Central Bank Digital Currency: Promises and Risks

Digital currencies have advanced rapidly over the past decade, not without controversy. But the most important experiment of all may be taking place at the People's Bank of China.

By Paradorn Pasuthip and Steve Yang
THE INVENTION OF MOVABLE TYPE IN CHINA IN THE 11TH century revolutionized more than just the printing of books; it also revolutionized money. The Song Dynasty was the first government to issue paper money. China’s currency had existed mostly in the form of copper coins, but coins were challenging to transport in large quantities and their supply was limited by the need to mine copper. When the economy expanded and trade boomed, the strain on the money supply led merchants and later the government to rethink coins as a medium of exchange. The Song government began to print paper money, and the subsequent credit and economic expansion lasted almost 100 years, until monetary mismanagement sent inflation spiraling and helped bring down the regime. Even though successive Chinese dynasties retained paper currency, it took a long time to learn how to manage the new risks that came with it. Even to this day, hyperinflation caused by “printing one’s debt away” still occurs. Such is both the promise and the risk of “new” money.

We are now entering another innovative age of currencies with the development of virtual, or digital, currencies, popularly known as cryptocurrencies. Over the past decade, a broad range of currencies has appeared that exist only as data in digital form. These digital currencies pose a theoretical challenge to central bank paper-currency printing. Not surprisingly, central banks have reacted to the rise of digital currencies with a combination of deep skepticism, anxiety and curiosity.1

A number of central banks have begun studying the process and implications of offering their own version of a digital currency — a central bank digital currency (CBDC). The Bank of England initiated a series of studies on CBDCs’ potential in 2015. In Sweden, where cash use has fallen to the lowest level in the world, the Riksbank, or central bank, proposed to study two forms of CBDC, called e-krona, in 2017.2 The next year, emerging economies including Uruguay, Lithuania, Tunisia and Venezuela implemented pilot programs to test CBDCs. However, central banks in major economies have been resistant to digital currencies. Some central banks believe current settlement systems are efficient enough without digital currencies.3 Others raise concerns about the risk to the global banking system if CBDCs increase the risk of structural disintermediation of banks and the risk of facilitating systematic runs on banks in a crisis situation.4 Yet others worry that the effects of CBCDs on monetary policy are not well understood.5

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There is one major exception to this resistance: the People’s Bank of China (PBoC), which under President Xi Jinping has embraced a CBDC. And that places Beijing at the forefront of public digital currencies.

THE RISE OF PRIVATE DIGITAL CURRENCIES

Cryptocurrency was invented, perhaps coincidentally, in 2009, when the world’s banking system was in turmoil. Initially, it referred to a private currency that relied on a new technology called blockchain, which uses a distributed ledger technology (DLT) that validates transactions by a consensus protocol and ensures the immutability of the data by cryptographic signature. Blockchain is maintained within a network of peer nodes and eliminates the need for a central authority to process and validate transactions, thus avoiding the danger of having a single point of failure. Blockchain gathers transactions into blocks and binds them together with a cryptographic “hash,” an algorithm that verifies the authenticity of a piece of data.

Blockchain is an example of a Merkle tree, a data structure that’s particularly efficient at verifying data. The information can be quite general — say, a record of transactions between two entities, much like how the first and best known of the cryptocurrencies, Bitcoin, is structured. However, blockchain can also be a software program that runs without downtime, such as Ethereum, which employs “smart contracts” (computer code) on a decentralized network of computers around the world to power its cryptocurrency, Ether.

The relatively short history of this new technology has created true believers and profound skeptics. Cryptocurrencies offer an alternative way to settle payments and automate contracts, and they function in an open and decentralized manner independent of any controlling entity, while ensuring anonymity. The price of Bitcoin has skyrocketed since 2009 — though it’s been extremely volatile — and remains a benchmark for cryptocurrency prices. Ethereum has become a platform underlying many distributed applications, and its concept of smart contracts has gained traction outside its own ecosystem.6

However, cryptocurrencies’ volatile prices and episodes of outright theft as a result of security loopholes have limited wider adoption. Bitcoin’s option-implied volatility fluctuates between 50 and 150 percent, compared with a roughly stable 10 percent range for most U.S. dollar pairs for fiat currencies. The famous 2016 bug in the DAO (decentralized autonomous organization) contract on the Ethereum network, which resulted in a $150 million theft of Ether, was exploited using callbacks — computer code automatically triggered when specific events occur, a key component of a “smart” contract.7

Cryptocurrencies are just one aspect of the rapid evolution of the payments infrastructure. Banks and technology companies have continued to seek new ways for consumers and businesses to
settle payments, and new systems have proliferated. In China, digital wallets such as Alipay and WeChat Pay now dominate most retail transactions — including panhandling.¹ In the U.S., Venmo (backed by PayPal) and Zelle (owned by a banking consortium that includes JPMorgan Chase & Co. and Bank of America Corp.) allow instant transfers between bank account holders within the country. There are four payment platforms in Singapore alone, with different bank partners that use various transfer modes, ranging from internet banking and instant messaging to QR code scanning, a kind of bar code with a matrix of dots.

These services all compete with cash, and in a sense they are winning. More people are becoming cashless. There is no single, cross-country comparable statistic to measure the usage of cash in an economy’s transactions. But in an International Monetary Fund working paper, authors Tanai Khiaonarong and David Humphrey focused on the share of cash withdrawals in total cash and cash-like payments — their preferred measure of cash usage.² They estimated that from 2006 to 2016, cash use fell annually by an average of about 3 percent in the U.S. and 10 percent in China. Using a regression model and survey results citing younger adults’ preference for cashless payments, the authors attributed this decline to demographic changes. This hinted at the limitations of cash in settling payments versus other payment platforms: its physical existence.

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Commercial banks and technology companies are aware of the potential of digital currency and are eagerly pursuing it to achieve strategic objectives. Banks have an early start, having digitized most account information by the 1980s. With their analytic platforms and client data, they have been able to offer services such as financial advisory, fraud detection and quick credit decisions to gain a competitive edge. More recently, tech companies have taken the innovation lead in financial services. They often possess massive amounts of user data from their other services, such as social networking or online shopping, and they recognize that payment platforms or cryptocurrencies will enable them to quickly roll out new services.

For instance, Alibaba’s microfinancing unit, MYbank, has been making small loans directly to consumers and small and medium-size enterprises (SMEs); it can now service the 900 million users in Alibaba’s ecosystem. MYbank uses its data on online shopping habits, bill payment patterns and digital wallet balances — among some 3,000 or so variables — to make credit decisions in seconds.³ Over its four-year history, MYbank has loaned more than $290 billion.

Another example is the Geneva-based Libra Association, which plans to launch a digital currency that it hopes to make financial services and capital accessible to a wider population, thus facilitating international capital movement. Libra aims to create economic value and promote a digital global currency as a public good.⁴ Facebook, the driving force behind Libra — whose founding members also include Spotify, Uber Technologies and Vodafone Group — plans a crypto wallet service known as Calibra that will be built into current services such as WhatsApp and Facebook Messenger. Facebook hopes that as more transactions are made using the Libra currency, many of which will most likely be done within its own ecosystem, more vendors and services will want to participate in the Libra network.⁵

Regulators are on the alert about these private initiatives gestating outside the banking industry. The Chinese government has been fairly open to the idea of private technology companies competing with state-owned banks. However, under Chinese regulations MYbank and similar virtual banks cannot take deposits from customers. Without deposits, 60 percent of MyBank’s liability structure is financed by the interbank market.⁶ Facebook, which already is a lightning rod of contention over privacy issues, has received considerable criticism since its introduction of Libra, including from traditional U.S. and European banks concerned that wide adoption of the new digital currency will draw deposits away from regulated banks and undermine central bank control over money.⁷

While one goal of these companies is to reward shareholders, governments may still play an important role. Demand for MYbank’s microfinancing exists in part because of the financial exclusion of smaller enterprises and consumers in rural or poorer areas. These customers have been underserved by state-owned banks since the reversal of Chinese financial policies in the 1990s.⁸ One of Libra’s goals is to increase financial inclusion and lower the cost of international fund transfers. Both “financial inclusion” and “cheap international capital movement” can be considered public utilities that governments are arguably better at providing. Also, social welfare payments and tax collection may be easier to manage with a digital currency, especially for a disadvantaged population.⁹

**CHINA TACKLES A CBDC**

In 2014, the People’s Bank of China established a working group to look into digitizing the paper currency invented ten centuries ago. The central bank focused on digital currency and its technology,
governance and impact on the existing banking system. In January 2016, the PBoC announced a digital currency conference, urging its research team to tackle early-stage technical work and establish effective protocols and tactical objectives, with the goal of issuing its own CBDC. In September of that year, the PBoC officially banned private cryptocurrencies and related activity, such as initial coin offerings (ICOs). Following news reports about Chinese censorship of anti-blockchain sentiment, Caijing, a Chinese magazine covering politics and economics, reported in December 2019 that the PBoC was prepared to set up a pilot program in Shenzhen and Suzhou. Much like the advent of paper currency in the Song Dynasty, CBDC in China is being developed out of a sense of necessity, aided by technology. This time, however, the stakes go well beyond mere credit creation or enhancement of the payment system.

A January 2019 paper published by former PBoC researcher Yao Qian discussed the challenge faced by central banks operating in a modern banking system, and provided a glimpse into how a CBDC could be designed to solve those problems. A central bank can try to manage the value of a currency by expanding or contracting its money supply, though commercial banks allocate the flow of money to the economy. Despite the ballooning of central bank balance sheets because of quantitative easing after the 2008–09 financial crisis, most new money in the U.S. and China flowed directly to asset markets or stayed within the financial system rather than feeding the real economy. This is contrary to what central banks normally wish to achieve through monetary policy. And there are other challenges for conducting effective monetary policy — notably, its countercyclical nature and the difficulties in managing public expectations.

Yao argues that these problems reflect inherent weaknesses in traditional fiat currencies. He labels these flaws “weak traceability,” “homogeneity” and “real momentness.” Weak traceability refers to the difficulty of tracking the flow of money in a banking system and the real economy. Homogeneity involves the difficulty of earmarking currency for transactions in certain activities (the real economy rather than asset markets, for example); real momentness captures the challenge of earmarking currency for transactions within specific time frames.

**TRACEABILITY AND BIG DATA**

Unlike a fiat currency, a digital currency is by its nature traceable. Much like a radioactive tracer used to establish flow profiles in oil wells, digital currencies can show the movement of money in an economy. In addition, digital currency can carry metadata about itself, building a record of the trail of transactions as it changes hands. Policymakers can learn not only the money flow but also what types of transactions the currency participates in, from capital investment to consumer spending to commodity speculation. These possibilities should intrigue economists and policymakers, who have long been mired in the delay and inaccuracies of economic data. A February 2017 Bloomberg report noted that with CBDC, “[t]he PBoC and therefore the government would have real-time readings on the pulse of consumers. Policies could then be fine-tuned on a day-to-day, even an hour-to-hour basis, giving an unprecedented level of precision to monetary management.” Just as the concept of gross domestic product was invented in the 1930s to aid the administration of U.S. President Franklin Roosevelt during the Great Depression, CBDCs can produce a much more granular and timely picture of current markets and economic behavior.

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The advantage of a traceable currency goes beyond monetary policy. Kenneth Rogoff, a Harvard University professor of economics and public policy, noted in an op-ed, “The High Stakes of the Coming Digital Currency War,” that a CBDC will allow the Chinese government to see everything that is happening within and beyond its borders. He cautioned that by the time China releases its CBDC, the U.S. will not have a similar capability; this will put at risk the U.S.’s ability to use the dollar’s global role to advance its national interest and international policy aims. The ability to see anything and everything that is going on is a clear advantage from a government’s point of view, in both domestic and foreign affairs.

**THE POWER OF PROGRAMMABILITY**

As far as monetary policy is concerned, traceability is only one side of the digital coin. The other is the question of “What can central banks and governments do with the resulting Big Data?”

By nature, digital currency is not only traceable but programable. Yao proposes four programmable functions of money: time contingency, sector contingency, loan rate contingency and economic state contingency. In other words, digital money can be programmed in such a way that it can be targeted to reach specific sectors within a specific time span at a specific rate that’s subject to specific economic conditions. The programs that run on each unit of digital money give monetary policymakers additional tools. Unlike the aggregate money supply that most central banks now manage, a programmable currency can control the allocation of new money. Not only will central banks be able to target the interbank interest rate, they’ll also be able to set different borrowing rates for different sectors at different time horizons under different market conditions. The number of such
Much like a radioactive tracer used to establish flow profiles in oil wells, digital currencies can show the movement of money in an economy. Programs probably goes beyond the four Yao cites, and the effects on the economy of these new levers of monetary machinery are not well understood. Yao speculates that some kind of machine learning algorithm may be employed to determine the functional relationship among these levers and the economic variables that policymakers measure.

Invisible, Visible and Algorithmic Hands

There are other benefits of a programmable CBDC. The Association of German Banks published a proposal in October 2019 urging the European Central Bank to start considering a programmable digital euro.21 Buried in the proposal is the idea of a smart contract, borrowed from Ethereum. A programmable CBDC could be the backbone for the implementation of smart contracts, in which contractual and monetary obligations are carried out automatically. As more people and companies move consumption and services online and more devices are connected to the internet, the direct embedding of contracts into the currency can facilitate these transactions.

One reason the PBoC is powering ahead with a CBDC may be President Xi’s directive, offered at the Third Plenum of the 18th Central Committee of the Communist Party of China in November 2013: “We should make good use of the roles of both the market, the ‘invisible’ hand, and the government, the ‘visible’ hand.” The new programmable CBDC will empower the visible hand of the Chinese Communist Party, giving it more tools to nudge its economy and society in the direction it deems appropriate. Western observers may argue that the use of these new tools represents overreaching by the Chinese government and a threat to a laissez-faire economic system and to personal liberty and privacy. However, both views may be ignoring the role of what could be the most consequential development of the 21st century: the algorithmic hand.

What no one has yet addressed is just how powerful the combination of traceability and programmability is. Traceability grants policymakers real-time feedback from the economy about money flows; programmability provides them instantaneous response tools they can use to direct these flows. Currently, policymakers have to wait a few quarters to see money move into the economy through the banking system, and they have only a few tools to change bank lending behavior. With a digital and programmable currency, both feedback and policy could take place all but instantaneously and simultaneously. As an economy overheated, the central bank could lengthen the time period before the money was lent out to consumers. As a housing market cooled, the central bank could lower minimum loan rates for mortgage borrowers. These are the visible hands of the government. However, just because the government was in possession of powerful monetary tools does not mean it would use them correctly.

In any case, the system created by large amounts of Big Data and new policy responses could soon become overwhelming for any entity to comprehend, let alone control effectively. In this scenario, one can easily imagine a future in which governments rely on reinforcement learning systems to adjust and learn the optimal monetary policy, with continuous feedback. In the two examples above, the algorithm might suggest that as the economy overheated (measured by real-time price feedback, for example, as digital currency tracks the cost of all household goods in real time) the optimal policy would be to lower interest rates on consumer deposits, perhaps even charging a negative rate. As the housing market cooled (measured by real-time real estate transactions, using smart contracts embedded in the CBDC), the algorithm might suggest lowering the minimum loan rate the bank could extend to mortgage borrowers with certain credit scores.

The Emergence of Interdisciplinary Studies

The fields of economics and public policy may be forever changed by the spread of CBDCs. In recent decades, the economics discipline has been heavily driven by mathematical models, while economists have been accused of suffering from “physics envy” for building elaborate mathematical models that often lack empirical support or are based on unrealistic assumptions about economic agents. However, higher-frequency data of better quality can benefit economic research. For example, a dynamic stochastic general equilibrium (DSGE) model proposed in 1978 had 97 equations, with most of the variables unobservable, at least in a timely manner. A simpler DSGE model still uses variables with low-frequency data, such as real GDP, inflation and real wages. The real-time availability of these data can change the way this type of model is researched and developed. In the Big Data era, the Taylor rule, a longtime central bank policy model that linearly relates the policy rate to the level of output gap and inflation, can finally be upgraded. Central bankers have historically lamented that they have only one tool — the policy rate — but two objectives: narrowing the output gap (the difference between real and potential output) and keeping inflation on target. With a programmable currency, meeting both of these objectives may be attainable.

Public policy research that relies on randomized experiments can also benefit from a digital currency.22 Policy choices can be tested — for instance, earmarking money for mosquito-net purchases or accruing a monetary reward for a vaccine, all the while tracking whether the
money has been spent within the desired period of time. The smallest population of randomized experiments is no longer restricted geographically to a town or village but can be chosen to target people in a specific economic class that's diffused geographically.

In addition to public policy and economics, other fields may benefit from the availability of such data. Consider the discovery of the microscope. The instrument was originally called flea glasses because one of its first practical uses was to inspect fleas and other insects on textiles. It was not until Antonie van Leeuwenhoek, a Dutch draper and scientist, developed ways to make superior lenses that microscopes allowed us to see things we had never seen before. That development changed our perception of the world. Having full transaction information could forever alter our understanding of the social sciences.

CONCLUSION

China is one of the first countries to explore creating a CBDC. With available tools to handle Big Data, a complete transactional record could be valuable. Still, most central banks continue to resist moving beyond physical currency. If China’s digital currency initiative can alleviate poverty and show superior technological advantages, it could be very difficult for other countries and their central banks not to follow its lead. ■

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ENDNOTES


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