

A DIGITAL RENMINBI: PLANS, FEATURES AND IMPLICATIONS

LIU Bojian & Bert HOFMAN

EAI Background Brief No. 1519

Date of Publication: 20 March 2020

Executive Summary

1. China may soon have a digital currency. It is exploring the possibilities of fintech (financial technology) given the latter's and e-commerce's rapid development, the rise and fall of bitcoin and other cryptocurrencies, and the announced plans for a "stable coin" (or cryptocurrency) issuance led by Facebook.
2. Some form of digital currency can be expected as early as 2020, possibly first on an experimental basis. This can have profound implications for China's payment system and monetary policy, and the future role of the Renminbi (RMB) in the international payment system.
3. There are three types of digital currency technologies. The first, used by Bitcoin and Ethereum, is based on public blockchain. The second, such as the Libra, is based on a private or consortium blockchain. The third comprises those who use the internet rather than cash to process payment, including Alipay and WeChat.
4. Central banks may have three main concerns with digital currencies. First, be it private or public, digital currencies can be competition for a sovereign currency. Second, the move to digital currencies may affect money supply. Third, digital currencies could reshape the international payment system.
5. A digital Renminbi has been discussed as far back as 2014. The People's Bank of China (PBC) established a study centre on digital currency in 2017. Recently, the plans have become more concrete and the PBC is considering launching in 2020 a pilot digital RMB, officially called Digital Currency/Electronic Payment (DC/EP).
6. The PBC is apt to dismiss blockchain as the underlying technology for its DC/EP. The blockchain technology currently could not be scaled to the needs of China's economy and could not meet the processing speed required by the PBC. It could also undermine the central bank's control of the money supply and is likely to be in conflict with China's cybersecurity law.

7. Using the existing infrastructure, a digital RMB will take a two-tiered issuing model, with the PBC as the first tier and licensed commercial banks, e-commerce platforms, and telecom companies as the second tier facing the public. The PBC also wants to avoid the much more direct competition between the digital RMB and other forms of digital payments.
8. According to the PBC's former governor Zhou Xiaochuan, producing and using DC/EP is cheaper, while DC/EP counterfeits are more difficult to produce. An anti-corruption campaign on anti-money laundering may be easier to conduct. Implementing monetary policies and monitoring the economy will be more accurate with the big data provided by the digital payment.
9. RMB's internationalisation could benefit from digitisation by lowering cross-border payments costs where a transaction through the digital RMB is immediate, bypassing clearance and settlement via central banks. The ease in licensing foreign banks and e-commerce providers using the digital RMB as transaction currency can facilitate international trade and ecommerce.

A DIGITAL RENMINBI: PLANS, FEATURES AND IMPLICATIONS

LIU Bojian & Bert HOFMAN*

Introduction

- 1.1 The People's Bank of China (PBC, China's central bank) is currently considering issuing a digital currency. If implemented, it will be the first central bank of a major country to do so. The rapid development of fintech (financial technology)¹ and e-commerce, the rise and fall of bitcoin and other cryptocurrencies, and the plans for a digital currency by a consortium led by Facebook have motivated China's financial authorities to explore the opportunities of a digital RMB.
- 1.2 China's relatively liberal regulatory regime for fintech, which has propelled the development of the Alipay and Tencent digital payment platforms, also generated a boom in cryptocurrency activities. However, after several issues with Initial Coin Offerings and fraud in the peer-to-peer (P2P) lending market, the government has tightened regulation. It banned trading and exchange activities of cryptocurrencies altogether, even though bitcoin mining remains big in China. Financial activities of ecommerce platforms were also more tightly regulated; since 2017, they have to use the central bank's payment system to settle payments, much like commercial banks. In response to the stringent regulation, internet giants such as Alipay and WeChat have obtained banking licences.
- 1.3 Nevertheless, China's authorities remain interested in the opportunities that fintech offers; in May 2017, the PBC set up a fintech research department and in 2019 it was considering issuing its own digital currency. With the announcement of plans

* Liu Bojian is Research Assistant of the East Asian Institute, National University of Singapore. Bert Hofman is Director of the same institute and Professor in Practice in the Lee Kuan Yew School of Public Policy, National University of Singapore. The authors thank Dr Chen Gang and Ms Jessica Loon for their helpful editorial advice.

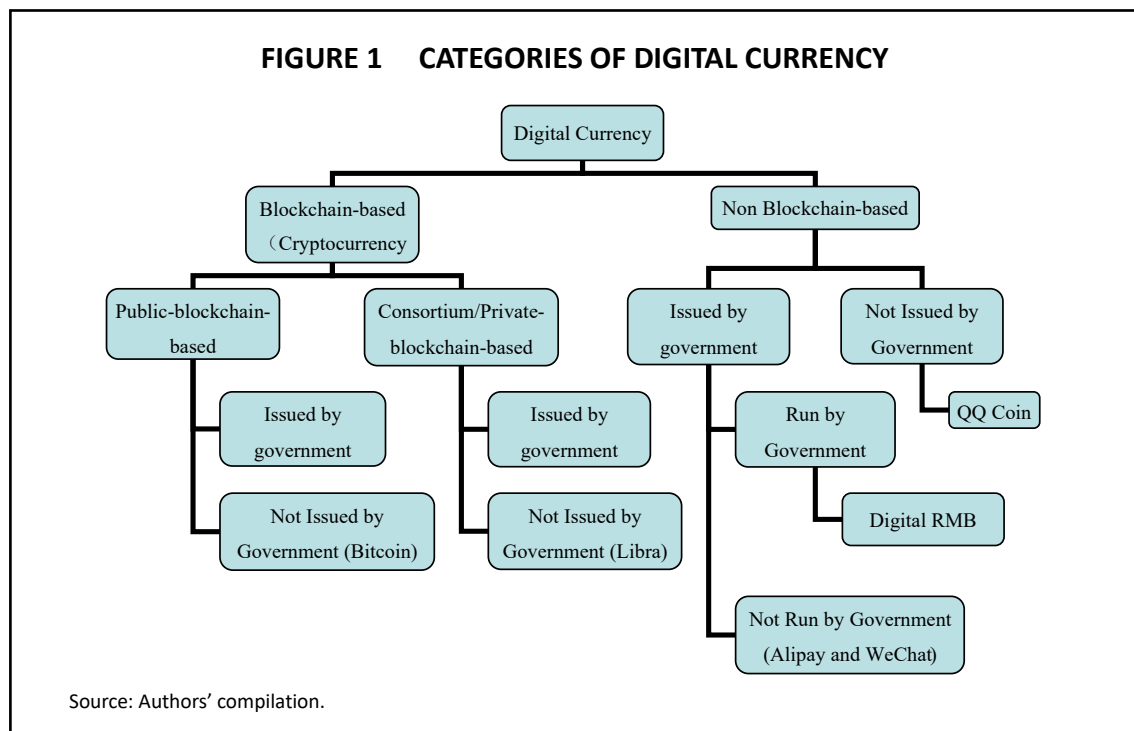
¹ Financial technology, fintech in short, is the technology and innovation that aims to compete with traditional financial methods in the delivery of financial services.

for the Libra, a cryptocurrency backed by Facebook and others, the PBC has intensified its work.

- 1.4 It now seems likely that some form of digital currency will be issued in 2020, probably first on an experimental basis, as is often the case in China with the introduction of new initiatives. This can have profound implications for China's payment system and monetary policy, and over time the role of the Renminbi (RMB, China's currency) in the international payment system. In his Congressional testimony on the Libra,² Mark Zuckerberg, founder of Facebook, one of the backers of the Libra, highlighted competitiveness and potential leadership of China's digital payment as a key motivation for the United States to pioneer the move on a digital currency.

A Primer on Digital Currencies, Cryptocurrencies and Blockchains

- 2.1 Digital currencies, cryptocurrencies and blockchains are related, but distinct. Digital currencies are categorised by the technology that is used and by the source of issue, notably, the government or the private sector (Figure 1).



² A digital currency based on blockchain technology, the plan was initiated primarily by Facebook roughly in 2019.

- 2.2 There are three types of digital currency technologies. The first, used by Bitcoin and Ethereum, is based on public blockchain. A blockchain is a distributed ledger, a way to keep the books on transactions with the currency. Cryptocurrencies are produced by “mining”, a means to add blocks to the chain, or simply put, to record transactions. This entails solving complex puzzles with computers. Anyone can mine and produce cryptocurrencies on the public blockchain. How much of currency to be issued is determined within the program: the number of Bitcoins is capped at 21 million. The creator of Bitcoin software, Satoshi Nakamoto, designed a decreasing-supply algorithm that sets the geometric decrease of Bitcoins generated per block. Although the upper limit of Ethers (the currency unit in Ethereum) has not been fixed, the annual issuance is capped at 18,000,000.
- 2.3 The second type of technology for digital currency, such as the Libra, is based on a private or consortium blockchain rather than public blockchain. Facebook, Visa, Mastercard and Uber were the original sponsors of the Libra. Access to a private consortium’s blockchain is controlled by an administrator and the supply of cryptocurrencies is determined by the sponsoring parties joining the blockchain project, a reason why some argue that the Libra is not a genuine cryptocurrency.
- 2.4 Blockchains are sustained with computing power contributed by miners, whose primary motivation is to acquire cryptocurrencies. All blockchains, other than privately owned blockchains, provide incentives to participants to maintain it, and cryptocurrency, such as Bitcoin and Ether, is the most important way to incentivise. Privately owned blockchains, such as IBM’s Hyperledger which does not rely on cryptocurrencies, is maintained by the private owner instead of the participants seeking cryptocurrencies as rewards.
- 2.5 The third type of digital currency does not use blockchain, comprising those who use the internet rather than cash to process payment, such as digital tokens used in online platforms or games.³ These include digital currencies of Alipay, WeChat and Tencent’s online community of video games. Although Apply Pay, a latecomer,

³ However, at present, the category of the third type is slightly controversial as it sometimes overlaps with the former two types. When the former two types of digital currencies become more popular, the third type may be discontinued.

employs latest technologies such as Near-field communication (NFC), it adopts a similar payment method as that of Alipay, WeChat and PayPal; it processes payments through bank accounts that their owners set into those online payment tools, so no new money is used. In online gaming and social network communities built by Tencent for purchasing services, people can change RMB into QQ Coin or gain rewards from gaming.

- 2.6 What differentiates Alipay and WeChat from a credit card or from a debit card is simply the instrument of payment they adopt:⁴ Alipay and WeChat rely on smartphones while credit and debit cards use chips embedded. The interoperability of digital payment systems made by platforms is highly restricted: the owner of the platform, such as Tencent, recognises only its payment vehicle (such as the QQ Coin) as the sole form of tender on its own particular platform.

Central Banks and Digital Currencies

- 3.1 Central banks have for decades used digital money, but only for wholesale transactions with other financial institutions—predominantly other central banks and commercial banks. Until now, apart from Ecuador, Venezuela, Tunisia, Marshall Islands and Senegal, there are very few countries issuing digital *national* currencies for retail use. However, in the foreseeable future, with Central Bank Digital Currency (CBDC), more and more digital currencies will likely be issued. Apart from the PBC, the Bank of England, Bank of Canada, Riksbank of Sweden and central banks of India, Japan and the US Federal Reserve have been studying digital currencies.⁵ Most recently, Sweden has announced its intention to start a pilot with digital retail currency.

⁴ It partially explains why PBC later termed its digital currency as “Digital Currency Electronic Payment (DC/EP)”, as some digital currencies are just a vehicle of payment and not a new currency.

⁵ See the Official Monetary and Financial Institutions Forum’s report of “Digital Currencies: A Question of Trust”, <https://www.omfif.org/wp-content/uploads/2020/02/Digital-currencies-A-question-of-trust-1.pdf>, accessed 8 February 2020.

3.2 Central banks may have at least three areas of interest regarding digital currencies:

- First, be it private or public, digital currencies can be competition for a sovereign currency. Though currency competition has long been a topic of discussion and it has always been a libertarian ideal to control the powers of a central bank, no headway has been made until the emergence of digital currencies. In an extreme case, the sovereign currency would lose sufficient market share and affect central bank seigniorage, that is, the revenues it gets from money issuance. Central banks hence monitor this development closely and intervened with regulations to protect their monopoly on legal tender.
- Second, the move to digital currencies may affect the money supply. Commercial banks create the bulk of the money supply by issuing credits on the basis of deposits. If the public hold fewer and fewer demand deposits because digital currencies provide the same services, then deposits in banks would fall and an economy could experience a credit crunch. Though past innovations such as credit cards and electronic wallets also affect monetary relationships, the speed with which digital currencies could be adopted could disrupt monetary policy more.
- Third, digital currencies could reshape the international payments system. This system is dollar dominated and bank centric, and relatively expensive for small transactions. Digital currencies allow for direct transactions between holders in different countries, hence lowering transactions costs. Such a competitive advantage of a currency, combined with the credible backing of a sovereign nation, could change the make-up of the international payment system. The global financial crisis had exposed some of the downsides of the system, giving China grounds to argue for alternatives to the dollar-denominated system. As the United States has been using the international payment system against some states in recent years, this view has gained even more traction now that the China-US relationship has become strained.

China's Digital RMB: Definition and Comparison

4.1 A digital Renminbi has been discussed for several years, going back to at least 2014. The PBC established a study centre on the topic of digital currency in 2017. Recently, the plans have become more concrete and the PBC is considering launching a pilot digital Renminbi in 2020.⁶ According to statements by PBC officials such as Mu Changchun, the development of China's digital money will not be biased towards

⁶ Li Xuanmin, "Research into China's sovereign digital currency is delayed amid epidemic", *Global Times*, 25 February 2020, <https://www.globaltimes.cn/content/1180737.shtml>, accessed 25 February 2020.

any particular technology. However, it will not use blockchain technology at least for now. The official name of the currency will be Digital Currency/Electronic Payment (DC/EP).⁷

4.2 The name DC/EP has been chosen to encompass all three types of digital currency as described earlier. It also comprises payments relying on chip-based electronic mediums such as credit and debit cards. Adopting a broad definition for China's digital currency allows for a gradual rather than radical reform. Naming it as DC/EP probably is to minimise the anxiety arising from the twilight of payment systems using more traditional technologies represented by mostly state-owned financial services such as China UnionPay. Late entrants to the Chinese market, such as VISA and Mastercard, could equally face competition from a digital RMB.

4.3 At least in the short term, the PBC is apt to dismiss blockchain as the underlying technology for its DC/EP due firstly to the limitation of the currently available blockchain technology which could not be scaled to the needs of China's economy. According to the PBC, DC/EP needs to have the processing capability of at least 300,000 transactions per *second*,⁸ close to Alibaba's peak processing capacity: the company's Apsara Operating System supported a record 544,000 orders per second on Singles Day 2019.⁹ Today's blockchain technology falls far short of this requirement: Bitcoin's theoretical transaction throughput is seven transactions per second, while Libra can support 1,000 transactions per second.¹⁰

4.4 Secondly, the decentralising features of blockchain technology would conflict with the centrality of the PBC in China's financial system. It also may challenge the

⁷ The Research Group of Blockchain in the Institute of Digital Currency of People's Bank of China, "The Development and Management of Blockchain Technology", *China Finance* (4) 2020, p. 28-30.

⁸ "'Shuzi Renminbi' You Xu Ru Shi ('Digital Renminbi' emerges from theory to reality)", *Jingji Cankao Bao (Economic Information Daily)*, http://www.xinhuanet.com/fortune/2019-09/26/c_1125042425.htm, accessed 20 January 2020.

⁹ "How Alibaba powered billions of transactions on Singles' Day with 'zero downtime'", *South China Morning Post*, 20 November 2019 <https://www.scmp.com/tech/e-commerce/article/3038539/how-alibaba-powered-billions-transactions-singles-day-zero-downtime>, accessed 12 February 2020.

¹⁰ Bernard Marr, "Facebook's Blockchain-Based Cryptocurrency Libra: Everything You Need To Know", *Forbes*, 7 October 2019. <https://www.cnbc.com/2019/07/19/bitcoin-vs-libra-how-facebooks-cryptocurrency-is-different.html>, accessed 20 February 2020.

government's control of monetary policy through the central bank. For instance, with Bitcoin technology, the money supply will be determined by market participants, not the central bank. With a Libra type of consortium, this consortium rather than the PBC will de facto become a central bank.

- 4.5 Thirdly, adopting public blockchain would allow market participants unlimited access to all data stored on the ledger, which would contravene China's Cybersecurity Law. As the Law stipulates, data generated within China's borders should be stored and processed exclusively in China. Thus, the PBC cannot allow DC/EP transaction data to be accessible by any computer connected to the public blockchain.
- 4.6 To maintain the regulatory power necessary for implementing monetary policies, the PBC is likely to adopt a centralised way to issue DC/EP. Digitising fiat currencies will considerably elevate the PBC's regulatory capability as it will be able to record every single payment. In principle, cryptocurrencies based on public blockchains, such as Bitcoin and Ether, are entirely anonymous, which makes it particularly costly or sometimes impossible to monitor suspicious transactions. The risk of money laundering and other illicit transactions led the PBC to ban the use of cryptocurrencies in the first place.

The Issuance of China's Digital RMB in Practice

- 5.1 So how would a digital RMB take shape? According to Yao Qian, a PBC official leading the designing of DC/EP, the Chinese digital RMB will take a two-tiered issuing model,¹¹ with the PBC as the first tier and commercial banks as the second. This is similar to the model of money issuance today, but the difference is that the digital RMB is a direct claim of the public on the central bank, unlike demand deposits, which are a claim on banks. It is also different from digital wallets, such as Alipay and WeChat money, which constitute a claim on the commerce platform companies. In the PBC's plans, partners other than banks such as telecommunication

¹¹ It is also called the binary operating system of central bank digital currency. See Yao Qian, "Zhongyang Yinhang Shuzi Huobi Yuanxing Xitong Shiyen Yanjiu (Experimental Research on the Prototype of Central Bank Digital Currency)", *Journal of Software* 29 (9), 2018, p. 2718.

companies and internet platforms can apply for banking services licence to join the second tier.

- 5.2 A two-tier structure will allow the digital currency to make use of the existing infrastructure. While it is possible theoretically for the central bank to hold an account for every holder of the currency (a one tier structure), this would require the central bank to heavily invest in retail payment structures. The much more direct competition between the digital RMB and other forms of digital payments is also something the PBC wants to avoid.
- 5.3 As there are indications that the PBC does want to maintain a record for each of the transactions done with digital currencies, the information infrastructure would need to allow for that. Such records at the central bank need not be held in real time though—it is for record and for legal purposes as it provides the authorities with the means to investigate whether a transaction in digital RMB was conducted legally. The payments, though, once done, are final, and no clearance and settlement at the PBC are needed.
- 5.4 If private bank account holders in a commercial bank demand for digital currency, banks in the second tier can exchange cash RMB for digital RMB at the PBC. This would either reduce the bank's reserves at the PBC or reduce the currency in circulation (Figure 2). The commercial bank would deliver the digital RMB to the private client, either in exchange for cash, by reducing the amount of deposit, or by extending credit to the client.
- 5.5 The PBC can on its own initiative increase the quantity of digital RMB in circulation. Much like existing open market operations, it can hold auctions or offer discount bonds for digital RMB rather than for bank reserves as is currently the case. Thus it can use digital RMB for monetary policy purposes.¹²
- 5.6 Commercial banks and others with a licence to administer digital currency can also initiate demand for digital RMB. For instance, their digital RMB services (say, e-

¹² Yao Qian, *A Glimpse of Digital Currency*, China Finance Publish House (Beijing: 2018), p. 214.

commerce) may be in high demand as people may want to use digital currency for transactions, hence necessitating a cash exchange or deposits for digital RMB on the platform and the subsequent exchange of this at the central bank for digital currency by the platform manager. The competition is hence at the service level, rather than at the currency level, where banks will have to compete with each other and with others who have access to the PBC's digital RMB.

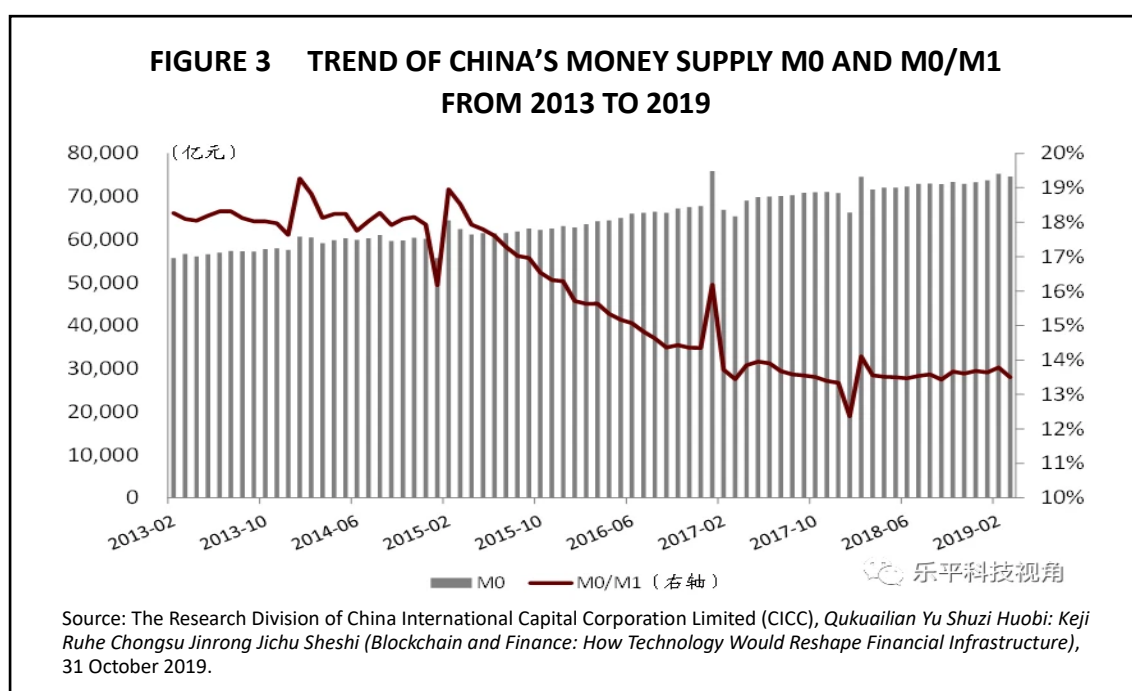
FIGURE 2 ISSUING DC/EP INDICATED BY THE BALANCE SHEET OF PBC, COMMERCIAL BANKS, PRIVATE SECTOR AND GOVERNMENT

Central Bank		Commercial Banks		Private Sector		Government	
ASSET	LIABILITY	ASSET	LIABILITY	ASSET	LIABILITY	ASSET	LIABILITY
International Reserves	Cash RMB ↓	Loans in Cash ↓	Deposit in Cash ↓	Deposit in Cash ↓	Loans in Cash ↓	Deposit in Cash ↓	Bonds in Cash ↓
Bonds in Cash ↓	DC/EP ↑	Loans in DC/EP ↑	Deposit in DC/EP ↑	Deposit in DC/EP ↑	Loans in DC/EP ↑	Deposit in DC/EP ↑	Bonds in DC/EP ↑
Bonds in DC/EP ↑	Bank Reserve in Cash ↓	Bank Researve in Cash ↓					
Other Assets	Other Liabilities	Other Assets	Other Liabilities	Other Assets	Other Liabilities	Other Assets	Other Liabilities

Source: Compiled by authors.

- 5.7 With China's rising GDP and demand for money, new RMB issued could be increasingly in the form of DC/EP rather than cash RMB. Digital RMB will then gradually take up a rising share of the PBC's expanding balance sheet on the liabilities side. Digital RMB assets, such as bonds, will also be on the asset side of the balance sheet. With an expansion of the volume of digital RMB, cash RMB will be phased out. This phase out will take considerable time, though, and cash and ATMs will not disappear in the short term.
- 5.8 For the PBC, withdrawing cash from the market and replacing it with DC/EP may be achieved through various instruments available such as repurchase agreement and mechanism of rediscount. Compared to those instruments, adjusting required bank reserves has little impact on cash in the market and it is more relevant to issuing DC/EP than withdrawing or replacing cash.

- 5.9 According to the PBC, without bringing significant changes to China's total money supply, the Chinese digital RMB aims to substitute money supply M0, which mainly denotes cash and coins in the market according to the Chinese definition. Therefore, DC/EP will not transform the government's liability to the Chinese public, which means foreign reserves and gold backing RMB's value are essentially the asset of the Chinese public, notwithstanding the fact that the public will never ask for paying off.
- 5.10 In recent years, the boom in digital payments in China has already caused considerable decline in the share of M0 (cash) in M1 (cash and demand deposits) as Figure 3 shows. According to the Digital Currency Research Team of the PBC, China as the biggest digital economy in the world makes issuing digital currency easier.¹³ However, compared to some economies such as Canada, Japan, South Korea and the United Kingdom (Figure 4), where credit card has been popularised much earlier than in China, China still has room to further digitise its money. The United States, though heavily digitised, has an unusually high share of cash issued, understandably with almost 80% of this held overseas according to some estimates. The share of 100 dollar bills held overseas is even higher, suggesting that the US dollar is a major currency in cash transactions abroad, some of which are associated with illicit trade.



¹³ The Digital Currency Research Team of PBC, "Fading Shuzi Huobi De Zhongguo Zhilu (The Chinese Way of Fiat Digital Currency)", *China Finance* 17 (2016): 45-46.

**FIGURE 4 A COMPARISON OF MAJOR ECONOMIES ON
THE RATIO OF M0/M1**

Period (May-August 2019)	M0	M1	Ratio M0/M1
Brazil (BRL million)	271,345	367,425	73.85%
Canada (CAD million)	95,547	1,026,561	9.30%
China (CNY billion)	7,270	55,300	13.10%
Hong Kong (HKD million)	482,846	2,428,901	19.87%
Japan (JPY billion)	102,110	797,798	12.80%
Russia (RUB billion)	9,193	21,718	42.30%
Singapore (SGD million)	46,881	193,035	24.30%
South Korea (KRW billion)	107,524	870,798	12.30%
United Kingdom (GBP million)	82,819	1,764,751	4.70%
United States (USD billion)	3,260	3,852	84.60%

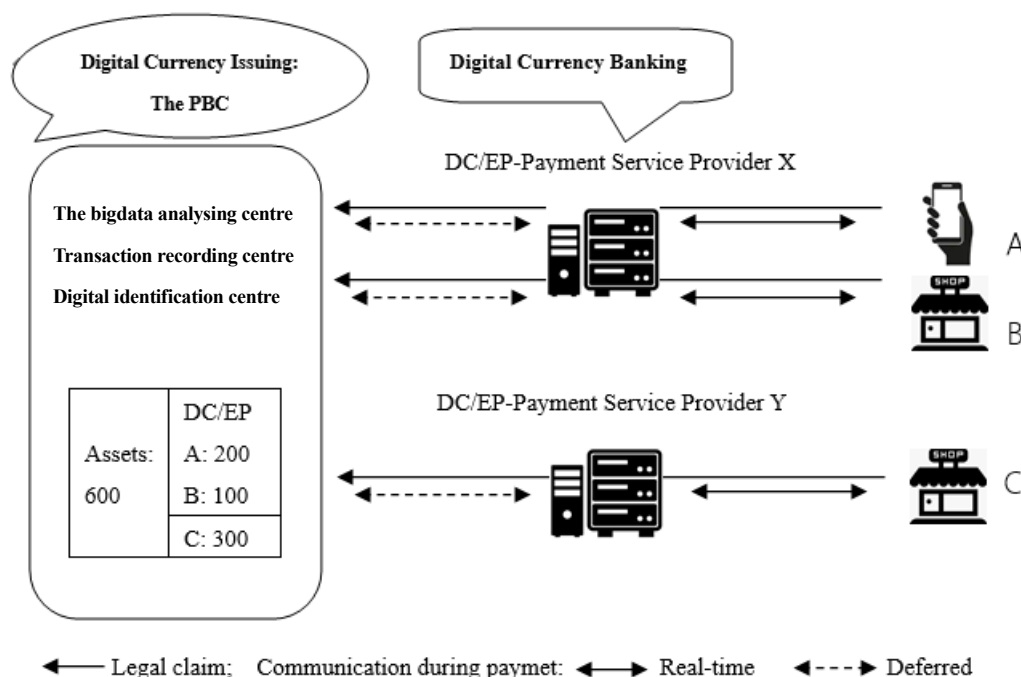
Source: Derived from “Trading Economics”. See <https://tradingeconomics.com/country-list/money-supply-m0?continent=g20> and <https://tradingeconomics.com/country-list/money-supply-m1?continent=g20>, all accessed 20 January 2020.

5.11 From what is currently known, the PBC is likely to want to retain the information on the transactions in digital RMB. As Figure 5 shows, the envisioned two-tier issuance model would require three operating centres in order to make the issued DC/EP practicable and operating systematically:¹⁴

- (i) The bigdata analysing centre. Primarily for preventing money laundering, and facilitating risk management and monetary policymaking, this centre is to summarise and analyse all data generated from the other two centres.
- (ii) The recording centre. The centre is constituted primarily of central bank accounts set up for commercial banks and enterprises, which record, process and store information of every transaction.
- (iii) The identification centre. It is to manage the system of digital identification, mainly built for ensuring ownership and necessary privacy of accounts on the second layer. The PBC will develop applications, also termed “digital wallet”, for smartphones and computers for this layer. The digital wallets can substitute for ATMs, and owned and encrypted by retail and personal users. Ensuring the ownership of the account requires digital identification through passwords or fingerprint, facial recognition and so on.

¹⁴ See Yao Qian, “Zhongguo Fading Shuzi Huobi Yuanxing Gouxian (A Blueprint of China’s Fiat Digital Currency)”, *China Finance* 17 (2016), p. 14.

FIGURE 5 TWO-TIER ISSUANCE AND THREE-CENTRE OPERATING STRUCTURE OF CHINA'S DC/EP



Note: X and Y could include commercial banks, telecommunication companies and perhaps some e-commerce companies. A are personal users, while B and C are commercial entities. In contrast to X, Y represents those payment systems tailored for commercial entities.

Source: Compiled by authors.

- 5.12 As emphasised by the PBC, it is not desirable to encrypt all three layers because identifying users by their real names is critical for the government to monitor financial activities. Therefore, though the last layer of the identification system is mostly encrypted by account owners, their transaction data will be managed by the PBC and authorised partners of the government.

Digital RMB: Implications

- 6.1 As suggested by the PBC's former governor Zhou Xiaochuan, producing and using DC/EP is cheaper and more convenient than either cash or metal coins in use today. Besides, if well managed, it is harder to produce counterfeit DC/EP than counterfeit cash. In practice, with digital fiat money issued by the central bank, an anti-corruption campaign centred on anti-money laundering might be easier to conduct.

Information stored in transactions will help detect possible corruption.¹⁵ Furthermore, implementing monetary policies and monitoring the economy would be easier and more accurate thanks to the big data recorded by digital payment.

6.2 RMB's internationalisation could also benefit from digitisation because it can lower cross-border payments costs than it is today. Once established, it would be easier to license foreign banks and e-commerce providers in their use of the digital RMB as transaction currency. This can help facilitate international trade as well as ecommerce. One advantage of the digital RMB as compared to current international payments is that a transaction is immediate, doing away with the need to go through clearance and settlement via central banks to achieve finality. Currently, aside from restrictions on capital flows, the RMB is at a disadvantage against Euro and US Dollar because the latter two currencies, and especially the dollar, allow for clearance and settlement late in the trading day, whereas RMB transactions beyond Asia can only be settled the following day. With the finality of digital RMB transactions, this is no longer an issue.

6.3 If properly managed, China's DC/EP may swiftly attain an advantage over other digital tools of payments such as Alipay and WeChat Pay issued by private sectors chiefly because it is a form of legal tender which the public can use to pay taxes or other payments to the government. As legal tender, it must be accepted in transactions, at least within China, whereas existing digital payment methods do not have the backing of the state.¹⁶ Nevertheless, existing providers may maintain advantage in the digital payment world even if digital RMB is used as the underlying currency simply because of the convenience that comes with their payment platforms.

¹⁵ Xinhua News Agency, "How Far is Central Bank Digital Currency from Us?" 10 April 2018, http://www.xinhuanet.com/fortune/2018-04/10/c_1122658121.htm, accessed 20 January 2020.

¹⁶ See Kenneth S Rogoff, *The Curse of Cash: How Large-denomination Bills Aid Crime and Tax Evasion and Constrain Monetary Policy*. Princeton University Press (2017).