Fintech, Cryptocurrencies, and CBDC: Financial Structural Transformation in China

Franklin Allen
Imperial College London

Xian Gu
Durham University

Julapa Jagtiani
Federal Reserve Bank of Philadelphia

Abstract

Fintech and decentralized finance have penetrated all areas of the financial system and have improved financial inclusion in the last decade. In this paper, we review the recent literature on fintech, cryptocurrencies, stablecoins, and central bank digital currencies (CBDCs). There are important implications from the rise of fintech and the introduction of stablecoins and CBDC in recent years. We provide an overview of China's experience in fintech, focusing on payments, digital banking, fintech lending, and the recent progress on its CBDC pilots (e-CNY). We also discuss important considerations in designing effective cryptocurrency regulations. Cryptocurrency regulations could promote growth of innovations through enhanced public confidence in this market. The e-CNY could become mainstream in the global market through effective regulations which provide incentives and protection to market participants. A key factor to success for digital currencies has been their widespread adoption. If the Chinese e-CNY were to become a mainstream currency, the introduction of CBDC could potentially offer solutions to existing problems inherent in the traditional financial systems.

Keywords: Fintech; Cryptocurrency Regulations; Stablecoins; CBDCs; e-CNY; China
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*Author contacts: Julapa Jagtiani, Federal Reserve Bank of Philadelphia, Ten Independence Mall, Philadelphia, PA 19106, julapa.jagtiani@phil.frb.org; Franklin Allen, Imperial College London, f.allen@imperial.ac.uk; and Xian Gu, Durham University, xian.gu@durham.ac.uk.

1. Introduction

Financial technology (fintech) and decentralized finance (DeFi) have penetrated all areas of the financial system and improved financial inclusion in the last decade. Traditional financial institutions have been disrupted and continued to face increasing risk that banking, investing, and payment processing could become decentralized, requiring no intermediation. A broad range of new innovations in financial products and services (real-time payments, online lending, and various financial services through mobile phones) have seen explosive growth. The digital transformation during the pandemic has expedited the process to reduce frictions in the financial and payment systems. China has been one of the few countries in the world that experienced very fast growth in fintech in the last decade.

The Chinese economy has been performing extremely well, and it has become the largest economy in the world in terms of purchasing power parity (PPP). However, its financial system has been relatively small compared to the size of its economy. Arguably, the allocational efficiency and stability of the global financial system could potentially be improved if all countries' financial systems were to become more balanced and reflect the sizes of the countries' economies. If the goals are for the Chinese currency Rmb to become much more important for international trade, cross-border lending, and central bank reserves, then the Chinese financial system will need to mature.

China has a unique financial system that is "bank-centered." Previous research has documented how the Chinese economy has been able to achieve such growth without having a well-developed financial system (Allen, Qian, and Qian, 2005). China's financial system has been dominated by a state-owned banking sector, which was designed to support the traditional growth model, led by large-scale capital investments as well as labor-intensive and export-oriented

industries (Song, Storesletten, and Zilibotti, 2011). This economic growth model is no longer sustainable given the rapidly advancing technology in both the financial and real sectors and the new fintech innovations around the globe. China's new economic growth model is driven by domestic consumption and new high-tech innovations. A more efficient way to finance these new industries has been through stock markets and an alternative financial sector (such as fintech), rather than traditional bank loans. The Chinese stock market has seen explosive growth since its launch in the early 1990s, but it has been underperforming in terms of returns to shareholders (Allen, Qian, Shan, and Zhu, 2021).

In addition to the traditional banking sector and the capital market, fintech firms have emerged to fill the credit gaps faced by small- and medium-enterprises (SMEs) as well as Chinese consumers. A new revolution in digital payments has also emerged – led by big Chinese fintech firms such as Ant Group and Tencent, where big data and more complex technology have been utilized in the financial services sector in China. Chinese fintech firms became some of the largest firms in the world with the largest market share in fintech and bigtech credit (Cornelli et al., 2020).

Fintech represents an opportunity for China's financial system and others to transform. A large number of cryptocurrencies have been created globally to facilitate faster payments and improve financial inclusion. Plans by the People's Bank of China (PBOC) for introducing a central bank digital currency (CBDC) represent an important step that in the long run can improve its international role and help transform the international economic order. In September 2017, the Chinese government banned initial coin offerings (ICOs) to protect investors and to curb inappropriate financial arbitrage. More recently, in September 2021, the Chinese government declared all private crypto-related transactions illegal, citing concerns about speculative investments, extreme price volatility, gambling fraud, and money laundering. Alongside the ban

on all ICOs and private crypto transactions, the PBOC was the first central bank that announced an intention to launch a CBDC, and it has made a significant progress in implementing its CBDC, the e-CNY, which is the digital version of the fiat currency issued by the PBOC.

In this paper, we discuss the recent development of fintech in China, focusing on digital banking, fintech credit, real-time payments, and recent progress with the Chinese e-CNY and its implications for the development of the Chinese financial system and economy. The remainder of the paper is organized as follows. Section 2 discusses China's experience in fintech/bigtech credit and digital banking, along with the related recent literature. Section 3 presents a discussion of the (recent) literature related to cryptocurrencies, stablecoins, and CBDC, and reviews China's progress with its e-CNY. Section 4 discusses recent regulatory development related to cryptocurrencies and stablecoins in China, Europe, and the United States. Section 5 provides concluding remarks.

2. Credit Scoring, Digital Banking, and Fintech Credit in China

2.1 Alternative Data, Credit Scoring, and Fintech Credit

Along with the use of more complex algorithms used in credit scoring, more and better data have played a key role in making credit scoring more accurate and more forward-looking. In addition to using the traditional credit history and other financial and accounting data (hard information) related to credit performance, today's credit scoring also relies on alternative data, including a large amount of unstructured data (soft information), based on machine learning and AI modeling. These big data and complex statistical algorithms have been adopted by financial institutions and fintech lenders to overcome the limitations of traditional models and data in evaluating borrowers' credit risks and default probability, especially for borrowers with thin credit

files and those without bank accounts (Jagtiani and Lemieux, 2019; Goldstein, Jagtiani, and Klein, 2019; Croux, Jagtiani, Korivi, and Vulanovic, 2020). These alternative and soft information sources can include online digital footprints, friendship and social networks, pictures, and handwriting or other text-based information (see Iyer, Khwaja, Luttmer, and Shue, 2016; Hildebrand, Rocholl, and Puri, 2017; Lin, Prabhala, and Viswanathan, 2013; and Berg, Burg, Gombovic, and Puri, 2020). Allen, Gu, and Jagtiani (2021) provide a comprehensive survey on the recent literature.

Unlike countries such as the US and the UK, China still lacks a universal credit scoring system. The formal Chinese banking system has stringent compliance and regulations, resulting in lenders' reliance on standard (traditional) credit information, which have prevented a large number of thin-file borrowers from getting access to traditional bank credit. Interestingly, one of the most significant developments in China's financial system in recent decades has been the entry of technology companies (including the "bigtech" ones) with existing platforms (such as payments or e-commerce) into the provision of financial services.[1] Platforms such as Alipay (launched in 2004) and Wechat pay (launched in 2011) have penetrated individuals' daily lives through both online and offline use, which in turn generates a tremendous amount of alternative data for these bigtech or fintech firms to use in credit decisions.[2] For example, Ant Financial uses purchase transaction data from Alibaba's online platform Taobao or from offline payments through Alipay to undertake an algorithm-based automated credit analysis and offers a credit line to Taobao

[1] "Bigtech" refers to large existing companies whose primary activities are in the provision of digital services, rather than mainly in financial services. In other words, bigtech firms offer financial products only as part of the support for their main business lines (Frost et al., 2021; Cornelli et al., 2020).

[2] The survey data by the Payment & Clearing Association of China show that, by 2020, 74 percent of the people who participated in the survey use mobile payments every day; among all mobile payments, payments through platforms including Alipay and WeChat pay account for 71 percent. See http://www.xinhuanet.com/fortune/2021-01/14/c_1126980065.htm.

vendors or any borrowers using the Alipay payment system with a sufficiently high credit score based on the estimation by Ant Financial.

China's experience in fintech and bigtech credit and credit scoring has been studied in the recent literature. Using 28.7 million monthly credit offers by Ant Financial to 2.9 million Taobao vendors, Hau, Huang, Shan and Sheng (2019) find that by having an information advantage over traditional banks, Ant Financial was able to extend credit to vendors who were previously excluded from traditional bank loans. Using the same data, Hau, Huang, Shan and Sheng (2021) further demonstrate that fintech credit improves entrepreneurial growth in the e-commerce sector. On average, sales growth and transaction growth spiked by an incremental 13.1% and 10.6%, respectively, in the month following the credit approval from Ant Financial. The growth effect is the most pronounced for young firms, among all the vendors on the platform. Using transaction-level loan data from another fintech leader in China, Gambacorta, Huang, Qiu, and Wang (2019) find that models based on machine learning outperform traditional models in predicting the borrowers' default probability, especially when there is a negative shock to the aggregate credit supply; and that data from mobile digital app transactions and e-commerce platforms also tend to improve default prediction. While emerging economies like China, India, Brazil, Mexico, and South Africa are characterized by rapid economic growth and an expanding middle-class population, they do not have a well-developed financial infrastructure to support it. Frost et al. (2019) compared the rise of bigtech credit in China to that in other countries, and they argue that the use of fintech services is more popular among tech-literate but financially underserved populations.

The pervasive use of digitalized data, especially those on customer information and consumer behavior, has intensified the concern around consumer protection and privacy (Chen,

Huang, Ouyang, and Xiong, 2021; Luohan Academy, 2021), discrimination in credit decisions (Morse and Pence, 2020; Ichihashi, 2020), and the temptation to take advantage of consumer data (Liu, Sockin, and Xiong, 2021). Chen et al. (2021) examine the data privacy paradox – that is, while most people claim they care about data privacy, they often volunteer to share their personal information in exchange for access to some free services or for a small amount of compensation. Using the survey and behavioral data of a sample of Alipay's users, the authors find that there is no relationship between the respondents' self-stated privacy concerns and the amount of data that they share, confirming the puzzling data privacy paradox. They explain this finding by arguing that users with stronger privacy concerns usually benefit more from using those digital programs, suggesting these users are relaxing the privacy concern as a byproduct of taking advantage of the convenience brought by these digital applications. Liu, Sockin, and Xiong (2021) investigate the relationship between data privacy and customers' vulnerability on these platforms and argue that the externalities of data sharing could be either negative or positive impacts on the consumers. Their theoretical analysis suggests that sharing data with a digital platform could benefit a consumer by improving the matching efficiency for consumption goods at the cost of exposing himself or herself to the "temptation goods," which are defined as goods or services that consumers may be persuaded to buy through platform advertisements (but that they ultimately do not want). Similarly, Cong, Xie, and Zhang (2021) provide a micro-foundation for how data sharing by consumers could play a role in the macroeconomy but potentially at the cost of consumer data privacy.[3]

[3] In their model, consumers choose the quantity of data to sell to intermediate firms, which utilize the raw data for research that contributes to the final goods production. From the consumers' perspective, they may be inadequately compensated for the potential information leakage and privacy violation.

2.2 Digital Banking and Investment Service in China

Innovations in banking services primarily rely on technological advances such as a faster internet, improved payment systems as well as higher computing power and the improved capability to utilize big data. In the late 1990s, fast-growing internet access spurred the adoption of internet-based banking; more recently, advances in financial technology and the entry of technology firms into the financial services industry have improved digitization in payments (e.g., Rysman and Schuh, 2016). A growing number of banks have formed partnership alliances with technology firms to digitize their credit decision processes and risk management strategies.

The adoption of mobile and digital payment has been much faster in China than in most other countries. As of 2019, Alipay and WeChat pay had surpassed 500 million and 900 million monthly active users, which were 36% and 65%, respectively, of the total population in China (Frost et al., 2019). The emergence of digital payments has also facilitated investment and trading services through these fintech platforms and changed the landscape of the asset management industry. In China, fintech platforms were given permission to distribute mutual funds starting in 2012. Ant Financial, a top player in this sector, began to distribute mutual funds via the one-stop Alipay app in 2014 and offered a broad coverage of Chinese funds. Using data from the Alipay platform, Hong, Lu, and Pan (2021a) find that a higher adoption of fintech platform use is associated with higher participation in investment and higher risk taking by individual consumers. This risk taking is measured by their portfolio choices among six types of risky mutual funds (bond, mixed, equity, index, QDII, and gold) as well as risk-free money market funds. The authors also show that, for retail investors, there is evidence of an associated welfare improvement, by focusing the analysis on investors who would otherwise have been more constrained in making investments (prior to the advent of these fintech platforms), such as those investors with high risk tolerance and

the unbanked population. In another recent paper, Hong, Lu, and Pan (2021b) focus on fund managers' behavior using the data from Howbuy, another top fintech platform in China. They find that the emergence of fintech platforms has resulted in a striking increase in fund managers' risk taking and performance chasing.

2.3 Marketplace Lending in China

One important component of fintech credit is marketplace or peer-to-peer (P2P) lending, which matches lenders and borrowers through online platforms. The use of big data and machine learning to analyze consumer information in P2P lending is very sophisticated. China has been the world's leader in this field. P2P lending was first introduced in China in 2007. Over the next decade, China's P2P market experienced significant growth starting from 2008 to the end of 2018, with a total of 6,621 fintech P2P platforms, facilitating loans accumulated to nearly US$1,209 trillion (He and Li, 2021). However, the nationwide tightening of regulations afterwards cracked down on the majority of the P2P platforms in China, leading to a major contraction in the Chinese P2P market.[4] Despite these problems, P2P lending remains an important market, and opportunities for making investments online remain widespread.

Recent research studies explore the impacts of fintech growth and the reasons behind the rise and fall of this market. The main driver for the rapid growth in this market in China before 2018 was the highly regulated standard banking system, the underdeveloped credit system, and weak law enforcement in China. Regarding the fall of this market, Huang and Wang (2021) examine the central-local co-regulatory regime in this P2P market. They conclude that the central government of China did not handle it well – by failing to make proactive regulatory responses

[4] A speech by Mr. Shuqing Guo, the chairman of China Banking and Insurance Regulatory Commission (CBIRC), mentioned that by June 2020, there were only 29 operating P2P platforms, and 20 of them were in Beijing: https://finance.sina.com.cn/roll/2020-08-14/doc-iivhvpwy1017266.shtml.

when the market boomed and by taking heavy-handed measures to control risks after the outbreak of the crisis in the P2P market.[5] Similarly, the local regulatory agencies failed to strike a balance between promoting innovation growth and protecting investors.

In addition, Jiang, Liao, Wang, and Zhang (2021) use weekly transaction data from over 1,500 fintech platforms from 2014 to 2018 to examine the roles of fintech platform's affiliation with the Chinese government on the success of the platform. The authors find that government affiliation is one important determinant of the platform performance, that is, those platforms with higher government affiliation have superior performance. Specifically, the transaction volumes and investor numbers for P2P platforms with government or state-owned enterprise (SOE) affiliations are, on average, more than double those of P2P platforms without these government or SOE affiliations. In addition, platforms with government or SOE affiliations are 87% less likely to fail.

Other studies attempt to examine the impact of VC funding on the success of the platform. Using similar datasets to those used in Jiang et al. (2021), Li, Liao, Wang, and Xiang (2020) find that loan volume and number of lenders increased by 25% and 49%, respectively, immediately after the platforms had successfully obtained VC funding. *Ex post*, VC-backed platforms are less likely to default than non-VC-backed platforms. In addition, He and Li (2021) find that P2P platforms that are more transparent, with better information disclosures, are more likely to survive (and less likely to go bankrupt). Moreover, Hasan, He and Lu (2021) attempt to examine other determinants for platform success, using loan-level information from Renrendai, which was one

[5] According to statistics from the Shenzhen Electronic Commerce Association, the national daily trading volume of P2P loans was only about US$0.2 trillion as of April 2013 and rose dramatically afterwards, before reaching its peak at US$24 trillion in October 2017. After the government started regulating this market, the daily trading volume then dropped to about US$0.4 trillion at the beginning of 2020. These data were retrieved from the WIND database on January 7, 2022.

of the largest P2P platforms in China. They find that social capital and trust affect P2P loan features and performance. Borrowers from higher social capital regions receive bids of a larger amount from individual lenders, have higher funding success, get larger loan amounts, and are less likely to default – and these effects are more pronounced for low-quality borrowers.

3. Cryptocurrencies, Stablecoins, and CBDCs

3.1 Cryptocurrencies and Stablecoins

Recent years have seen exponential growth in crypto-assets as a new form of innovation in payments, investments, and wealth management. Cryptocurrencies are built on a blockchain, which is an open, distributed ledger technology that can record transactions between two parties efficiently and in a verifiable and permanent way.[6] There are three main types of blockchain: private blockchain (one gatekeeper); permissioned blockchain (multiple gatekeepers); and public blockchain (needs a consensus mechanism). Bitcoin (and many other digital currencies) is based on a public blockchain with a consensus mechanism where proof-of-work requires a computationally difficult task to be solved first before getting the right to update the ledger.

As of December 2021, there were a total of more than 15,000 different cryptocurrencies in existence, with total market capitalization of US$2.28 trillion.[7] At the same time, the price of cryptocurrencies has been extremely volatile, which created concerns about rampant speculation and financial instability. For example, the price of Bitcoin, after reaching a peak of just under US$20,000, dipped to a little over US$3,000 in 2018, was a little over US$4,000 in March 2020,

[6] Halaburda (2016) examined the economic drivers that led to the creation of digital currencies and showed that they were a natural step in the evolution of means of payment. For more detail overview of evolution of digital payments, see Halaburda, Sarvary, and Haeringer (2022). For the development of digital payments specific to China, see Klein (2020) and Wang and Dollar (2016).

[7] By far, the three cryptocurrencies with highest market capitalization are Bitcoin (BTC), Ethereum (ETH), and Binance Coin (BNB). We retrieve these data from CoinMarketCap (https://coinmarketcap.com/).

and increased dramatically afterwards to peak at over US$67,000 in November 2021, and then declined by 23% within the next month.[8] Bitcoin was originally designed as a means of payment, but its price volatility has made it a poor means of payment – and it has been banned in China and South Korea. The large increase in price over time and the volatility have attracted speculative flows. Bitcoin mining was banned in China in May 2021, and the Chinese government subsequently banned all private cryptocurrency-related transactions in September 2021.

A large number of recent studies examine the price dynamics of cryptocurrencies as well as the impact of crypto on central banking policies. Jagtiani et al. (2021) review the literature on cryptocurrency, whether cryptocurrencies could replace the official central bank digital currencies, and the potential impact on monetary policy effectiveness. Halaburda, Haeringer, Gans, and Gandal (2022) provide an overview on the microeconomics of cryptocurrencies, what drives their supply, demand, trading price, and competition amongst them. Chen, Cong, and Xiao (2021) give a brief introduction to blockchain economics. Hardle, Harvey, and Reule (2020) provide a general overview of cryptocurrencies. Allen, Gu, and Jagtiani (2021) survey the literature on the pricing of cryptocurrencies, their structure, and regulatory issues. Cong and Xiao (2021) provide a comprehensive categorization of crypto-tokens as well as the major issues concerning token usage, including platform finance, user adoption, crowdsourcing, and related agency issues.

Several recent studies focus on Bitcoins and blockchain. John, O'Hara and Saleh (2021) survey the economics of blockchain fundamentals with particular focus on Bitcoin, proof-of-work and proof-of-stake, providing insights regarding fees, forks, and price volatility. They conclude with a few considerations to reflect on regarding the next generation of blockchain innovations. These include blockchain scalability issues and the potential roles of blockchain in the future

[8] We retrieve the data of Bitcoin price from CoinMarketCap (https://coinmarketcap.com/currencies/bitcoin/).

growth of decentralized finance, which is expected to be a future financial system that relies not on centralized intermediaries but on smart contracts in decentralized settings.

Prat and Walter (2021) study the equilibrium behavior of Bitcoin miners, using a model that uses the exchange rate of Bitcoin against the US dollar to predict the computing power of Bitcoin's network. They forecast the evolution of the network computing power over time and show that a significant share of mining rewards was invested in mining equipment and that the seigniorage income of miners was limited. John, Rivera, and Saleh (2021) study the equilibrium staking levels in a proof-of-stake blockchain when investors have different trading horizons. They find that block rewards serve as an inflationary transfer from short-horizon cryptocurrency investors to long-horizon cryptocurrency investors. Thus, increasing block rewards tends to decrease total cryptocurrency investment, which leads to a reduction in the equilibrium value of staked cryptocurrencies. Bhambhwani, Delikouras, and Korniotis (2021) examine how blockchain characteristics such as network size and computer power affect cryptocurrency price and returns. They find that a stochastic discount factor with aggregate network and computing power explains the cross-sectional variation in expected cryptocurrency returns at least as well as models with cryptocurrency return-based factors (market size and momentum).

The extreme price volatility of cryptocurrencies has led to the development of stablecoins. A key feature of these is that the price is designed to be pegged to another asset or a pool of assets, such as cryptocurrencies, fiat monies, or exchange-traded commodities. Stablecoins are backed by assets held by the issuer of the stablecoins. As a result, stablecoins might be more capable of serving as a means of payment and store of value, so they can potentially improve global payment arrangements in terms of speed and cost. In principle, the issuers of stablecoins can employ multiple methods to stabilize the price. The easiest way is to link the value of a stablecoin to a

single currency or a basket of reference assets. Another approach to support a stable value is to leverage the financial strength and stability of the offering institutions. Commercial banks can issue stablecoins as an alternative to deposits, notes, or other financial instruments (BIS, 2019).[9]

One of the most prominent stablecoin projects was initiated by Facebook.[10] Facebook's Libra and various other stablecoins are an attempt to overcome the disadvantages of Bitcoin and other cryptocurrencies as a means of payment, but it remains unclear whether they will be successful for a variety of reasons. The initial announcement of the launch of Facebook Libra sparked several concerns among regulators – as it would compete with national currencies. There are also other technological and transparency issues, and there are serious concerns around consumer protection and privacy. The first version of Libra 1.0 was announced in June 2019. The plan was that it would be backed 1:1 by a basket of fiat currency bank deposits, including the US dollar, euro, pound sterling, Japanese yen, and government securities.[11] The intention was for Libra to serve as a global stablecoin, based on the large customer base of Facebook, for real-time cross border payments.[12] In April 2020, an updated version, Libra 2.0, was introduced to address the major concerns raised by the international regulatory community, and a formal application for supervision by the Switzerland's Independent Financial Market Regulator (FINMA) was made. Instead of creating a global digital currency, Libra 2.0 opts for a series of domestic currency stablecoins, linked in a global basket, and aims at being regulated by a lead regulator and international supervisory cooperative approaches. In December 2020, the Diem Association was

[9] Balvers and McDonald (2021) examine stablecoins with stable purchasing power rather than stable exchange rates.
[10] Facebook changed its company name to Meta as of October 2021 – to reflect the company's growing ambitions beyond social media.
[11] Libra's ambitious objective was to "enable a simple global currency and financial infrastructure that empowers billions of people," according to Libra Association, in *An Introduction to Libra* (White Paper) https://www.diem.com/en-us/white-paper/#introduction. Libra's announcement was immediately disruptive and drew the attention of policymakers, central bankers, and regulators worldwide.
[12] Didenko et al. (2020) argue that the elements of stablecoin include size, scale, and interconnectedness.

created to replace the previous Libra Association.[13] The new stablecoin, Diem, follows a different approach than the Libra 2.0 in that each of the Diem stablecoins would be backed by a single fiat currency instead of a basket of currencies (although a multi-currency backed stablecoin could still be created in the future). The primary goal would be to reduce frictions in the current payment systems, making payment processing faster and cheaper. If successfully approved and implemented as planned, there would be a stablecoin Diem for each of the currencies, including the US dollar, Eurodollar, British pound, and other major fiat currencies. Diem would then operate as a payment and settlement system, on a blockchain network, where all the members of the Diem Association could operate. However, in response to increased volatility in the value of stablecoins in January 2022 and the potential regulatory crackdown on stablecoins, Facebook started to explore potential buyers to liquidate Diem. The Diem project was reportedly shutting down as of January 27, 2022.

For all stablecoins that are currently in existence, price volatility has been much lower than for Bitcoin, Ether, and other general cryptocurrencies (Arner, Auer, and Frost, 2020) although not always "stable." Stablecoins have play an important role in providing liquidity in real-time payments and cross-border payments in the past year. Since the outbreak of COVID-19 pandemic, the market capitalization of stablecoins has grown significantly. As of December 14, 2021, the total market capitalization of stablecoins was US$157.6 billion, representing 7.3% of the total cryptocurrency market capitalization.[14] Private stablecoins could also continue to be issued to potentially compete with central bank digital currency (to co-exist with the CBDC). Although

[13] Facebook's Diem is a stablecoin designed to be a permissionless payment system, based on blockchain technology. The Diem Association will oversee the entire operation of the Diem project. For more information about Diem and the Diem Association, see its website: Learn | Diem Association.

[14] Tether's USDT has by far the largest market share, followed by Coinbase's USDC, Binance's BUSD, and many more. We retrieve the data from Coincodex on December 14, 2021: https://coincodex.com/cryptocurrencies/sector/stablecoins/.

stablecoins are backed by sovereign currencies or a basket of reference assets, their market value can still rise or fall rapidly with purchases and redemptions by investors. In addition, without private or public backstops, stablecoins can be subject to severe price discounts or self-fulfilling runs especially during episodes of market turmoil (Arner, Auer, and Frost, 2020).

Recent research studies have examined the economic designs of stablecoins. Catalini and de Gortari (2021) suggest that fiat-backed stablecoins must rely on reserves of high-quality, liquid assets and be subject to a framework that protects coin holders from credit risk, market risk, operational risk, as well as the insolvency or bankruptcy of the issuer. Although decentralized stablecoin designs eliminate the need to trust an intermediary, they either are exposed to a death spiral (where the coins would become worthless) or are highly capital inefficient. Li and Mayer (2021) find that even over-collateralized stablecoins could "break the buck" when the issuer's reserves fall below a critical threshold. Consistent with this, Gorton and Zhang (2021) argue that privately issued stablecoins are not an effective medium of exchange, because they are not always accepted at par and are subject to runs. The authors' proposals to address the systemic risks potentially created by stablecoins include issuing stablecoins through insured banks, backing stablecoins one-for-one with safe assets like Treasuries and central bank reserves, and establishing a central bank digital currency.

By considering the migration of Tether from Omni to the Ethereum blockchain in 2019, Lyons and Viswanath-Natraj (2021) examine how arbitrage activities can stabilize the price of the dominant stablecoin, Tether. They find compelling evidence that arbitrage serves as the central stabilizing mechanism – an increase in arbitrage access leads to a significant increase in peg efficiency for stablecoins. This suggests that the introduction of forward and futures markets on

stablecoins could attract arbitrage capital from regulated financial institutions, which could induce greater stability by keeping the pegs fully credible and collateralized.[15]

Li and Mayer (2021) point out that when stablecoins become unstable, the issuer could debase the stablecoins to avoid liquidation. However, whether the issuer decides to do so would depend on the trade-off between sustaining a stable value that stimulates demand and sharing risk with users to avoid liquidation. Mayer (2021) shows that debasement could invite speculation, which would further amplify price fluctuation and might then trigger a vicious cycle. Routledge and Zetlin-Jones (2021) examine speculative attacks on under-collateralized stablecoins and coordination failure. They show that an exchange rate policy, which involves less than 100% backing and dynamically adjusts to traders' conversion demand can eliminate speculative attacks and maintain exchange rate stability.

3.2 CBDCs and China's experience in e-CNY

The announcement of Facebook's Libra and the public response to stablecoins have prompted central banks to explore the potential benefits and costs of issuing central bank digital currencies (CBDCs). The current status of CBDCs around the world is such that China is significantly ahead, Sweden is far along, and some other countries are in the development stage. Different countries have been moving at different speeds, according to a Bank for International Settlements (BIS) survey with 68 central bank respondents representing jurisdictions covering about 80 percent of the world population. Barontini and Holden (2019) show that many central banks are progressing from conceptual work on CBDCs into experimentation and proof-of-concept, including cooperating with other central banks. There have also been intensive debates on whether

[15] In December 2020, members of the US House of Representatives proposed the *Stablecoin Tethering and Bank Licensing Enforcement (STABLE) Act* that emphasizes full collateralization: https://tlaib.house.gov/media/press-releases/tlaib-garcia-and-lynch-stableact.

central banks should take the operating roles to issue CBDCs or play a supporting role in providing a payment rail for the private sector to operate private digital currencies. The BIS updated dataset as of January 2022 reports the various CBDC pilots around the globe.[16]

Jagtiani et al. (2021) and Allen, Gu, and Jagtiani (2021) survey the recent literature on CBDCs. The growing literature has concentrated on two fundamental questions. One is how central banks should create retail digital money and whether CBDCs are desirable to replace physical cash (see Keister and Sanches, 2019; Brunnermeier, James, and Landau, 2019). The other is the systemic implication of CBDCs and how to cope with the related risks and instability they may cause (see Brunnermeier and Niepelt (2019); Niepelt (2020); Fernandez-Villaverde, Sanches, Schilling, and Uhlig (2021); Fernandez-Villaverde and Sanches (2019); and Keister Sanches (2022)). Veneris, Park, Long, and Puri (2021) present an example of CBDC design and implementation plan, based on academic research of the possible technological, legal, and economic components of CBDC.[17]

In terms of policy implications, there have been intense discussions around the specific designs of the CBDCs. First, there is the question of whether the CBDC should be a wholesale instrument used for settlement between financial institutions or a retail system where the CBDC is a central bank liability accessible to all consumers. Second, if it is a retail system, there is the question of whether the financial system architecture should have the central bank interacting with the general public directly or whether the private sector (including banks) should handle all the

[16] Auer, Cornelli, and Frost (2020) report that the central banks in the survey were exploring various technical infrastructures for their CBDCs and that current proofs-of-concept seem to be based on blockchain and distributed ledger technology (DLT), although the specific designs vary by their domestic-focused objectives. The data have recently been updated to January 2022. More details and data can be found here: https://www.bis.org/publ/work880.htm.

[17] In early 2020, the Bank of Canada issued a contingency plan for the potential introduction of a CBDC and later that spring ran a global competition among universities to sample arm length designs. This paper is the proposal that was selected as a finalist in this competition – proposal for Bank of Canada's Central Bank Digital Loonie (CBDL).

customer-facing activities. Third, there are questions around what would be permissible in creating CBDC, with different features resulting in different implications on monetary policy effectiveness and financial stability overall. Examples include whether CBDC should replace cash or supplement cash (i.e., whether there should be a cashless economy); whether the CBDC would earn interest, and if so, whether the interest rates on CBDC should be allowed to be negative; what is the right balance for level of transparency, security, and consumer privacy when using CBDC for payments; how to encourage consumers to widely adopt the CBDC usages (in place of the current payment methods such as cash, credit/debit cards, check, and Buy Now Pay Later), the possibility of having some offline components of CBDC (for small transactions) for users to use CBDC in areas that have no internet access or no electricity; and, the level of interoperability across platforms and for cross-border payments.

Auer, Cornelli, and Frost (2020) develop a novel CBDC project index based on central bank research and development (R&D) projects and examine the economic and institutional drivers of CBDC development. Their empirical analysis shows that higher mobile phone usage and higher innovation capacity are positively associated with the likelihood that a country is currently researching or developing a CBDC. They also find that, as expected, retail CBDCs are more likely to be introduced and beneficial in economies with a large informal economy where a large portion of the population remains unbanked or underbanked.

The PBOC has been at the forefront of CBDC research for several years, and it was also the first central bank that declared an intention to launch an official CBDC. In 2014, the PBOC formed a task force to study digital fiat currencies, including their issuance framework, key technologies, issuance, and circulation environment, and to learn from experiences from other countries. In early 2016, the PBOC announced a “strategic goal” of launching a CBDC, which

could enhance financial inclusion and efficiency in the payment system. The CBDCs are also expected to reduce (or eliminate) the high costs related to issuing, printing, transporting, and managing paper cash.[18] Afterwards, there was a global wave of cryptocurrency speculation and a boom in ICOs. The PBOC quickly banned all ICO transactions in September 2017. Only digital currency issued or effectively regulated by the PBOC could be circulated in China.[19]

In late 2017, after approval by the State Council of China, the PBOC began to work with commercial institutions to develop and test the digital fiat currency, the e-CNY. The goal was to provide a state-backed monetary system, rather than just a payment system. After some years of work, in April 2020, the PBOC announced a set of trials in four cities (Shenzhen, Suzhou, Xiong'an, and Chengdu) to take place in preparation for the 2022 Winter Olympics in Beijing in early February, which has been seen as an opportunity for the PBOC to raise awareness about the e-CNY. According to a speech by Governor Gang Yi in November 2020, the number of transactions with the new digital currency had reached 4 million by then, adding up to a total of 2 billion RMB.[20] Starting from November 2020, a few more cities including Shanghai, Hainan, and Changsha joined the CBDC pilots. Since January 2022, Tencent has launched e-CNY services on WeChat, and a number of other internet giants including JD.com and Didi Taxi have also started accepting e-CNY payment in trial cities. During the Winter Olympics, China has provided the access of e-CNY's mobile application to visiting foreigners, to test the appeal of the e-CNY. The trial was notable that over 2 million RMB (US$315 thousands) e-CNY was used per day at the

[18] The PBOC organized a meeting about digital currency in January 2016, discussing the framework of cryptocurrencies and CBDCs, and announced it was preparing to launch a CBDC soon: http://www.pbc.gov.cn/goutongjiaoliu/113456/113469/3008070/index.html?luicode=10000359&from=timeline&isappinstalled=0.

[19] All private crypto-related transactions were later prohibited in China starting in September 2021.

[20] In Shenzhen and Suzhou, the trials chose regular people by lottery as participants, "airdropping" currency into new pilot wallets that could be used in designated places in the cities during the trial period. For more details, see, for example: https://www.chinadaily.com.cn/a/202012/16/WS5fd94b02a31024ad0ba9c08d.html.

Olympics. Both e-CNY's mobile application and payment cards or wristbands are available to visitors during the Games. The hardware wallets in physical payment cards or wristbands can be linked to the digital wallet in e-CNY's mobile application easily, so that money and all the transactions can be stored and recorded in the mobile application. Visitors can also convert foreign bank notes to e-CNY at self-service machines. Convenience stores and small merchants inside the Olympic Village, where many of the foreign visitors live, as well as the shops at railway stations near the game venues are equipped with machines that take e-CNY.

At the same time, the PBOC made special efforts to ensure that the development of the e-CNY is in line with the legal framework of China by issuing the newly revised version of *Law of the People's Bank of China* (Revised Draft for Comments), which clarifies that "RMB includes both physical and digital forms." Consumers can withdraw e-CNY from state-bank ATMs to smartphone e-wallets, and payments can be made by holding the phone close to a point-of-sale device that all vendors will have.

In the white paper published by the PBOC in July 2021, e-CNY is formalized as the digital version of fiat currency issued by the PBOC and operated by authorized operators. It is a value-based, quasi-account-based, and account-based hybrid payment instrument, with legal tender status and loosely coupled account linkage. E-CNY is a retail CBDC issued to the public. To protect consumers' privacy, the e-CNY follows the principle of "anonymity for small value and traceable for high value." The e-CNY system adopts a distributed and platform-based design, based on a mix of technologies such as trusted computing and special encryption, which can support the rapid growth of e-CNY transactions (PBOC, 2021). In addition, China has been growing its own payment system, the Cross-border Interbank Payment System (CIPS), to facilitate interoperability across jurisdictions, real-time cross-border payments, including international

trades and investments, and to internationalize the Chinese currency in the global market.[21] Although currently the e-CNY is still designed mainly for domestic retail payments, the PBOC documents in the white paper that one of the goals of developing the e-CNY system is to echo the international initiative and improve efficiency in cross-border payments, therefore it will also explore a pilot for cross-border payment programs in the future (as e-CNY is technically ready for cross-border use) and work with relevant central banks and monetary authorities on digital fiat currency (PBOC, 2021). Once the e-CNY is implemented for cross-border payments, it will likely promote the internationalization of the RMB.[22] In the long run, the introduction of the e-CNY and its successful adoption could potentially help to foster structural transformation of the Chinese financial system.

4. Regulation of Cryptocurrencies and Stablecoins: China Compared to Other Countries

Cryptocurrencies and digital assets have grown exponentially and become increasingly complex in recent years. Despite their dramatic growth, volatility, and evolving technologies, cryptocurrency regulations have been slow to catch up with the pace of the market. In China, the PBOC announced in September 2021 that all the activities related to cryptocurrencies and stablecoins are illegal. Similarly, Russia's central bank announced in January 2022 that all activities and mining of cryptocurrencies are illegal, citing financial stability and monetary policy concerns. But around the globe there are no overarching and centralized regulatory frameworks

[21] CIPs was launched by PBOC in 2015 to settle international trades in CNY. For more discussion about CIPS, see: https://www.bloomberg.com/news/articles/2021-09-22/china-s-fledgling-cross-border-payments-system-grows-its-reach#:~:text=China%20is%20quietly%20growing%20its,System%2C%20run%20by%20CIPS%20Co.
By January 23, 2022, there are 75 direct participating banks using this system: https://www.cips.com.cn/cips/ywfw/cyzgg/55496/index.html.

[22] A recent article in *ChinaDaily* also discussed the possible cross-border usage of e-CNY and its impact on RMB's internationalization based on the PBOC's white paper: https://global.chinadaily.com.cn/a/202107/29/WS610201faa310efa1bd66528b.html.

regarding cryptocurrencies and stablecoins. This lack of regulatory clarity at the national level and international level has created risks and uncertainties – leaving investments in the cryptocurrencies and other crypto-assets vulnerable to fraud, manipulation, and other abuse from bad actors. Some market participants seem to be more concerned about the regulatory uncertainty than the regulation itself. However, designing effective crypto regulations is extremely complex because of the moving targets driven by the rapidly changing technology.

In contemplating cryptocurrency regulations, there are several potential challenges and obstacles for financial regulators to overcome. Important considerations in designing and implementing fintech regulations include systemic risks, consumer protection, transparency, KYC/AML (Know-Your-Customers and anti-money laundering), and balancing improvements in efficiency without discouraging fintech innovations and risks inherent in many fintech developments. For example, Switzerland has provided a good example of a regulatory system that encourages fintech innovations. The UK's "regulatory sandbox" approach has also been helpful in supporting industry efforts to explore new innovations without causing harm to the public at large.

We have discussed earlier (Section 3.2) some regulatory concerns around CBDCs in general and some lessons learned from the introduction of the Chinese (government-issued) digital currency, e-CNY. In this section, we concentrate on the regulatory issues around privately issued cryptocurrencies, especially stablecoins. In general, cryptocurrencies that are not backed by assets that have stable intrinsic value would have unpredictably fluctuating market values, which undermines their ability to be used as an alternative to cash.[23] Stablecoins were initially created to

[23] See for example, Paul Vigna, Why Bitcoin Hasn't Gained Transactions as a Form of Payment. *Wall Street Journal*, February 9, 2021: https://www.wsj.com/articles/why-bitcoin-hasnt-gained-traction-as-a-form-of-payment-11612886974#:~:text=Because%20the%20Internal%20Revenue%20Service,gains%20taxes%20on%20that%20transaction.

address the disadvantages observed with Bitcoin and other cryptocurrencies. Stablecoins have been adopted as a means of payment for e-commerce, peer-to-peer, and a range of potential future applications. Therefore, they have the potential to be used as an alternative digital monetary instrument, which has raised new regulatory challenges.

There have been concerns around private cryptocurrencies, including legal certainty, sound governance, anti-money laundering and countering the financing of terrorism compliance, cyber security, and consumer protection (BIS, 2019; Didenko, Zetzsche, Arner, and Buckley, 2020). For example, the decentralized nature of stablecoin arrangements may pose some governance challenges; stabilization mechanisms and redemption arrangements may pose market, liquidity, and credit risks; and the infrastructure and technology used to record cryptocurrency transactions may pose significant operational risks, cyber-security risk, and financial stability concerns.

In October 2020, the Financial Stability Board (FSB) issued a report with a set of ten high-level recommendations on cryptocurrency regulations and the oversight of global stablecoins.[24] The key considerations in designing stablecoin regulations include: 1) how to design and implement such regulations in a continuously changing environment (with advanced technology and new innovations); 2) to effectively minimize the economic and financial risks arising from new technologies; 3) to avoid regulatory arbitrage; 4) to maximize consumer protection; 5) to avoid causing harm to the growth of innovations. In addition, the BIS (2021) provides further principles for financial market infrastructures to stablecoin arrangements, including that, a systemically important stablecoin arrangement should have clear ownership structure, review

[24] On October 13, 2020, the FSB issued a report "Regulation, Supervision and Oversight of 'Global Stablecoin' Arrangements: Final Report and High-level Recommendations": https://www.fsb.org/wp-content/uploads/P131020-3.pdf.

regularly the material risks, provide clear and final settlements, and keep low credit and liquidity risks.

Arner, Auer, and Frost (2020) suggest that "embedded supervision" could potentially be used to monitor blockchain-based stablecoins that are fully backed by high-quality assets. The embedded supervision allows bank supervisors to verify stablecoins' regulatory compliance by reading the market's distributed ledger (such as monthly public auditor reports of the smart contract or the reserve on the websites of stablecoins) without the need for businesses to actively collect, verify and deliver the data, and therefore, can largely reduce the compliance costs (Auer, 2019). These reports could also be fully automated and/or made available on a real-time basis for the embedded supervision.

As mentioned earlier, regulators around the globe have expressed concerns around the explosive growth of cryptocurrencies. Stablecoins are not as volatile but could have significant impact on consumer welfare and the overall financial stability. Regulators are making progress in coming up with effective regulations for stablecoins. Cryptocurrency regulations overall could eliminate uncertainty around the lack of clarity and could further promote growth in this market. With effective regulations, market participants would have more confidence in the market, and financial institutions would likely participate, allowing cryptoassets to go mainstream. Crypto regulations are also likely to vary across jurisdictions (to focus on KYC/AML under Bank Secrecy Act, tax invasion, illicit financial activities, consumer protection). We discuss the current status of stablecoin regulations in different parts of the world below, focusing on the US, Europe, and China.

Stablecoin Regulations in China

As mentioned earlier, China announced in October 2021 that all activities/transactions related to digital currencies, cryptocurrencies, or stablecoins are considered illegal. This was a

blanket ban on all transactions and mining/issuing of private cryptocurrencies. Prior to the ban, it had the largest market share of private-issued cryptocurrencies. China is now the front-runner in the CBDC race. While it remains unclear whether the cryptocurrency ban might be lifted in the future, financial institutions in China are currently not allowed to offer any crypto-related services. However, Chinese citizens who had already owned cryptocurrencies could continue to hold them.

In addition to banning all private-issued cryptocurrencies and stablecoins in China, the PBOC has issued its own CBDC and is experimenting with a partial implementation in several major cities. Assuming that the e-CNY will eventually be fully implemented, the PBOC has determined that it should be the government's role to take full control of the digital currency, with no interference from the private sector. There has been no right or wrong answer so far on who would be best to issue the currencies. While central banks are likely to be more effective in consumer protection, the private sector may be better in designing a superior consumer interface and timely adoption of evolving underlying technology. In addition, unlike in China, some other countries are considering having the central bank play a supporting role while allowing the private sector to design and issue the cryptocurrencies – to promote decentralization in finance. An extreme case is in El Salvador, which announced in 2021 it was making Bitcoin a legal tender in the country.

In designing the new payment landscape dominated by government-issued CBDC (rather than private-issued cryptocurrencies), the PBOC has been strategic in providing incentives for the public adoption of its CBDC, as evident through several pilot programs. The cryptocurrency and stablecoin regulations in China could effectively promote public confidence and a widespread adoption of e-CNY. Furthermore, if the e-CNY could build public trust globally and become a mainstream digital currency, new business opportunities would be created, including global e-

commerce, which would promote growth in the Chinese financial sector.[25] This would be possible if the high adoption rates we recently observed in the trial regions (and other venues around the Winter Olympics in February 2022) continue into the future.[26] We believe that the crypto regulation in China, which restricts private cryptocurrencies and issues the government CBDC, could alleviate the problems inherent in China's financial system, as more credit would be made accessible to those previously "underserved" SMEs and startups, allowing the Chinese financial systems to grow more rapidly (with more efficient and more inclusive lending and payment system outside the banking sector) to keep pace with the size of its real economy. This transformation could not be achieved without the risk of highly volatile currency valuation and significant uncertainties if relying on private-issued cryptocurrencies.

Stablecoin Regulations in the US

The most recent proposals around cryptocurrency and CBDC in the US are one on stablecoins (released on November 1, 2021) and another on CBDC (released on January 20, 2022).[27] In designing stablecoin regulations, Schwarcz (2021) points out two key risks related to stablecoins that need to be considered: the redemption risk and the risk that the protective cryptology underlying stablecoins may fail or be compromised. These risks have been recognized in the US through the recently proposed legislation by the US President's Working Group on Financial Markets (PWG) in November 2021 as well as the *Stablecoin Classification and Regulation Act of 2020.*[28] The most recent PWG report (November 2021) views stablecoins as a

[25] As of January 2022, China's CBDC has about 261 million users, with transactions worth US$13.8 billion, and with more than 8 million merchants already accepting e-CNY.
[26] Trial regions include Shenzhen, Suzhou, Xiong'an, Chengdu, Shanghai, Hainan, Changsha, Xian, Qingdao, and Dalian.
[27] See President Working Group (2021), President's Working Group on Financial Markets Releases Report and Recommendations on Stablecoins | U.S. Department of the Treasury; and Board of Governors of the Federal Reserve System (2022), Money and Payments: The U.S. Dollar in the Age of Digital Transformation (federalreserve.gov).
[28] The *Stablecoin Classification and Regulation Act of 2020* was introduced as a bill in the House of Representatives. Please see: https://tlaib.house.gov/sites/tlaib.house.gov/files/STABLEAct.pdf.

complex multifaceted product with a complex multifaceted set of risks. As a result, it was proposed that stablecoins convertible into US dollars must be issued only by insured depository institutions and that laws should be created to enforce regulations on stablecoins as insured deposits, subject to supervision at both the depository institution and the holding company levels. Schwarcz (2021) proposes that the regulators might require stablecoin issuers to back up the cryptology through separate networks, to address the second risk of failed cryptology.

Other potential risks associated with stablecoins are risks that stablecoin users face (end-user protection), risks of stablecoin runs, payment system risk, systemic and financial stability risk, concentration of economic power among bigtech firms, illicit finance risks, and risks related to operational resiliency and market integrity. Schwarcz (2021) also points out that the government might consider mandating a strategic public-private partnership to protect against the risk that the wide use of stablecoin might undermine the government's ability to operate monetary and economic policy. Stablecoins may be created in different forms for different purposes, such as stablecoins for payments, stablecoins for investment (treated as securities and regulated by the Security Exchange Commission, SEC), or commodity stablecoins (the futures trading of these coins would be regulated by the Commodity Futures Trading Commission, CFTC). Other regulators are the Financial Crimes Enforcement Network (FinCEN), the Office of the Comptroller of the Currency (OCC), the Consumer Financial Protection Bureau (CFPB), state-level regulators, and the Financial Stability Oversight Council (FSOC). The number of regulators in the US could make stablecoin regulations more complicated to implement – requiring significant efforts among US regulatory agencies to coordinate and collaborate to avoid contradiction and unintended consequences of stablecoin regulations.

The recently proposed rules on stablecoins by the US PWG focused mostly on the payment stablecoins. It is interesting to note that the US's overall approach to stablecoin regulations would create some common quality between stablecoins and CBDC, as they both are equal in value to fiat dollars and both are digital tokens, although stablecoins would be issued by banks and are built on decentralized exchanges while CBDCs are issued by the central banks under the government's control in a centralized market.

Regarding the initial thoughts around issuing CBDC in the US, the Federal Reserve (2022) report's initial analysis suggests the following important considerations if the US were to issue CBDC: 1) it would focus on consumer privacy and protection; 2) it would involve financial intermediation (rather than direct consumer account with the Federal Reserve); 3) it would be widely and seamlessly transferable; and 4) it would be identity-verified (a CBDC intermediary would verify the identity of a person accessing the CBDC, similar to the current KYC process in banking). The report does not include specific details about the policy outcome and does not necessarily suggest that the CBDC would ultimately be desirable in the US

In addition to stablecoins and CBDC, the US Federal Reserve has also been working on developing a completely new payment system for domestic real-time payments (called FedNow) that would be available to all banks and other depository institutions (approximately 6,000 institutions). FedNow is expected to be fully implemented in 2023. The introduction of FedNow would likely reduce the need for private-issued stablecoins – at least for all payments within the US.

Stablecoin Regulations in Europe

The current regulatory framework of digital assets in the EU relies on *Regulation on Markets on Crypto-Assets (MiCA),* which was adopted in September 2020. *MiCA* covers utility

tokens, stablecoins including payment tokens, asset-backed tokens, and other "significant" stablecoins. Investment and securities tokens are subject to the existing EU financial and securities law.[29] Zetzsche, Annunziata, Arner, and Buckley (2020) point out that the scope of *MiCA* remains uncertain, as it does not take a clear position in the definition of utility tokens and securities tokens; a systematic approach to EU law is absent; and a framework for supervisory cooperation relating to global stablecoins is missing. The UK has set out its proposal on crypto-asset regulation in January 2021, which uses a staged and proportionate approach. Specifically, the UK government proposes to regulate stable tokens used as a means of payment initially.[30]

Unlike the US approach to stablecoin regulations, it is not required under *MiCA* that stablecoins be issued only by insured depository institutions and be regulated like bank deposits. However, *MiCA* proposed significant challenges for stablecoins – requiring that stablecoins are registered with regulatory groups for anyone to legally trade them. In addition, under the *MiCA* proposal, most of the relevant stablecoins, (including Tether, USDC, and Dai) would be subject to stringent rules related to capital and the amount of reserves that stablecoin issuers are required to hold. It is expected that the issuance of stablecoins in Europe would be unprofitable in most cases – resulting in stablecoins being effectively banned in the EU, potentially driving the activities to other jurisdictions that are more stablecoin friendly.

The European Central Bank (ECB) has also launched a two-year investigation of a possible European CBDC – the digital euro. An initial report was issued in January 2022 to address several questions and concerns regarding the purpose of a digital euro, how it would work, and the

[29] The European Commission published its new Digital Finance Strategy on September 24, 2020: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020PC0593.
[30] The UK government issued the consultation paper on January 7, 2021, "UK Regulatory Approach to Cryptoassets and Stablecoins: Consultation and Call Evidence": https://www.gov.uk/government/consultations/uk-regulatory-approach-to-cryptoassets-and-stablecoins-consultation-and-call-for-evidence.

potential consequences on the banking systems and consumers at large. The study has also identified cost-benefits and the trade-offs among the various policy options and possibilities – see Brunnermeier and Landau (2022) for the full report.

5. Concluding Remarks

Fintech and decentralized finance (DeFi) have penetrated all areas of the financial system, disrupted traditional financial firms, and reduced frictions and opacity in payments and lending. The recent growth in fintech and DeFi has also improved financial inclusion around the globe, especially in countries that did not previously have a well-established payment system, such as India, China, and Kenya. Traditional financial systems face the problems of centralized control, high costs, limited access, inefficiency, lack of interoperability, and lack of transparency (Harvey, Ramachandran, and Santoro, 2021). With big data, new technologies, complex algorithms, and DeFi, the way financial products and services are produced, delivered, and consumed has dramatically changed in recent years. Consumers' preference and expectations have also changed.

China has been one of the few countries in the world that experienced very fast growth in fintech in the last decade. In this paper, we have reviewed the development of fintech and cryptocurrencies in China, as well as the recent literature and policy discussion. We also compared these to developments in the US and Europe. China's financial system was traditionally dominated by a large banking sector, which led to credit shortage in SMEs and new industries. We argue that the rapid fintech growth in China (fintech credit, digital payment system, and the pilot testing of e-CNY) has helped to expand credit access to the SMEs and startups, thus offering partial solutions to the credit shortage problems inherent in the traditional financial system in China. Fintech growth has also reduced the costs of financial transactions and will likely continue to transform China's

financial system and the overall Chinese economy to achieve a more balanced economic structure with sustainable growth.

Despite the recent exponential growth in fintech and cryptocurrencies (with high volatility and complex underlying technology), cryptocurrency regulations have been slow to catch up with the pace of the market. Currently, there are no centralized regulatory frameworks for cryptocurrencies and stablecoins. This lack of regulatory clarity at the national level and the international level has created significant risks and uncertainties, leaving investments in the cryptocurrencies and other crypto-assets vulnerable to fraud and manipulation. Regulators have an important role to play in designing effective crypto-asset regulations, focusing on protecting consumers, financial stability, and market efficiency. Some economists argue that cryptocurrency regulations would in fact further drive innovations, rather than suppress innovations. This is because regulatory clarity would eliminate much of the uncertainties in the crypto markets, resulting in enhanced market confidence – thus, promoting widespread adoption and investment.

There remain several unanswered questions and opportunities for future research. One of the challenges in regulating cryptocurrencies and the underlying technologies is monitoring and enforcement, because it would be harder to identify the bad actors on a blockchain platform. In addition, it would be hard to impose effective crypto-asset regulations without having in-depth understanding of the impact and mechanisms to prevent activities from being moved outside the regulatory umbrella. This is similar to the regulatory arbitrage in banking, where certain types of loans are driven to the shadow banking sector. It is also critical for all cryptocurrencies regulators across jurisdictions to coordinate their programs to prevent regulatory arbitrage, where crypto activities would be moved cross border to avoid heavy regulations. Bitcoin miners moved their activities to other countries around the globe when Bitcoin mining was banned in China. This

could be a real challenge, as it is likely to be extremely difficult to have all regulators around the globe to reach some kind of “global consensus” on how cryptoassets should be regulated.

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