforms and infrastructure necessary to negotiate, conduct and settle trades. In addition to gatekeeping, brokers and dealers have an informational advantage over their clients—for example, in the sophistication of retail clients or in the asset characteristics that institutional investors acquire through their dealers.

Fintech is challenging the access function of intermediaries in two ways. At the retail level, robo-advisors are providing a more transparent and competitive way to access financial markets. They offer automated return and risk preference analysis to investors as well as portfolio selection and rebalancing tools. Usually these firms champion the benefits of passive management and

[12] Examples are the joint use of the standard demographic, income and credit bureau data with data from social media and behavioural statistics, such as the click patterns in the filling of online application forms.

[13] One Canadian P2P and I2P lender has a business model of lending to segments that typically cannot get unsecured credit from banks and that are mid-income individuals who rely on credit cards for revolving credit.

low-cost index instruments. Like the competition over the provision of means of payments, the battle over asset management has older roots. In fact, the preference over passive management is a consequence of the efficient-market hypothesis, one of the oldest intellectual debates in finance. Although the trend towards passive investing was already well under way, fintech has accelerated the process by allowing customers, usually younger ones, to use these cheaper products to access financial markets.

The second and more fundamental challenge to the access restrictions and information-processing advantages of intermediaries is in the business of asset custody, clearing and settlement, corporate actions, and asset servicing, sometimes called back-office functions. DLT has been proposed as the technology that will streamline post-trade processing and asset servicing. Fintech advances in this area have been championed mostly by the intermediaries involved in these businesses, via several consortia of banks and technology companies testing different proofs of concept.[14] It is possible that the different developments in DLT will increase competition in the market for *inputs* used in the back-office function. However, it is unclear at this time whether the cost savings would be passed on to customers accessing markets through the intermediaries. We explore this topic more deeply in Section 3.

In summary, to understand the economics of fintech firms and the potential responses of incumbents, it is useful to keep in mind the following factors for each of the functions mentioned above: economies of scope and scale, platform effects on the supply side and network effects on the demand side. Broadly speaking, there are two types of business models of fintech firms: entrants and suppliers. Entrants are trying to make inroads into traditional businesses or create new ones, while suppliers are competing to provide the inputs to these traditional businesses.

## 3. Distributed Ledger Technologies

In this section we further explore one of the technologies that has attracted the most attention from central banks and operators of financial infrastructures.[15] DLT has been the subject of much experimentation because of its potential to improve payments and other financial intermediation systems. The Committee on Payments and Market Infrastructures (CPMI) defines a DLT as "the processes and related technologies that enable nodes in a network (or arrangement) to securely propose, validate and record state changes (or updates) to a synchronised ledger that is distributed across the network's nodes" (CPMI 2017, 02). In this

[14] Some examples are R3, a consortium of global investment banks focused on DLT for post-trade processing, and Hyperledger, an open-source project led by IBM focused on creating standards for the development of code and applications of DLT.

[15] This section is based on Kahn, Rivadeneyra and Wong (2017).

paper, we take the abstract view of DLT as a record-keeping technology. Any record-keeping arrangement necessarily has the following three elements: the records, the access permissions to the records, and a protocol to update the records. Loosely speaking, it is a history of who knows what, about whom and when.

DLT is a record-keeping arrangement in which the records themselves are distributed, and the update protocol is based on some consensus protocol. Given its distributed nature, the expected benefits are (i) improved settlement speed, (ii) transparency, (iii) availability, (iv) immutability and auditability of the records, (v) resilience of the system and (vi) cost-efficiency.[16] Research on DLT has mostly been focused on the technical aspects, while the economic understanding has lagged behind.[17] Therefore, to discuss the risks and opportunities of DLT arrangements for central banks, we draw on a key insight: fundamentally, all DLT schemes store and transfer value via digital tokens.[18] However, not all token systems are DLT systems. In other words, DLTs are a subset of token systems. Thinking of DLT as a token system applies not only to payment systems but also to securities settlement systems or smart-contract ledgers. In these more general cases the purpose of the system is also to safely exchange tokens, with the only difference being that these tokens take more complex or varied forms.

**Table 1** is a stylized description of record-keeping systems using two dimensions: who has access to the records and how the records are updated. For both, the polar opposites are complete centralization and complete decentralization (distributed). Pure DLT systems have full decentralization of records and full decentralization of the updating. In contrast, core financial infrastructures like high-value payment systems, central counterparties (CCPs) or central depositories of securities are the opposite on both dimensions. These infrastructures are usually account-based systems. Researchers are actively exploring whether some version of DLT systems can be used to run these infrastructures. Similarly, others are looking at hybrid versions—for example, systems in which records are distributed but verification is performed by a trusted party among a selected subset of participants.[19]

With this basic model we can analyze the risks and opportunities of three types of applications of DLT that are relevant for the mandates of central banks. The first type is cryptocurrencies. E-

[16] See Mills et al. (2016) and CPMI (2017) for the technological underpinnings motivating these potential benefits. See also the latter for a framework to evaluate the different DLT applications. Mainelli and Milne (2016) estimate savings of billions of dollars from the reduced need of multiple databases in reconciliation in securities settlement.

[17] Most of the interest of developers has been speed of processing, scalability of the network and the consensus algorithms used to update records. A notable exception is the work of Chiu and Koeppl (2017). They explore the economics of cryptocurrencies by analyzing the optimal design of a system in terms of the verification costs, the verification delay and the endogenous value of the currency.

[18] See Kahn (2016) for a description of the differences between token- and account-based systems. The key difference is that in a token system the transaction requires the verification of the authenticity of the object, while in an account system the verification is of the individual's identity.

[19] See Hearn (2016) for details of these new types of systems.

money (or even digital notes) is an important application if central banks decide to create a widely held central bank digital asset. Our analysis below suggests that in cases where a central trusted party is available, the cost of a fully decentralized system is not offset by benefits like resiliency.

We briefly mention the second and third types of DLT applications. The second type of application is in asset custody and servicing, securities settlement, and core financial infrastructures, such as CCPs. In these applications DLT can potentially replace three roles of the infrastructures, typically record keeping, risk management and account management. The third type of application is smart contracts. One could argue that smart contracts implemented in DLT are a newer type of financial intermediation application. Contracts that are contingent on a future uncertain outcome and that do not require subsequent intervention of the parties already exist, such as pre-authorized billing. Similarly, smart contracts in DLT are automated contingent contracts, but they allow more complexity.

**Table 1:** Examples of record-keeping systems

| | | Records | |
|---|---|---|---|
| | | Decentralized | Centralized |
| Updating of records | Decentralized | Cryptocurrencies like Bitcoin and all other token systems | Not applicable |
| | Centralized | Active research | Traditional FMIs using account-based systems (HVPS, CCP, CDS[20]) |

## DLT as token-based systems

Describing the fundamental attributes of token-based systems, in contrast to account-based systems, is helpful to evaluate a key expected benefit of DLT: cost-efficiency. The main trade-off in a token-based system is the cost of verification of transactions versus the cost of counterfeiting the tokens. To see why, think of a situation in which the seller and the buyer of a good agree to trade using a token. The seller, however, fears that the buyer could deliver a fake token. This is called the double-spending problem. To avoid it, the token *system* offers, at a cost, the possibility of verifying the authenticity of the token. In the case of Bitcoin and other cryptocurrencies, this is called mining. Note that it is the system design that determines both the cost of counterfeiting and the cost of verification. To better understand this idea, think of a

[20] HVPS refers to high-value payment systems; CCP refers to central counterparties; CDS refers to central depositories of securities.

ubiquitous token system: central bank notes. In this system, the cost of verifying the authenticity of notes is rather low because when notes have recognizable features, the simple physical exchange of a note implies the instantaneous verification of authenticity. At the same time, when those same recognizable features are hard to replicate, the costs of counterfeiting notes are prohibitively high for small quantities. For small-value transactions, bank notes tend to be a very efficient system, whereas for large-value transactions they are not, because notes have to be managed and exchanged physically.

Cryptocurrencies and most DLT systems prevent the counterfeiting of digital assets by tracking the provenance of the tokens by creating a history of tokens called the blockchain. The cost of altering the history of the ledger is the cost of falsifying the provenance of a token. For tokens to be valuable, the ledger has to be immutable or costly to alter. The efficiency of the system is determined by the relative cost of verification and counterfeiting. Depending on the value of the trade and the relative cost of verification to counterfeiting, some transactions might occur and some might not. For example, for an exchange that might yield a large surplus for both parties, it might be worthwhile to trade even if the cost of verification is high. This partly explains why some illegal activity is conducted with bitcoins.

Understanding the nature of token systems allows us to make some general conjectures on the efficiency of different technologies. In particular, we can compare the efficiency of different ledger implementations depending on the various verification protocols, such as proof of work, proof of stake or the relationship between verification and counterfeiting costs. In general, a lower verification cost, holding the cost of counterfeiting constant, can improve the efficiency of the system, all other things being equal. Currently, the cost of verification implied in most cryptocurrencies using proof-of-work verification suggests that DLT is unlikely to be a suitable technology for wholesale payment systems.[21]

Note that this analysis avoids discussing any of the technical underpinnings of DLT. However, it is useful to discuss one specific aspect of distributed ledgers based on proof-of-work blockchains. Because of the distributed nature of the records in a network and the latency of communication between the nodes, the immutability of the records at any point in time is not certain but rather probabilistic. This means it is possible, although very unlikely, that a transaction that has been added to the history of transactions could be reversed. This presents a legal problem for some applications, such as high-value payment systems. Different updating verification techniques are being explored to reduce their cost and increase the speed and certainty of the transactions. Some developers are looking into need-to-know systems in which

[21] Chiu and Koeppl (2017) find that the lower bound of the verification cost in token systems with proof of work is an order of magnitude larger than the costs of current HVPS.

only the parties involved have access to the details of the records.[22] Other verification techniques are voting-based mechanisms.

## Tiering and the role of the central bank

Tiering is likely to emerge in equilibrium because there are returns to scale in verifying identities, monitoring individuals or managing tokens. Returns to scale in these activities are natural, since through specialization in these functions the unit cost of performing these tasks should be reduced. As part of their day-to-day tasks, banks now specialize in verifying the identity of individuals. This cost structure will very likely apply to tokens as well. For example, in Bitcoin it is possible to have a public address for every transaction (the limit of addresses is the number of IP addresses). However, there are fixed, albeit very small, costs in doing so; for example, think of the cognitive cost of tracking all of them. Therefore, given this structure of incentives, individuals are likely to do either of the following: (i) use the same address for multiple transactions (thus reducing anonymity), or (ii) use an intermediary that creates one public address for every transaction but maintains the private keys secure. In this case, these intermediaries would be comparable to the function that banks perform today as custodians of identities.

Thus complete decentralization seems to be socially wasteful. This leads to a natural role for *trusted* central banks.[23] Tiering will involve central banks because some trades, such as large interbank transactions, require certainty of settlement and a stable value of tokens. Central banks are in a better position to commit to the legal certainty of transactions, called finality, and to the stability of the value of the tokens when those tokens are their liability. The trust placed in central banks by users of currency or the high-value payment system is a sunk cost, paid over a long period of time. As mentioned above, a decentralized token system must provide costly incentives to avoid the counterfeiting of tokens. On the other hand, a credible central bank would maintain the value of tokens as part of the conduct of monetary policy. Therefore, not exploiting this sunk cost is socially inefficient.

Central banks control risk in the high-value payment systems by restricting access, among other measures. In a token-based system, the central bank could control risk in a similar way, by legally and technically restricting which entities are allowed to directly hold tokens. For other applications, a central bank system might not be well suited. Probably the worthwhile applications of DLT will be in instances where the information asymmetries are large and cannot be resolved by collateral, screening of participants or relationships. One example is cross-border

[22] Corda is a DLT implementation that uses a richer system of permissions to manage access to records. See Hearn (2016) for details.

[23] For this line of argumentation, we assume that central banks have a credible monetary policy that maintains the value of the token. The ability to commit relies generally on the power of taxation.

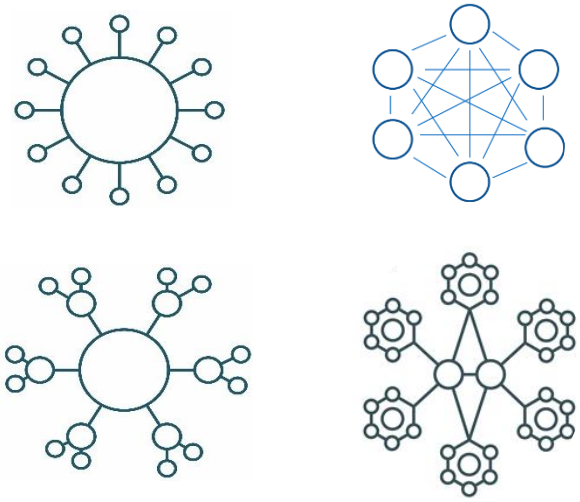
payments and transfers at the retail level. Securities settlement is another example mentioned frequently.

If central banks issue a widely available digital asset, these digital tokens could be held and traded by any individual (legally and technically). The challenge of this scenario is that the distinction between the high-value transactions and the retail transactions could be blurred. In other words, the same instrument used to conduct an interbank transaction could be used directly by individuals for a retail trade. A central bank digital token with the anonymity of a paper note, and the speed and security of the high-value payment system, could profoundly change the incentives of financial intermediaries.

In summary, it is unlikely that permissionless DLT systems will replace high-value payment systems. Central banks would most likely provide these systems with restricted access rather than introduce tiering in other systems like retail payments, and other financial infrastructures (Chapman et al. 2017).

**Figure 1:** Centralized, decentralized and distributed networks

*The top row represents two extreme but idealized versions of verification arrangements: centralized (left) and decentralized (right). The second row represents two versions of tiering arrangements. The left represents a tiering arrangement in which a central party verifies transactions for preferred nodes, which in turn verify transactions for other local nodes. The right represents a model with no unique central node.*



# 4. Analytical Framework

In this section we present our analytical framework for fintech companies and technologies based on Porter's (1980) five forces analysis. Since Porter's analysis is best suited for analyzing the challenges faced by an established industry, we begin by discussing the trade-offs in technology adoption.

## Adoption of innovations

Describing how a market would develop for a new fintech company is helpful in evaluating the immediacy of new innovations and their potential impact on the mandates of central banks. This understanding can help guide policy questions and strategies relevant to central banks, such as where central banks should focus their near-, mid- and long-term resources.

Market development for a new technology relies on the premise that for an innovation to succeed it must be widely adopted at a rate that eventually reaches critical mass. The diffusion of innovation is the process by which an innovation is communicated through certain channels over time among the members of a social system.[24] All members of the social system make their own decisions regarding whether or not to adopt a new technology. However, the opinions of certain members of the market will strongly influence the receptiveness to innovation of other members of the market. This is because other members' adoption of technology helps to remove the uncertainty surrounding a new innovation. This is an example of network effects, which are likely to determine the success of P2P, DLT and other innovative platforms.

There are five key stages in a technology's adoption life cycle, which help to illustrate the sequential nature of creating network effects. (See **Figure 2**). Developing the market for a new technology requires progressively capturing different adopter groups in the market. The five adopter groups of a new technology are (i) the innovators, the technology enthusiasts who are willing to take risks; (ii) the early adopters, who are regarded as visionaries who see opportunities that others cannot; (iii) the early majority, or the pragmatists who confirm the utility of a new innovation; (iv) the late majority, or conservatives who approach new technology with doubt, and adopt new technologies after the average person; and (v) the laggards, who are the skeptics or traditionalists who are last to adopt any new innovation.

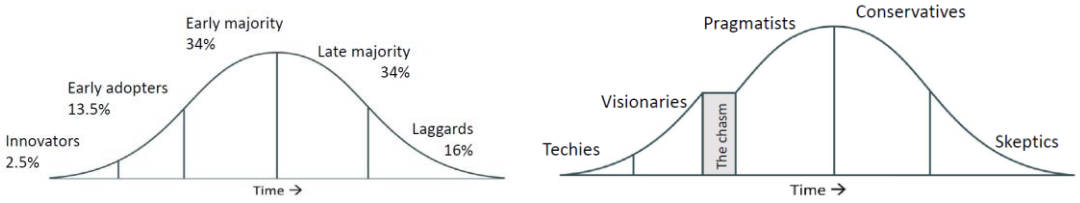
Note that while innovation adoption tends to be sequential, progress along the life cycle is not as simple as working through each adopter group, smoothly increasing acceptance. Adopter groups are heterogeneous, with different needs and wants. While in most instances the opinions of the previous adopter group will influence the subsequent group, at the chasm they do not.

[24] This section is based on Rogers (2003).

This large divergence in needs and wants, and consequently innovation receptivity, is captured by the chasm between the early adopters and the early majority.[25] Early adopters are willing to accept flaws and imperfect features for the sake of being first with a promising yet unproven technology, whereas the early majority will wait until a new technology has proven itself, weighing the costs and benefits of an existing problem. As a result, the early majority is the key adopter group to capture, as these individuals will likely be the first to create network effects and achieve critical mass.

Understanding the chasm and different adopter groups allows us to make some initial conjectures on the adoption of fintech technologies. First, a significant majority of fintech firms are operating within the early stages of the adoption life cycle with innovators and early adopters. Receiving approval from this adopter group does not equate to successful market development. An example of a segment of fintech currently operating within this market is robo-advisory. Second, while new firms try to cross the chasm, incumbents will respond through partnerships, acquisitions or the development of similar technology. Third, many, if not most, fintech firms will fail trying to cross the chasm. Establishing utility, altering business models or adapting to increased customer acquisition costs may prove too difficult for many early-stage companies. What happened with Mondex is an example of some of the issues with introducing new fintech innovations to the market. See **Box 1**.

**Figure 2:** The five stages in an innovative technology's adoption life cycle




[25] This section is based on Moore (2009).

**Box 1:** Mondex and Its Failure to Cross the Chasm

In July 1995, Mondex sought to disrupt the world's payment systems with its advanced electronic cash technology.[26] The Mondex smart card (stored-value card) allowed consumers to transfer electronic cash directly from their bank account to the account of a receiver. Unlike debit or credit cards, it removed the need for third-party intermediaries.

As is typical when attempting to establish platforms, the company's smart card never gained traction.[27] Swindon, the company's initial test market, failed to adopt the technology sufficiently to reach critical mass. Merchants did not have an incentive to acquire the Mondex equipment, and customers were wary of its security. The company failed to illustrate its benefit over existing technology or means of payment, forgetting that the early majority's needs were different than those of early adopters (the financial backers).

## The Porter approach

If a new technology is indeed able to cross the chasm and reach the early majority, the analysis then turns to whether the fintech firm can secure a sustainable competitive advantage within the market. Its feasibility and potential profitability can be determined by Porter's (1980) five forces model.

Porter's five forces are the attributes that shape an industry and govern its profit structure (see Table 1).[28] Economic value may be weakened by strong supplier bargaining power and customer bargaining power, by the threat of new entrants and the threat of substitutes, and by the intensity of the competitive rivalry among market participants. While many of these forces can be interrelated, it is helpful to understand each force separately. Changes in the strength of any one of these forces can adjust an industry's overall competitive landscape and determine whether a business is profitable, as different forces take on prominence.

(i) **Supplier bargaining power.** This force addresses the relative influence suppliers hold over participants in an industry. In the case of fintech, suppliers can be thought of as the providers of funds. Suppliers can exert bargaining power by raising the cost of funding or reducing the stability of funds. The fewer the number of suppliers in an industry, and the greater the industry's dependence upon them, the more power a supplier holds over profitability.

(ii) **Customer bargaining power.** This force refers to the relative strength customers have to reduce prices, demand more service and move between competitors. The number of customers a firm has, the availability of substitutable products and the cost customers

[26] See the MasterCard Connect website.
[27] See Batiz-Lazo and Moretta (2016).
[28] This section is based on Porter (1980).

face to switch to a competitor all influence the significance customers have over an industry's profits. Typically, the smaller the client base, the more power they hold.

(iii) **Threat of new entrants.** This threat represents the ease with which new entrants enter the market. Its strength is dependent upon on the barriers to entry and incumbents' responses. If barriers to entry are high or new entrants can expect a strong response from incumbents, then newcomers will not pose a serious threat. The most significant barriers to entry are economies of scale, cost advantages and capital requirements.

(iv) **Threat of substitutes.** This threat signifies the ease with which customers can substitute one firm's service or product for another's. The more attractive the price-performance trade-off of a substitutable product, the more significant the threat to an industry's profit potential.

(v) **Competitive rivalry.** This force denotes the intensity of competition among incumbents in an industry. The strength of the rivalry is dependent upon several factors, including the number of competitors, industry growth prospects, the similarity of products or services offered, capital intensity and exit barriers.

The relative strength of these forces may be influenced by several external factors, such as government policy, acquisition activity and consolidation. That is why it is important for policy-making institutions, including central banks, to be cognizant of the effects that new fintech policies might have on the overall competitiveness of the financial industry—for both incumbents and entrants.

**Table 2:** Porter's five forces

| Force | Description | Attributes |
|---|---|---|
| Supplier bargaining power | The amount of pressure suppliers are able to place on a business | • Provider of funds[29]<br>• Knowledge experts[30] |
| Customer bargaining power | The amount of pressure and/or influence customers are able to place on a business | • Customer vs. firm concentration<br>• Switching costs<br>• Substitutable products<br>• Price sensitivity |
| Threat of new entrants | The ease with which new companies can enter the industry | • Cost advantages<br>• Economies of scale<br>• Barriers to entry<br>• Capital requirements |
| Threat of substitutes | The likelihood that a customer will switch to a competitive product or service | • Relative price and/or performance<br>• Propensity for substitution<br>• Switching costs |
| Competitive rivalry | The intensity of competition among existing firms in an industry | • Competitor concentration<br>• Capital intensity<br>• Growth prospects<br>• Exit barriers<br>• Product differentiators |

While each of the competitive forces can help reveal the root causes of an industry's current profitability, they also provide a framework for anticipating and influencing competition and profitability over time.[31] Put simply, this framework provides fintech firms with the knowledge necessary to gain a sustainable competitive advantage over incumbents. To achieve this, fintech firms can adopt a strategy that does one of two things: it either creates a defence against some of the forces or influences the forces in its favour. It should be made clear that the first option may limit the prospect for long-term profitability. A defence against a weak force provides greater opportunity for a competitor to provide superior service. As a result, ideally, the first option should be followed by the second. China's social app, WeChat, is a great example of a competitor influencing the forces within its industry to build a more favourable structure for itself. See **Box 2** for more information.

[29] For some fintech companies, and in particular P2P lenders, suppliers are the companies' provider of funds (i.e., deposit holders, investors) who provide the capital that the company then uses to generate new business.
[30] Knowledge experts are the engineers and technologists who can either create much of the value fintech firms provide, or dictate when the technology or value the fintech firm provides becomes obsolete.
[31] See Porter (2008).

**Box 2:** WeChat Influencing the Competitive Environment in Its Favour

WeChat, China's largest social app, is slowly emerging as one of the world's largest fintech players. With over 700 million active users,[32] the app is integrated into people's lives, offering food delivery, instant messaging, medical appointment bookings, P2P payments, bank transfers and wealth management services.

Unlike most fintech players that focus on a single vertical market such as lending, payments or remittance, WeChat integrates multiple markets into a single mobile app. This breadth of service reduces the threat of substitutes, increases barriers to entry and creates a strong competitive advantage. More than half of WeChat's customers have also linked their bank accounts to the app, allowing them to navigate multiple services without cash, credit or debit.[33]

WeChat helped create a single digital identity for its users by becoming a central hub. By accumulating significant amounts of information on each user, the company created another competitive advantage through its data collection. This allows it to continually capitalize on its social network and expand its economies of scope through personalized offerings and cross-selling—much like the banks have done for years.

By gaining a first-mover advantage into customer's everyday lives, WeChat has significantly weakened customer bargaining power, the threat of substitutes and competitive rivalry from incumbents. It has materially altered the structure of the mobile banking industry. Customers have now come to expect this level of offering. Few fintech players have been able to influence "fintech 2.0" to the same extent.[34]

What does this all mean for central banks? The Porter framework provides central banks with a framework for evaluating the likelihood that a fintech firm can not only disrupt the financial industry but also be self-sustaining into the foreseeable future. It provides the basis for strategic agendas, and highlights the critical strengths and weaknesses of not only an industry but also a firm. This increased understanding of how the makeup of the financial system can and will change can help central banks shape macroprudential regulation and help them better anticipate and manage changes to their duties as oversight authorities.

## Test case

With this in mind, we have used this framework to make some initial conjectures on the P2P (or I2P) lending industry. Based on our analysis, to be successful in the consumer lending space, a firm needs four key success factors: (i) a strong customer experience, (ii) low-cost funds, (iii) low customer-acquisition costs and (iv) accurate identity authentication and risk estimation. We

[32] See eMarketer (2016).
[33] See *The Economist* (2016).
[34] Fintech 2.0 is often described as the next phase of fintech innovation. Instead of offering new competition like the first phase of fintech, it is believed fintech 2.0 will provide fundamental changes to the infrastructure of financial services and will bundle many services together.

believe that while many P2P lenders have an advantage over banks in customer experience, they fall short in all three other areas. This is because of the relationship between the competitive pressures within the lending industry, and the strength of those pressures. The weak supplier bargaining power and strong competitive rivalry of incumbents are too great of a competitive advantage or obstacle for any new entrant to easily overcome. See **Table 2** for a breakdown of our analysis.

Traditional banks benefit from a deposit base that provides a low-cost, stable source of funding for new loans. The stickiness of these funds allows banks to adapt to changing business environments with relative ease, as it is highly unlikely these funds will be pulled from a bank. As a result, for them, supplier bargaining power is relatively low. However, the same cannot be said for P2P lenders. Regardless of the source of funding, whether retail, institutional or high-net-worth individuals for P2P or I2P, the funds for new entrants tend to behave like wholesale funding. That is, funds tend to be available during booms but dry up during busts.[35] These investors also have various investment opportunities at their disposal. Thus, to entice investors to invest in their loans, P2P lenders must offer high, attractive returns. These two items combined imply strong supplier bargaining power, which significantly limits firm profitability. Many P2P lenders based in the United States, which are among the largest and most evolved, have realized this funding issue. See **Box 3** for more detail.

**Box 3:** P2P Funding Problems

Social Finance (SoFi), one of the most heavily funded fintech start-ups, is a marketplace lender that provides student loan refinancing, mortgages and personal loans. Since 2011, SoFi has made close to US$17 billion in loans[36] by targeting "high earners not rich yet" (HENRYs), and promising better service than traditional banks. However, a dramatic slowdown in sector growth, increased competition and shifting investor preferences that plagued the industry in 2016 reportedly curtailed the lender's funding base. As a result, the company was said to be considering a state banking charter, offering credit cards, deposit accounts and partnerships with financial institutions,[37] thus dramatically changing the original business model.

[35] For more information on the procyclicality of wholesale funding, see Damar, Meh and Terajima (2010).
[36] See SoFi website.
[37] Rudegeair and Demos (2016).

It is interesting to note that many SoFi competitors developed relationships with traditional financial institutions much earlier in their business life cycles. For instance, several years ago, LendingClub partnered with WebBank, a Utah-based chartered financial institution, to originate its loans. By 2016, 31 per cent and 13 per cent of loan originations were funded by banks and other institutional investors, respectively.[38] OnDeck, which specializes in small business loans, funds most of its loans through securitization, or pre-arranged credit facilities provided by large banks, such as Deutsche Bank and Credit Suisse.[39] Even with these partnerships, both companies face unstable funding models because of their dependence on short-term wholesale funding. Credit facilities must be regularly rolled, securitization markets can dry up at any moment, and investors can cease the purchase of new loans. As seen in early 2016, these funding sources do not compare with the stickiness of long-term bank deposits.

Platform effects are also key to the business model of P2P lenders. The more investors a firm has funding loans, the more customers a company will have. However, investors will not come unless the customers are already there. Therefore, suppliers hold significant bargaining power. This unique relationship outlines the difficultly P2P lenders have in attracting new customers. The two groups must be in equilibrium to reach critical mass. Incumbent business models tackle this issue through the use of economies of scope and scale, which help lower their customer-acquisition costs. As single-product-producing firms, however, P2P lenders in their current form are unable to make use of these cost-cutting initiatives by offering several different products and services.

Also, for very similar reasons as above, incumbents have a stronger ability to authenticate identity and estimate risk. A greater number of contact points with a customer through multiple products or services equates to better information and an increased likelihood of accurately identifying a customer or fraud.

That is why our analysis suggests that fintech entrants will have incentives to become regulated entities, accepting deposits, to be able to exploit the traditional economies of scope and liquidity transformation of banks. Factors including strong competitor concentration, high capital intensity, low growth prospects and limited product differentiation underlie the intense rivalry in the traditional lending industry, and the need to adopt similar practices.

[38] See LendingClub Corporation (2017).
[39] See OnDeck company website.

**Table 3:** Consumer lending Porter analysis

| Force | Analysis | Conclusion |
|---|---|---|
| Supplier bargaining power | • Depending on source of funding:<br>  ○ Institutional and high-net-worth individuals (high)<br>  ○ Retail depositor (low)<br>• Other investment avenues | The lowest cost and most stable source of funding—deposits—will be tied to incumbents. |
| Customer bargaining power | • Price sensitivity (high)<br>• Customer concentration (low)<br>• Switching costs (high) | Financial and behavioural switching costs reduce customers' power. |
| Threat of new entrants | • Barriers to entry (high)<br>  ○ Customer information<br>  ○ Switching costs<br>  ○ Regulation<br>• Cost advantages (low)<br>• Capital requirements (low for new business models)<br>• Economies of scale (high)<br>• Incumbent response (strong) | Overall, this is a crowded industry to enter. |
| Threat of substitutes | • Relative price/performance of substitutes (better in niche products)<br>• Switching costs (high)<br>• Propensity to substitute (low following early adopters) | The threat is more credible in niche markets than in mass markets. |
| Competitive rivalry | • Concentration (high)<br>• Capital intensity (high)<br>• Growth (low)<br>• Product differentiation (low)<br>• Exit barriers (high) | A strong response from existing industry players is expected. |

# 5. Implications

In this section we explore the implications of our analysis for the fintech monitoring efforts of central banks. We also discuss the changes in firm organization and how this might challenge the traditional institution-based regulation model.

## Monitoring fintech

Central banks, as part of their core mandate, have a public policy interest in both understanding and monitoring developments in fintech. To separate the wheat from the chaff, we utilize our analysis from above to outline how central banks may determine when a fintech innovation should become a cause for concern.

To understand the potential implications of new fintech solutions, a central bank should ask itself four main questions: (i) Does the fintech solution solve an economic friction? (ii) Is the fintech solution better than currently available technology? (iii) Does the fintech firm offering the solution hold a competitive advantage? (iv) Does the solution affect the central bank's mandate? The answers to these questions will help clarify whether a central bank should monitor the solution and include its investigation under its mandate. A "no" answer to any of these questions implies that the innovation should not be a primary concern. For example, a "no" answer to each question suggests the solution is (i) not a financial concern to central banks, (ii) will not affect the industrial organization of financial intermediaries, (iii) will not be able to reach mass adoption and, finally, (iv) should be the responsibility of other branches of government. The fintech solution should instead be viewed as a secondary innovation that may eventually progress into something the central bank should actively monitor.

If after considering these questions the central bank believes that monitoring the fintech solution is in its best interest, it is crucial that the central bank work with the entire network of the financial system—start-ups, financial institutions, infrastructures, technology providers and regulators—to effectively monitor changes in fintech, and focus on areas where risks must be managed and where the private sector can be left on its own. Regular discussions with fintech innovators, incubators and investors are the easiest and most effective way to monitor developments, gather new information and stay informed of upcoming changes to the marketplace. For a hands-on approach, development partnerships, proofs of concept or business development programs with fintech start-ups provide opportunities to experiment with the technology and go beyond fundamental research. One example of this is the Bank of Canada's Project Jasper, a joint initiative between the central bank, Payments Canada, R3 and some of Canada's largest banks to develop and experiment with a proof of concept for a DLT-based interbank payment system.[40] Collaboration like this provides all parties with a greater understanding of the incentives that drive decisions and the issues important to others.

## Redrawing organizational boundaries

The effects of fintech will be felt at the firm level as much as at the industry level. In Section 4 we discussed the balance of factors at the industry level. Here we use the case of banks to illustrate the effects of fintech at the firm level—in other words, how financial intermediaries will organize themselves. One common argument about the effects of fintech on banks is the so-called unbundling of banking services. The argument is that thanks to information technology, the costs of transacting between the business units that today form a bank will be cheaper in the marketplace than within the firm. If that were true, then the different business units might not

[40] See Chapman et al. (2017) for more information.

need the bank structure. Alas, this is unlikely. As discussed in the theory section, economies of scope are prevalent and could in fact become stronger.

Economies of scope are pervasive in financial intermediation, usually because of fixed costs and informational asymmetries. Incumbent banks will exploit these economies of scope to defend their position. New entrants, most likely platforms, will look for new economies of scope. For example, Square—a payments processor—provides point-of-sale software for merchants. Using data analytics from the merchants' transactions, it is now able to forecast their cash demands and credit risk. Consequently, Square recently started offering loans to its clients.

Another reason why the unbundling of the traditional bank is unlikely just now is because these institutions enjoy another important advantage over fintech entrants: access to the established payments and settlement infrastructure.

Other factors determining the organization of firms are changes in demand determinants that could change the economies of scope of retail banking. One fundamental change is how customers perceive trustworthiness. One could argue that banks' marble branches of the past were a stand-in for trust. Today few customers visit branches; instead they perform most of their banking via web or mobile applications and have little interaction with agents or branch representatives. Likewise, most customers of webmail services have never been in an office of the big technology companies that provide the services, and yet they trust these companies with a lot of sensitive information. Younger people in particular tend to trust that technology companies will manage their identities and information judiciously. Evidently, the monetary value in each type of transaction is quite different, but this illustrates the change in attitudes. Another changing determinant of demand is the experience that customers demand from financial intermediaries. Customers, young and old, who have experienced the speed and simplicity of mobile applications in many other sectors of the economy might demand the same level of experience from banking and financial services. If banks cannot match those expectations, customers may be willing to incur the costs of switching, thereby reducing the strength of the economies of scope and weakening the incentives of firms to bundle multiple business lines.

Our analysis at the industry and firm level leads us to two conjectures: (i) banks will have the incentives to "integrate forward," and (ii) fintech firms will have incentives to "integrate backwards." Forward integration will be the trend of banks and other financial intermediaries to acquire or adopt the technology that fintech firms are developing. In many cases this is possible because neither the technology nor the business models are proprietary. The direct banking model is an old example of this. Since the advent of the Internet, banks have tried to attract deposits via a simple banking model without branches. Many of the established banks have direct banking as one of their business models. Backwards integration, on the other hand, will be the attempt by some fintech firms to exploit the traditional economies of scope of banks. For

that, some start-ups or big technology firms might seek traditional banking licenses. Some P2P lenders, and traditional technology companies, have gone this way.

## Regulatory approaches for fintech

Although the focus of this paper is not on the response of central banks to fintech developments, we close this section with a brief discussion of the challenges that central banks face as regulators. The typical regulatory model assumes well-defined institutions. For example, the usual definition of a bank is an institution that takes deposits from the public and makes loans. An alternative model is to regulate activities regardless of which type of institution carries out these activities. The reality is that there is a mix of both: financial intermediaries are regulated because of the type of entity they are and because of what they do. Still, regulation based on the institution and not on activity will be challenged by the fact that new types of institutions are performing intermediation activities.

Central banks and regulators face a trade-off of innovation versus risk when deciding their regulatory approach to new firms and new activities. Deciding on the right approach is a difficult challenge since the benefits of innovation are sometimes complicated to evaluate quantitatively, while some of the risks are relatively clear, such as for consumer protection, financial stability and monetary policy. However, the hardest challenge will be evaluating the new applications of financial intermediation and new organizational forms of intermediaries.

Institution-based regulation makes sense in part when there are strong economies of scope or when they are the dominant factor in determining the outcome of the industrial organization structure of financial intermediation firms. Some regulators argue that interventions usually occur at the legal entity level even if the problems arise from activities. Sandboxes have been proposed and implemented in some jurisdictions.[41] These sandboxes permit both policy-makers and firms to test to a certain extent the implications of regulation on firms as well as the instances in which new applications fall out of regulatory provisions. Curiously, both established intermediaries and fintech entrants are arguing for a "level playing field" in terms of regulation. The established firms argue that fintech entrants should not be given more leniency in regulatory terms, while they fail to recognize the advantage some of them have in the access to the core payments infrastructure that comes with the regulation. On the other hand, the fintech entrants are demanding this access while failing to recognize the burdens that come with regulation.

[41] Examples are the Monetary Authority of Singapore FinTech Regulatory Sandbox, the Ontario Securities Commission LaunchPad and, to some extent, the Bank of England FinTech Accelerator.

## 6. Concluding Remarks

Fintech is likely to increase competition and improve financial inclusiveness, which could reduce the cost of financial intermediation. If financial intermediation changes fundamentally, the traditional tool kit of central banks might be at risk. In this paper, we provide a framework to analyze the economics of various fintech solutions by focusing on the component technologies and underlying frictions that they solve. Moreover, we study the business models that some fintech firms are employing to understand which characteristics will likely lead to broad adoption of their technology. Our framework is meant to be general enough to use as fintech advances. Going forward, central banks and regulators will have to monitor whether these new technologies and business models are fundamentally changing money demand and the industrial organization of financial intermediation.

In this paper we focus mostly on banks and DLT. With respect to banks, we conclude that fintech firms will have incentives to either find new economies of scope or exploit the traditional economies of scope of banks by becoming regulated entities. Banks, on the other hand, will acquire or adopt the fintech innovations but might be hindered by their current business models. Lastly, we conclude that fintech might bring more change by creating new financial intermediation applications than by changing the ones that exist today.

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**Table 4:** List of financial services sector business lines and products

In red we highlight the areas in which some fintech work is ongoing. This non-exhaustive list shows the current product that financial firms provide to clients. However, there are also fintech innovations ongoing *within* institutions, such as AML and KYC.

| Main Service Categories | Lines of Business | Types of Products |
|---|---|---|
| Commercial banking | Consumer/retail | Consumer loans |
| | Corporate | Home loans |
| | Project finance | Card services |
| | Leasing | Export credit |
| | Factoring | Back-up lines of credit |
| | Trust services | Committed lines of credit |
| | Deposits | Savings deposits |
| | | Time deposits |
| | | Mobile banking |
| Investment/wholesale banking | Advisory services | Robo-advisory |
| | Commodities | Asset-backed securities |
| | Leveraged buyouts | CDOs, CLOs, CBOs |
| | Loan syndications | Syndicated loans |
| | Mergers & acquisitions | Structured finance |
| | Underwriting | Leveraged syndicated loans |
| | Warehousing | Green bonds |
| | Prime brokerage | Bookrunning high-yield |
| | Securitization | Corporate bonds |
| | | Equity |
| | | Foreign exchange |
| Trading | Market making | Swaps, forwards, futures |
| | Equity | Repurchase and reverse |
| | Fixed income | repurchase agreements |
| | Derivatives | Tri-party repos |
| | | Sell and buybacks |
| | | Foreign exchange |
| Operating services | Custody | Remittances |
| | Clearing | Cross-border payments |
| | Settlement | Deposits |
| | Payments | Trade finance |
| | Corporate treasury | Cash management services |
| | Transactions services | Check clearing |
| | Issuer services | Liquidity management |
| | Securities lending | Foreign exchange |
| | Correspondent banking | International funds transfers |
| | Safekeeping | Letters of credit |

Source: List adapted from the Organisation for Economic Co-operation and Development. Contact the authors for a list of fintech instances in each product highlighted.