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Fintech: The Impact on Consumers and Regulatory Responses☆

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ABSTRACT

Advanced technology, Big data, and complex AI/ML algorithms have provided benefits to both consumers and lenders. Fintech has a potential to disrupt and to create new types of risk.

Regulators around the globe are working diligently and thoughtfully to provide consumer protection and to maintain financial stability while at the same time to create an environment for safe Fintech innovations.

1. Introduction

The Federal Reserve Bank of Philadelphia and New York University Stern School of Business jointly held a conference on "Fintech: The Impact on Consumers, Banking, and Regulatory Policy" on September 28–29, 2017. The conference aimed to engender a robust exchange and discussion from leading scholars, regulators, and market participants on Fintech's potential disruption and its impact on financial landscapes and financial stability.

This special issue of the *Journal of Economics and Business* presents selected papers from the conference. The papers appearing in this volume addressed questions related to Fintech's potential disruption on consumers and the financial systems. We are interested in understanding the implication of disruptive Fintech in the financial services industry and more generally on the overall financial landscape and consumer behavior. Fintech can potentially benefit underserved consumers around the globe. Advanced data analytics combined with the increased use of Big data and alternative data in conjunction with increased usage of mobile phones in the developing world creates a potential for everyone to be connected to the financial system. Advances in artificial intelligence (AI) and machine learning (ML) have allowed us to make sense of this vast amount of data from internet sites and mobile phones. Utilizing new technology, Fintech advancement is expected to have huge ramifications around the globe, particularly in the less developed part of the world, over the next decade and in all financial respects including saving, loans, investments, payments, etc.[1] Approximately 3 billion unbanked consumers around the globe could potentially be connected to the financial system.

Financial regulators and the Federal Reserve have a role to play in understanding and adapting to the Fintech challenges. The Federal Reserve's mission to maintain safety and soundness in the banking system and financial stability overall would likely be affected significantly by Fintech growth in areas such as the increased use of nontraditional data in credit decisions, in conjunction

☆ This paper is an introduction to the Fintech and related issues discussed at the conference held at the Federal Reserve Bank of Philadelphia on September 28-29, 2017. The conference was jointly organized by the Federal Reserve Bank of Philadelphia and New York University Stern School of Business. Thanks to Dan Milo for his research assistance and to Franz Hinzen and Fahad Saleh for their comments on the paper. Please direct correspondence to Julapa Jagtiani, Federal Reserve Bank of Philadelphia, Supervision, Regulation & Credit Department, Ten Independence Mall, Philadelphia, PA 19106; 215-574-7284; e-mail: julapa.jagtiani@phil.frb.org. The views in this paper are the authors' and do not necessarily reflect the views of the Federal Reserve Bank of Philadelphia or the Federal Reserve System.

[1] China is a good example of a less developed country with a massive population who own a mobile phone but no bank account. China has taken a lead in using mobile-centric technologies to lead the world in mobile applications and adoption in all finance activities.

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with complex algorithms and advanced technology like AI and ML in the financial industry (some through partnership with Fintech firms or outsourcing to AI vendors) – see Jagtiani, Vermilyea, and Wall (2018). Other Fintech innovations were also discussed at the conference, including Bitcoin, other cryptocurrencies, smart contracts, the internet of things, mobile payments, use of AI/ML for anti-money laundering, blockchain applications, the Hyperledger platform, etc. As financial firms share their consumer data through an AI vendor or data aggregator, it has remained unclear who owns the customers and who owns the customer information. Abusive use of personal data has become one of the primary concerns among consumers and regulators. Consumer protection agencies are also concerned about fair lending and financial inclusion to ensure that the disruptive Fintech innovations would benefit those underserved consumers.[2] Central banks and other financial regulators could benefit from a more in-depth understanding of the applications of AI/ML and blockchain for supervision and regulation.

The remainder of this paper reviews how the papers in this special issue along with other papers in the Fintech literature have addressed these questions. The next section focuses on Fintech lending and its role in enhancing competition as well as potential benefits to consumers and traditional banks. Section III discusses the type of risks that emerge in the new financial environment. We discuss blockchain and digital currencies in Section IV. The concluding remarks are presented in Section V.

2. Fintech Lending and Partnership with Banks

The financial services industry has undergone an unparalleled transformation in the past decade as market shares in banking activities have increasingly moved from the banking sector to the shadow banking sector. For example, Buchak, Matvos, Piskorski, and Seru (2018) find that the market share of shadow banks in originating residential mortgages nearly doubled from 2007 to 2015. Interestingly, a larger market share of the residential mortgage growth was loans to less creditworthy borrowers.

Fintech lending platforms, first created around the financial crisis, have been growing rapidly in the past decade. They are often referred to as crowdfunding, marketplace lending (MPL) or peer-to-peer (P2P) lending. Rau (2018) documents that crowdfunding is a new global phenomenon, which has allowed borrowers to have greater ease of access to the financial system and provided sophisticated investors with new investment opportunities.[3] Its use relies much on the level of trust individuals have for strangers, through online platforms.[4]

Unlike traditional lenders, Fintech lenders take advantage of Big data, alternative data, and complex AI/ML algorithms to make fast (almost instantaneous) credit decisions. Fintech lenders have joined the shadow banking sector in offering banking and other financial services – providing convenience and faster services than traditional firms without being subject to the same regulations that traditional firms are subject to.[5] LendingClub, for example, has become one of the largest lenders for unsecured personal installment loans in the country. Fintech lenders have presented both traditional financial institutions and consumers with challenges as well as opportunities.

Jagtiani and Lemieux (2016) demonstrate that advanced technologies in the last decade have allowed for greater competition in small business lending, where increasing shares of local small business loans have increasingly been originated by lenders that do not have local presence (no branch office). While there are challenges for community banks to compete with Fintech lenders, there are also opportunities for partnerships. Similarly, for consumer loans, while Fintech lenders compete with banks for market shares, many have also formed partnerships and created values.

Likewise, Anagnostopoulos and Ionnis (2018) also conclude that competition between banks and Fintech challengers has given way to direct collaboration across the Fintech/Regtech ecosystem.

There have been several instances of incumbent banks and disruptor Fintech firms working together and forming partnerships through acquisitions or joint ventures. Examples include Japanese Soft Bank investing in Kabbage, WebBank originating loans that came through the LendingClub and PayPal platforms, consortiums such as Bank Alliance (a group of about 250 small community banks) serving as a pipeline for loans from the LendingClub platform, JPMorgan Chase and PNC partnering with the OnDeck lending small business platform, HSBC partnering with Avant personal lending platform, and Goldman Sachs operating a Fintech lending platform Marcus. The industry has embraced Fintech innovations and partnerships, while consumers have hope for potential expanded credit access to at least 26 million Americans with thin credit files.[6]

Research studies using limited data from Fintech lending platforms have indicated that the use of alternative data, which are not currently incorporated into the models that assign consumer credit scores, could potentially make it possible for lenders to identify good borrowers from the pool of subprime (based on traditional credit scores only) consumers. This has resulted in creditworthy

[2] Grennan and Michaely (2018) find that Fintech firms also disrupt incumbents (such as the sell-side research analysts) in the market for financial analysis. Fintech aggregates and synthesizes investment analysis, which may change how investors discover such advice. FinTech firms could serve as substitutes to analysts if investors forgo reviewing original content.

[3] Related to this, Li (2017) studies profit sharing mechanisms to harness the wisdom of the crowd. The author also discusses specific implications for the security design of investment crowdfunding. Brown and Davies (2018) analyze early-venture fundraising from dispersed, privately-informed investors. They show that with crowdfunding, profitability and investor behaviors depend much on the circumstances providing access to private information about the project.

[4] Parallel to this is the trust that individuals have for strangers through online lending platforms, rather than traditional institutions, and the trust that passengers have for strangers to step into someone's car when taking an Uber ride because the drivers are monitored by the platform.

[5] For more details about the various Fintech platforms and their practices, see Jagtiani and Lemieux (2016).

[6] Drasch, Schweizer, and Urbach (2018, in this special issue) propose a taxonomy based on 136 real-world cases and 12 expert interviews to structure and describe cooperation between banks and Fintech firms along 13 different dimensions.

"subprime" borrowers being able to access credit and at a much lower cost than otherwise. Jagtiani and Lemieux (2018a) find that most of the "invisible prime" borrowers

who have been rated poorly by the traditional credit scoring process have a very low default probability that is similar to the default probability of (traditional) super-prime borrowers. With additional data and enhanced analysis, Fintech lenders could focus on making loans to these "invisible prime" borrowers and help expand credit access to the underserved without incurring more credit risk.

In addition, Jagtiani and Lemieux (2018b, in this special issue) find that, based on consumer lending data from LendingClub, Fintech lending has also penetrated into underserved areas, such as areas with insufficient banking services (proxied by a smaller number of bank branches per capita).

Some of the Fintech lenders have claimed to enter local markets where there are more payday lenders per capita, using payday lender concentration as a proxy for being in an underserved neighborhood. What remains unclear is whether this expanded access to credit has a potential for some consumers to become excessively leveraged, which could potentially lead to long-term deterioration in their financial conditions. This is a good topic for future research.

3. The New Financial Landscapes and New Types of Risk

With rapid growth of Fintech innovations and the new financial landscapes, financial firms are exposed to new types of risk, and regulators are faced with evolving implications for systemic risk and financial stability. New tools would likely be needed to address the key new risks from the digitalized financial ecosystems, such as cyber security risk and third-party vendor risk.

Advanced technology has been used more commonly in financial market evaluation. For example, Chen, Rui, and Whinston (2017) document usage of natural language program (NLP) which utilizes artificial intelligence algorithms to derive useful information about firms' earnings from conference calls. In general, executives often face significant emotional pressure when presenting a scripted managerial discussion and spontaneously answering analysts' scrutinized

questions, which often results in evasive answers and incoherent responses. The paper finds that AI-based measures of language patterns, built upon deep learning and topic modeling, could transform analysts' perceptions to emotion-free Fintech solutions. The authors find a relationship between evasive and incoherent answers and the firms' earnings and stock returns. Therefore, a trading strategy based on this AI-based measure could yield a positive risk-adjusted return.

Along with several benefits, there are new types of risk that emerge through the use of advanced technology and complex AI/ML algorithms by financial firms without full understanding of their own business decisions – see Jagtiani, Vermilyea, and Wall (2018) and Wall (2018). The complex AI/ML models, especially unsupervised deep learning, generally outperform traditional modeling approaches, such as in predicting borrowers' default risk, but the algorithms are often so complicated that the modelers cannot document the decision process in detail. This problem arises especially when some of the variables that enter the model may be related to race, gender, or other protected classes. As described in Petrasic and Saul (2017), when the AI/ML process is properly implemented, the algorithms would increase processing speed, reduce human errors, minimize labor costs (requiring less staff), streamline the application process, and enhance customer experience. However, as the AI/ML algorithms become more ingrained in the credit decision process, previously unforeseen risks are beginning to appear—in particular, the risk that a perfectly well- intentioned algorithm could lead to potential biased lending discrimination against some protected classes of borrowers.

Wall (2017) explains that there is a risk of potentially identifying relationships that are not causal since the algorithms typically involve taking "iterative and experimental" samples to determine which identified correlations can be used in a causal manner. It is designed to process more data than a human ever could, allowing the ML process to identify relationships that a human would easily miss. In other words, the ML process emphasis on prediction may result in identifying relationships that are not supported by any economic theory. Other potential issues with AI/ML have also been documented in Jagtiani, Vermilyea, and Wall (2018).

There has also been evidence that Fintech lenders have a potential to undermine existing financial regulations. Braggion, Manconi, and Zhu (2018) analyze how the supply and demand of P2P lending in China by the lender RenrenDai are affected by regulatory changes in Loan-to-Value ratios. They find that restrictions on lending in traditional markets increase demand for P2P lending while prices of credit remain unchanged.

Regulators have a role to play in encouraging the productive use of Fintech innovations. Regulatory policies and guidance involve a trade-off between protecting consumers and encouraging Fintech innovations and competition. Should regulators determine which alternative data should be allowed or not allowed in credit decisions? To what extent should regulators be responsible for cyber security of the market infrastructures that they run and oversee? While it is important to be thoughtful and to move cautiously, the lack of Fintech regulations could create significant uncertainty in the business environment and could put us behind the innovation curve when compared with other countries. And, like other financial regulations, the various Fintech regulations could potentially interact with existing financial regulations or with other Fintech related regulations. Thus there is an important role for coordination within the public sectors and between the public and private sectors. What is the best approach to develop and effectively implement cross-industry guidance, cross-jurisdiction guidance, and cross-country guidance?

4. Blockchain, Bitcoins, and Other Currencies

A blockchain constitutes a tamper-evident, shared digital ledger. The ledger records data in discrete chunks known as blocks which are cryptographically linked together into a chain hence the term blockchain. Blockchain, or more broadly distributed ledger technology (DLT), is believed by many to have a potential to create disruption more than any other previous technological

innovation. There have been thousands of blockchain startups emerging around the globe, focusing on supply chain finance, digital asset- backed lending, securitization, credit information, digital identity and much more.

A blockchain may be implemented as a permissionless or a permissioned system. A permissioned system restricts participation in the ledger's validation process to a pre-specified set of agents whereas a permissionless system makes no such restriction. Prominent examples of permissioned blockchains include Ripple and Hyperledger. Prominent examples of permissionless blockchains include Bitcoin and Ethereum.[7] Blockchain's value proposition requires that the ledger provides a single historical record. Having a single historical record means that ledger validators must agree on the ledger's contents. To induce such consensus, the blockchain requires an economic mechanism to create appropriate incentives for validators. Within a permissionless setting, Proof-of-Work (PoW) and Proof-of-Stake (PoS) constitute the most frequently employed economic mechanisms. As noted in Elendner, Trimborn, Ong, and Lee (2016), the PoW and PoS have been designed to maintain the accuracy of blockchains and to make them resilient to attack.[8] The PoW requirement is infeasible because it would require an attacker to surpass the mining capacity of the entire rest of the mining community. The PoS is also infeasible because game theory predicts that this is an unconvincing threat since the attackers would be destroying their own wealth. Malinova and Park (2017) argue that the implementation of blockchain technology in the financial markets could provide investors with new options for managing the degree of transparency of their holdings and their trading intentions.[9]

Multiple digital currencies have been built upon blockchain technology which are then called cryptocurrencies. The most prominent examples of cryptocurrencies are Bitcoin and Ether – which have been traded on the Bitcoin and Ethereum blockchains, respectively. However, numerous other cryptocurrencies exist. As of 2017, over 900 crypto currencies are estimated to be active.

Bitcoin allows for pseudonymity (pseudo-anonymity) while preserving the reliability inherent in the blockchain. (For more information about Bitcoins see the white paper published under the pseudonym Satoshi Nakamoto (2008).) The first Bitcoin exchange was opened in 2009, and the first transaction using Bitcoin occurred in 2010. Several large retailers have begun accepting bitcoin as a method of payment.[10] Bitcoin could potentially serve as a low-cost avenue to facilitate the transfer of money internationally – allowing for potentially unbanked consumers to set up a global bank account that would be accessible from anywhere (as long as there is internet access).

However, there are limitations to Bitcoin becoming a widely use currency for transaction purposes. Easley, O'Hara, and Basu (2018) note that Bitcoin can only process roughly 7 transactions per second and that their transaction rate scales with the size of their blockchain linearly. Moreover, the authors argue that transaction fees will not be enough to overcome the rate limits. Furthermore, Kroeger and Sarkar (2017) show that there exist persistent and statistically significant differences between U.S. dollar-denominated bitcoin prices in multiple bitcoin exchanges. Price differences are higher on exchanges with smaller trade sizes. Arbitrage frictions impose limits on the speed of arbitrage and the amount of price discovery. Similarly, Aloosh (2018) finds that Bitcoin prices, unlike other globally traded assets, are not consistent globally. The paper documents Bitcoin price discrepancies for various pairs of denominated currencies, namely the U.S. dollar, euro, British pound, and Canadian dollar. Another related finding, Benos, Garratt, and Gurrola-Perez (2018) discuss the potential impact of DLT on securities settlement and find that the DLT-based settlement is likely to be concentrated among few providers – thus likely to result in sub-optimally high (rather than low cost) prices of transaction. They conclude that the DLT is more likely to achieve its potential with some degree of coordination which could be facilitated by relevant authorities.

Other cryptocurrencies are distributed in the form of initial coin offerings (ICOs), which have been used by tech startups as a way to raise funds. Adhami, Guidici, and Martinazzi (2018, in this special issue) examine 253 ICOs, focusing on their success rate in terms of liquidity and pricing conditions in the post-ICO period. Of the 253 ICOs observed, 205 closed successfully. The rest failed to meet their funding goal, had a security flaw, or had their token distribution suspended. The majority of offerings were based on the Ethereum blockchain, which has served as a platform for various smart contracts. Howell, Niessner and Yermack (2018) find that successful ICOs tend to be more transparent about future uses of funds.

Cryptocurrency has been a big reason why many believe that blockchains would become a potential mainstream financial technology for the future. Liu and Tsyvinski (2018) and Hinzen (2018) study pricing in the market for cryptocurrencies. Liu and Tsyvinski (2018) find that cryptocurrency returns are not exposed to stock market or macroeconomic risk factors. This points to cryptocurrencies being valuable for portfolio diversification purposes. Furthermore, they find that cryptocurrency returns can be predicted based on the attention that a coin receives. Hinzen (2018) studies valuations of cryptocurrencies. He finds that both the

[7] Cong and He (2018) analyze how decentralization improves consensus effectiveness. Smart contracts can mitigate information asymmetry and deliver higher social welfare and consumer surplus through enhanced entry and competition, yet blockchains may also encourage collusion due to the irreducible distribution of information.

[8] PoW and PoS were initially proposed with only heuristic arguments asserting that they induce consensus. Nonetheless, subsequent work by Biais, Bisiere, Bouvard and Casamatta (2018) and Saleh (2018a) provide formal economic models that demonstrate existence of consensus equilibria for PoW and PoS, respectively. Within a permissioned setting, formal economic analysis of consensus mechanisms remains scarce although John and Saleh (2018) formally analyze a simple economic mechanism for permissioned blockchains.

[9] Much extant work has highlighted the economic value of blockchain. Prominent examples include Malinova and Park (2017), Cao, Cong and Yang (2018) and Cong and He (2018). Malinova and Park (2017) identify welfare gains that may be achieved by employing blockchain technology in financial markets. Cao, Cong and Yang (2018) highlight gains from incorporating blockchain technology into the auditing process. Cong and He (2018) study smart contracts and demonstrate that they may deliver higher social welfare and consumer surplus through enhanced entry and competition.

[10] In 2017, the US Security Exchange Commission (SEC) rejected the proposed creation of a Bitcoin ETF investment vehicle.

attention that a cryptocurrency receives, and its underlying technological properties are priced. Consistent with recent theories such as Pagnotta and Buraschi (2018), Saleh (2018a) and Cong and He (2018), cryptocurrencies are more valuable when the consensus mechanism of the blockchain is more secure or when the blockchain offers smart contract functionalities.

Despite the blockchain hype, Halaburda (2018) argues that advantages of the blockchain technology do not come from elements unique to blockchain. Instead, they arise from more conventional elements such as encryption and smart contracts. Therefore, the author concludes that several applications that would benefit from a decentralized ledger technology (DLT) system could benefit more from a non-blockchain DLT environment.

Cryptocurrencies have exhibited tremendous volatility. Zimmerman (2018) and Saleh (2018b) examine the sources of these volatility. The impact of digital currencies on the effectiveness of monetary policy and financial stability overall has been discussed in Nelson (2018, in this special issue). In addition, central bank digital currency (CBDC) has also been a popular topic of discussion.

It might be unavoidable for central banks to start issuing their own digital currency in the foreseeable future, using one of the distributed ledger technologies. The CBDC would have stable value because it is backed by the federal government and the central bank. With CBDC, however, there emerges a new question related to the response of the banking system during a period of uncertainty – would all depositors prefer to keep their saving with the central bank rather than at a commercial bank that could fail? Raskin and Yermack (2016) discuss how sovereign digital currencies could lead to serious de-funding of the commercial banking sector spilling over into credit creation and monetary policy. Jagtiani, Papaioannou, and Tsetsekos (2018) provide a more comprehensive discussion on these issues. Moreover, since bitcoins and other cryptocurrencies are still not as tightly regulated as traditional payment mechanisms, there remain loopholes which have allowed the innovations to be used for illicit activities. Regulators have been working on developing guidelines related to use of blockchain and other DLT in dealing with anti- money laundering (AML) and know-your-customers (KYC) practices.

5. Concluding Remarks

The AI revolution is believed to be a game changer. The advanced technology, Big data, and complex AI/ML algorithms have created a new financial landscape. Both traditional institutions and the Fintech platforms have been competing and have benefited from their partnerships. The new financial landscapes have a potential to connect billions of unbanked and underserved consumers to the financial systems. Whether the expansion of credit access to consumers via Fintech platforms would result in consumers becoming over-leveraged and cause harm in the long run is an interesting topic for future research.

There have also been concerns that the advanced technology would result in machines replacing humans in the work force. Industry experts seem to believe that while ongoing technological developments will require employees to possess new skills, advanced analytics will likely enhance human capabilities. Machines and humans would work together more effectively, resulting in better outcomes.

The vast Fintech benefits do come with new types of risk. Regulators around the globe are working diligently and thoughtfully – to avoid creating an over-regulated or under-regulated environment. Ideally, the Fintech rules should reach the right balance between providing consumer protection and maintaining financial stability while simultaneously providing sufficient incentives for Fintech innovations.

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