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**MONEY AND CENTRAL BANK
DIGITAL CURRENCY**

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Abstract

This paper takes an overview of the concepts and features of central bank money and private sector money and focuses on the actual performance of these types of money in selected advanced and emerging economies. In addition, digital coins (crypto assets), such as bitcoin, are newly emerged private sector money. Much attention has been given to digital coins because the underlying distributed ledger technology (DLT) enables a decentralized verification process while maintaining features similar to cash. Some central banks have expressed unease about these digital coins because of the high volatility in their values. However, the size of the newly emerged private sector money currently remains limited due to its limited use as a payment tool. Thus, it is likely to take time before digital coins are a threat to commercial banks and central banks. Meanwhile, some central banks have examined the potential application of DLT and the issuing of their own digital coins to the general public or financial institutions—the so-called “central bank digital currency” initiatives. So far, no central banks have found strong advantages of the initiatives because of several technical constraints. Given that technology has been progressing quickly, however, it is possible that central banks may increase their interest in the central bank digital currency proposals based on DLT and consider actual implementation in the near future. Meanwhile, Sweden’s Riksbank has initiated a separate move by considering the issuance of deposit accounts and prepaid payment methods to the general public in the face of declining cash use. Other central banks have shown little interest in the Swedish initiative because of the potential adverse impacts on the banking system caused by a shift in retail deposits from commercial banks to the central bank.

Keywords: money, central bank digital currency, cash, digital coins, bank deposits

JEL Classification: E42, E44, E51

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1. INTRODUCTION

Money is a financial instrument that fulfills the basic functions as a medium of exchange, unit of account, store of value, and standard of deferred payment. The function as a medium of exchange allows efficient transactions of goods and services among people without forming an inconvenient barter system. The unit of account enables the value of all goods and services to be expressed in common criteria, thereby smoothening the comparison of goods and services and facilitating their transactions. The store of value refers to any asset whose value can also be used in the future because of the ability to maintain its value, thereby enabling people to save to finance their spending at a later date. In addition to these three basic functions, the function as a standard of deferred payment is regarded as an additional important function of money since it enables it to express the value of a debt so that people can purchase goods and services today by paying back debt in the future. To meet these four functions, money must be durable, portable, divisible, and difficult to counterfeit.

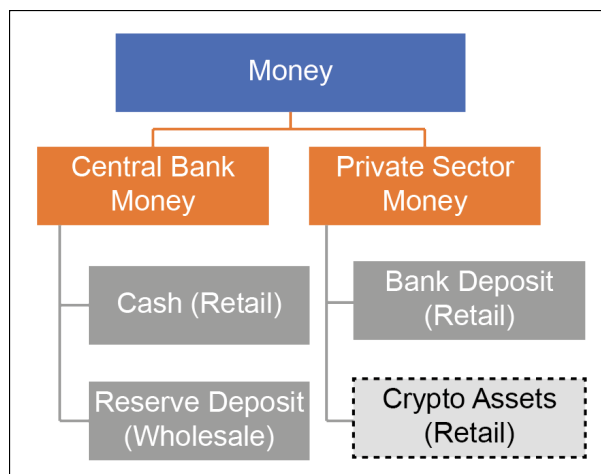
In the contemporary monetary system, the general public (firms and individuals) tends to associate cash (central bank notes and coins) with money. A central bank has the sole right to issue paper notes (fiat money) to the general public and distribute them through commercial banks. While coins are issued mostly by the government as a supplement to central bank notes, in many cases, they are also distributed by a central bank to the general public through commercial banks. Therefore, this paper regards both notes and coins or cash as central bank money. In addition to cash, a central bank issues another type of money to designated financial institutions (mainly, commercial banks) in the forms of reserve balances or current account balances at the central bank. These deposits held by commercial banks and other depository institutions in their accounts at the central bank are called “reserve deposits”. Thus, central bank money is comprised of cash and reserve deposits. In addition, Sweden’s central bank, Riksbank, has currently been investigating the possibility of issuing deposit accounts to the general public in addition to the existing reserve balances issued to financial institutions (this initiative is described in detail later as part of the “central bank digital currency” proposals).

The coverage of money does not stop here since money also includes private sector money (Figure 1). Private sector money has increasingly become important in our daily lives and corporate sector activities. The most important private sector money is bank deposits. Bank deposits can be used to make payments using automated teller machine (ATM) cards, internet banking, and/or debit cards. Bank accounts can also be used to pay credit card companies by allowing the credit card companies to debit payments for bills from the accounts. Developments in digital wallets and cashless devices that enable payments through apps on smartphones by adding debit cards, cash cards, and credit cards have enabled faster and more efficient retail payments.

In addition, new types of private sector money based on distributed ledger technology (DLT) have emerged over the past decade. These are called digital tokens, crypto assets, crypto currencies, encrypted currencies, or virtual currencies. The first and most famous example is bitcoin. These digital coins have caught considerable attention globally because of their potential to serve as a new payment tool and, thus, become part of “private sector money”. While central banks and governments across the globe have not regarded these digital tokens as “money” and have warned the general public to use them with great caution because of the high volatility in their value and, thus, the high degree of risk involved. Nevertheless, they have been paying close attention to the developments. Some central banks have also experimented with the application of

digital tokens in their existing businesses by issuing their own digital tokens. The idea of issuing digital tokens by central banks is called “central bank digital currency” proposals, together with the Swedish initiative to possibly issue bank accounts to the general public.

Figure 1: Classification of Money



Source: Prepared by the author.

This paper takes an overview of the concepts and definitions of money by differentiating central bank money and private sector money as well as shedding light on their developments. The paper also summarizes recent central bank digital currency proposals. The paper is comprised of five sections. Section 2 clarifies the concepts and features related to central bank money and focuses on the actual performance of cash and reserve deposits in four selected advanced economies (the eurozone, Japan, Sweden, and the United States [US]) and two major emerging economies (India and the People’s Republic of China [PRC]). Section 3 clarifies the concepts and features related to private sector money. The features of digital coins are also discussed as part of private sector money. Section 4 sheds light on the details related to central bank digital currency proposals. Section 5 concludes.

2. CENTRAL BANK MONEY AND ACTUAL PERFORMANCE

2.1 Concepts of Central Bank Money

Central bank money refers to the liability of the balance sheets of central banks—namely, money created by a central bank to be used by fulfilling the four functions of money described earlier. Cash used to be the most important means of payment in the past. The amount of outstanding coins issued is much smaller than the amount of outstanding central bank notes in circulation due to the smaller units, so coins are used only for small purchases. Meanwhile, the development of the banking system and technological advances have given rise to interbank payments and settlement systems where commercial banks lend to each other. A central bank manages interbank payments and settlement systems through monitoring the movements of reserve deposit balances at the central bank. The amount of cash is issued based on the quantity demanded by the general public, which is associated with transaction demand

(normally proxied with nominal gross domestic product [GDP]) as well as the opportunity cost (normally a deposit rate paid by the commercial bank to the general public). Thus, a central bank supplies cash passively in response to changes in demand. A central bank provides commercial banks with cash by withdrawing the equivalent amount from their reserve deposit accounts; commercial banks then distribute the acquired cash to the general public on demand through windows of bank branches and/or ATMs.

Reserve deposits can be decomposed into *required reserves* (the amount set under the statutory reserve requirement system) and *excess reserves* (the amount in excess of required reserves). Banks use reserve deposits to lend to each other in the interbank market. In normal times, when the effective lower bound is binding, the central bank pays a (positive) interest rate on excess reserves (IOER), and this IOER forms a floor for the short-term market-determined interest rate corridors (while the ceiling is formed by a discount rate charged by the central bank when lending to commercial banks against collateral). The floor in the market interest rate can be established because no commercial banks should be willing to lend to each other at a rate below the IOER.

Both cash and reserve deposits are the safest and most liquid financial instruments held by commercial banks. *Reserve money* (base money or the monetary base [M0]) is comprised of cash and reserve deposits. Cash is regarded as legal tender by governments and central banks for all debts, public charges, taxes, and dues in their respective economies. The value of cash is stable in an economy where a central bank successfully conducts monetary policy in accordance with the price stability mandate (mostly at around 2% in advanced economies) and, thus, avoids substantially high inflation or serious deflation. The value of reserve deposits is also stable and is equivalent to cash in a one-to-one relationship.

2.2 Differences in Features between Cash and Reserve Deposits

While both cash and reserve deposits constitute central bank money, they have different features (Table 1). For example, cash is *physical money*, while reserve deposits are *digital currency*. Digital currency is a type of currency available in digital form, in contrast with physical, visible cash. Moreover, cash is used mainly among the general public (thus called “retail central bank money”), is available 24 hours a day and 365 days a year and is usable anywhere within an economy where the legal tender status prevails. By contrast, reserve deposits are available only to designated financial institutions, such as commercial banks (thus called “wholesale central bank money”) and are used for managing the real-time interbank payments and settlements system. Wholesale central bank money is not necessarily available 24 hours a day or 365 days a year, depending on the computer network system managed by each central bank. With technology advances, central banks have been making efforts to improve systems for enabling faster and more efficient transactions.

From the perspective of users (the general public), the most important difference between cash and reserve deposits is that cash is *anonymous* and cash transactions are *non-traceable* since transactions cannot be monitored or traced by the central bank that issued the cash. In contrast, all the transactions based on reserve deposits are *traceable* by the order of the time sequence of transactions made, since they are a digital representation of money that enables the recording of all footprints. Reserve deposits are *non-anonymous* since they are based on an account-based system that uses an owner register so that information—such as the ownership of money in the respective accounts and the amount of money transfers from one account to the

other—is available fully to a central bank. In addition, cash provides a *peer-to-peer* settlement form, while reserve deposits are non-peer-to-peer settlements as transactions between commercial banks are intermediated by a central bank. Because of anonymity and non-traceability, cash is often preferred by the general public who wish to maintain privacy but is often used for money laundering and illegal activities and tax evasion purposes. Cash handling costs are quite high when considering not only the direct fees (i.e., cost of paper and design fees to prevent counterfeiting) but also the security and personnel cost associated with the maintenance of cash provision and payment services by commercial banks, shops, firms, and individuals.

Table 1: Main Features of Central Bank Money and Private Sector Money

		General Public	Anonymous	Traceable	Peer-to-Peer	24 Hours/365 Days	Interest Rate
Central Bank Money	Cash	0	0	x	0	0	x
	Reserve Deposits	x	x	0	x	Δ	0
Private Sector Money	Bank Deposits	0	x	0	x	Δ	0
Private Sector Money	Digital Tokens (Crypto Assets)	0	0	0	0	0	0

Source: Prepared by the author.

From the perspective of an issuer (a central bank), the most important difference between cash and reserve deposits is the presence or absence of an interest rate. Cash is an interest-rate free instrument, while a positive or negative interest rate can be applied to reserve deposits. It is known that a negative interest rate policy can be a monetary policy tool under the effective lower bound, as has been adopted, for example, by the European Central Bank (ECB), the Bank of Japan, and Sweden's Riksbank. A negative interest rate policy can be applied by a central bank to the IOER and can be more effective if commercial banks pass the increased costs (arising from the negative interest rate) on to their retail bank deposits held by the general public to maintain interest margins and profits. This is likely to happen when the general public no longer utilizes cash (so mainly uses private sector money or bank deposits) and, thus, is unlikely to substitute cash with bank deposits in order to avoid a negative interest rate charged on bank deposits.

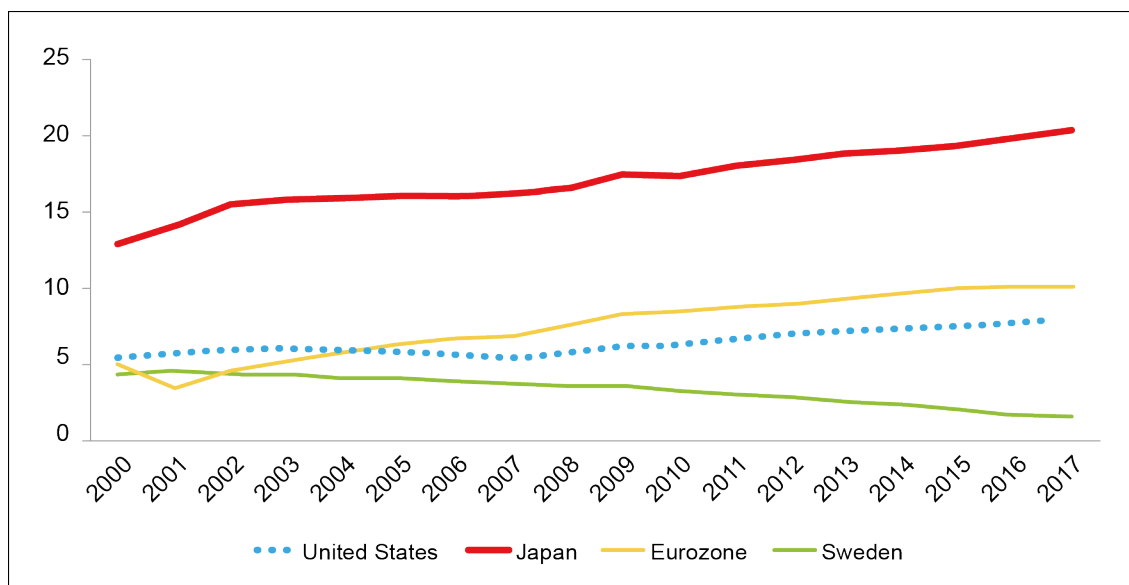
2.3 Actual Performance of Central Bank Money in Advanced and Emerging Economies

The performance of central bank money is examined by focusing on cash and reserve deposits separately. Cash is likely to rise as economic activities (proxied by nominal GDP) grow, reflecting transaction demand. Reserve deposits also tend to rise when greater economic activities are associated with the deepening of the banking system and, hence, an increase in bank deposits. Thus, this paper measures cash and reserve deposits by dividing these data by GDP in order to examine the trend excluding the direct impact coming from greater economic activities.

Figure 2 shows cash in circulation as a percentage of nominal GDP for the period 2000–2017 in advanced economies (the eurozone, Japan, Sweden, and the US). The ratio of cash to nominal GDP declined steadily in Sweden since 2008, suggesting that Sweden has progressed to become the most cashless society in the world. It is interesting to see that the Swedish cash-nominal GDP ratio continued to drop even after a negative interest rate policy was adopted on the repo rate (namely, the rate

of interest at which commercial banks can borrow or deposit funds at the central bank for seven days) from February 2015 (−0.1% initially in February 2015, deepening to −0.25% in March 2015, then further to −0.35% in July 2015 and to −0.5% in February 2016 before increasing to −0.25% in January 2019 as part of normalization). This indicates that substitution from bank deposits to cash did not happen in Sweden despite a negative interest rate.

Figure 2: Cash in Circulation in Advanced Economies
(% of GDP)



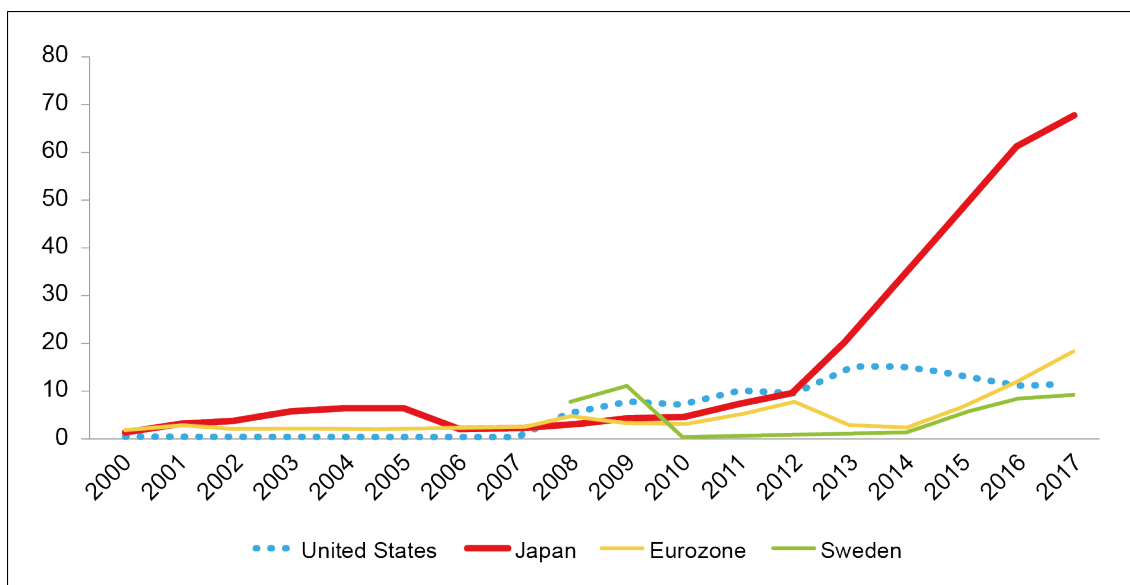
Source: CEIC, US Federal Reserve of St. Louis, IMF.

In contrast, the cash-nominal GDP ratios have risen over time in the eurozone, Japan, and the US. These rising trends were maintained before and after the massive unconventional monetary easing—namely, quantitative easing in the three economies and the negative interest rate policy in the eurozone and Japan. Japan's cash-GDP ratio has been always higher than those of the eurozone and the United States, suggesting that cash is more frequently used in Japan as a means of exchange and store of value. This may reflect that Japan's inflation has remained more or less stable at around 0% or in the moderately negative territory since the late 1990s. Japan's preference for cash may also reflect its long-standing low interest rate since the Bank of Japan implemented a series of monetary easing after the collapse of the stock and real estate bubbles in the early 1990s (see Shirai [2018a, 2018b] for details). It is also interesting to see that cash is growing fast in the US, even after the monetary policy normalization that has taken place since December 2015 with a continuous increase in the federal funds rate.

Regarding reserve deposits, Figure 3 exhibits the ratios of reserve deposits to GDP for the period 2000–2017 in the same four economies. These ratios in the four economies have risen after the global financial crisis of 2008–2009, perhaps reflecting the quantitative easing tool adopted in the presence of the effective lower bound (i.e., large-scale purchases of treasury securities and other financial assets). The US currently faces a decline in the ratio because the Federal Reserve has begun to reduce its balance sheets by reducing the amount of reinvestment on redeemed bonds from October 2017—after having recorded a peak in October 2014 when the process of

“tapering”, or a gradual decline in the amount of financial asset purchases, was completed so that the amount outstanding of reserve deposits reached the maximum of around \$2.8 trillion. The European Central Bank (ECB) initiated net purchases of financial assets from June 2014 and introduced a large-scale asset purchase program in March 2015 but completed net purchases in December 2018 after conducting tapering. From 2019, a full reinvestment strategy will be maintained so that the size of the ECB’s balance sheet will remain the same. Sweden adopted quantitative easing in 2015–2017 and has since continued to engage in a full reinvestment strategy to maintain the amount of holdings of government bonds. Currently, therefore, the Bank of Japan is the only central bank among advanced economies to continue asset purchases and, thus, expand reserve deposits and the balance sheet—although the pace of net purchases dropped substantially since a shift from the monetary base control to the yield curve control in September 2016.

Figure 3: Reserve Deposits in Advanced Economies
(% of GDP)

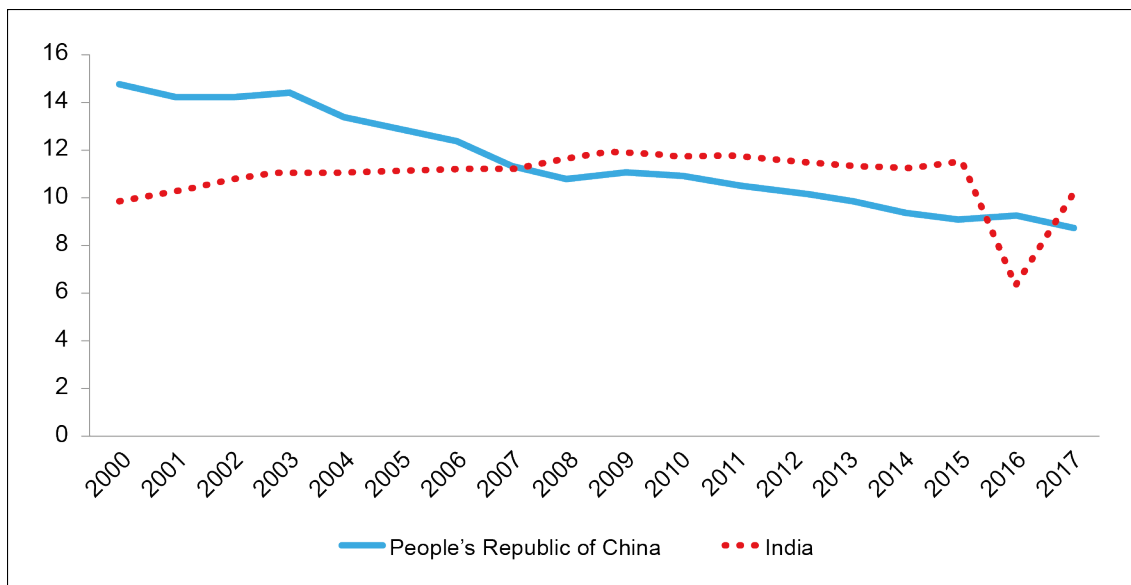


Source: CEIC, Bloomberg, US Federal Reserve of St. Louis, Riksbank, IMF.

In the case of emerging economies (India and the PRC), Figure 3 shows their cash-GDP ratios for the period 2000–2017. The ratios in the two economies have not risen like in the eurozone, Japan, and the United States, even though the amount of cash in circulation has grown rapidly in line with GDP (reflecting transaction demand). In particular, a declining trend in the ratio in the case of the PRC is noticeable, and this is likely to reflect a shift in the money held by the general public from cash to bank deposits or other cashless payment tools in line with the deepening of the banking system and an increase in the number of depositors at commercial banks, as pointed out later. A sharp drop in the ratio in India in 2016, meanwhile, reflected a temporary decline in cash after the government suddenly implemented a currency reform. India’s government banned the Rs100 and Rs500 notes and instead introduced a new Rs500 note and issued new Rs2,000 notes for the first time. This currency reform was meant to fight corruption and anti-money laundering/illegal activities but created severe disruptions to economic activities by creating serious cash shortages. While the cash ratio recovered somewhat in the following year, it appears that the ratio was lower than the past trend, suggesting a moderate shift from cash to bank deposits or cashless

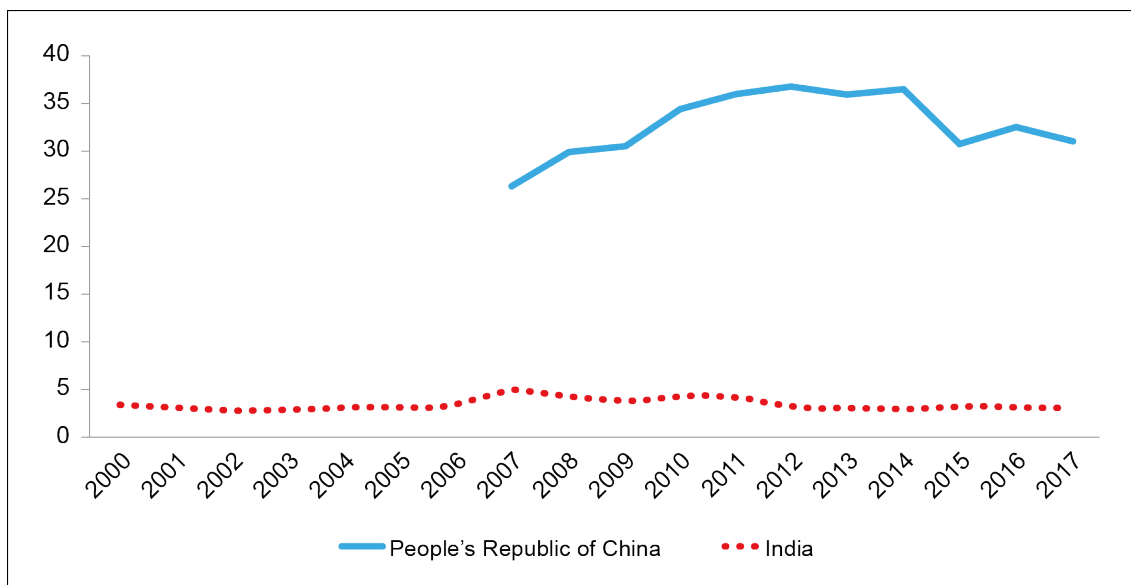
payment tools. Meanwhile, reserve deposits in these two economies have remained stable (data are available only from 2007 in the case of the PRC); and this makes sense since the central banks have not conducted quantitative easing like those in advanced economies.

Figure 4: Cash in Circulation in the People’s Republic of China and India (% of GDP)



Source: CEIC, PBOC, IMF.

Figure 5: Reserve Deposits in the People’s Republic of China and India (% of GDP)



Source: CEIC, PBOC, IMF.

To summarize, central bank money grew rapidly during the period 2000–2017 in the selected advanced economies because of an increase in cash in circulation, with the exception of Sweden. In addition, central bank money expanded significantly as a result of the adoption of large-scale asset purchases as part of unconventional monetary easing tools in the face of the effective lower bound. Meanwhile, cash in emerging economies has grown rapidly but does not show a rising trend when cash is measured in terms of nominal GDP. India’s cash-GDP ratio remained stable until 2016, suggesting that India’s cash growth is associated with transaction demand. The 2016 currency reform created a sudden decline in the ratio. The ratio since then has recovered but appears to be lower than the previous trend. The declining trend is more visible in the case of the PRC, and this appears to reflect a shift in the payment tool used by the general public from cash to bank deposits or other cashless payment tools (such as Alipay or WeChat Pay), which has contributed to the banking sector deepening as the prepaid system is linked to bank accounts. Reserve deposits in the emerging economies have remained stable due to a lack of an unconventional asset purchasing program. Overall, central banks in both advanced and emerging economies have continued to issue ample central bank money for various reasons.

3. PRIVATE SECTOR MONEY AND ACTUAL PERFORMANCE

3.1 Concepts of Private Sector Money and Bank Deposits

Private sector money mainly takes the form of bank deposits or deposits held by the general public at commercial banks (so-called “retail private sector money”), as shown in Table 1. Bank deposits are liabilities for commercial banks and are financial assets for the general public. While bank deposits are not legal tender, their values are denominated in legal tender and can be exchanged at a one-to-one value and are, thus, stable. Nonetheless, they are riskier than cash because the issuers are private sector financial institutions that could go bankrupt and might not fully reimburse cash from bank deposits—although the deposit insurance system guarantees up to a specific amount of bank deposits of a failing bank per depositor. Similar to reserve deposits, bank deposits are *non-anonymous* and transactions are *traceable* since the commercial banks that issue bank deposits can monitor all the transactions of depositors and trace their transactions by the time sequence in which they were made, as shown in Table 1. Bank deposits are also digital currency, so a positive interest rate can be applied. A negative interest rate is technically applicable, but commercial banks generally refrain from charging it for fear of losing clients. Thus, banks may increase charges on their services (such as ATM usage and transfer fees) instead of directly charging a negative interest rate. Real-time fast settlement systems are increasingly available 24 hours a day, 365 days a year for retail bank depositors in many countries, including India, Japan, the PRC, the Republic of Korea, Singapore, Sweden, Switzerland, Turkey, and the United Kingdom.

The size of bank deposits is generally much larger than the size of central bank money due to the large number of financial institutions and their sheer asset sizes, as shown later. This is also because bank deposits can also be expanded through the *money creation* activities of commercial banks, which generate deposits and loans. Namely, new bank deposits are created when commercial banks extend new loans to firms and individuals, which in turn deposit those proceeds and, thus, increase the size of bank deposits. Commercial banks are the major entities engaging in money creation as depository institutions.

The money stock or money supply is defined as a group of safe assets that the general public can use to make payments or to hold as short-term investments. The money stock can be measured in a narrow or a broad sense (normally using M1, M2, M3, M4, etc.) and are comprised of cash, bank deposits, and other liquid assets. M1 is a narrow measure of money and is comprised of cash, demand (or checkable or transaction) deposits, and traveler's checks. Demand deposits can be withdrawn immediately without penalty so that both cash and demand deposits are viewed as a proxy for spending for goods and services in the economy. Broad measures of money, such as M2, cover M1 plus less liquid bank deposits, such as savings deposits, small-denomination time deposits, and retail money market fund shares. The detailed components of M2 and broader measures of money (such as M3, M4) can be different among central banks, depending on financial market conditions. Some countries include M2 plus long-term time deposits and foreign-currency deposits of residents in the measure of M3. M4 could include M3 plus certificates of deposits, repos, and securities with a maturity of less than five years held by nonbank firms and individuals. It should be noted that various cashless payments, such as digital wallets and prepaid payment systems, do not add to the measures of money since they do not create money. Credit cards are not included in the measures of money since they are loans.

3.2 Monetary Policy Relating Private Sector Money with Central Bank Money

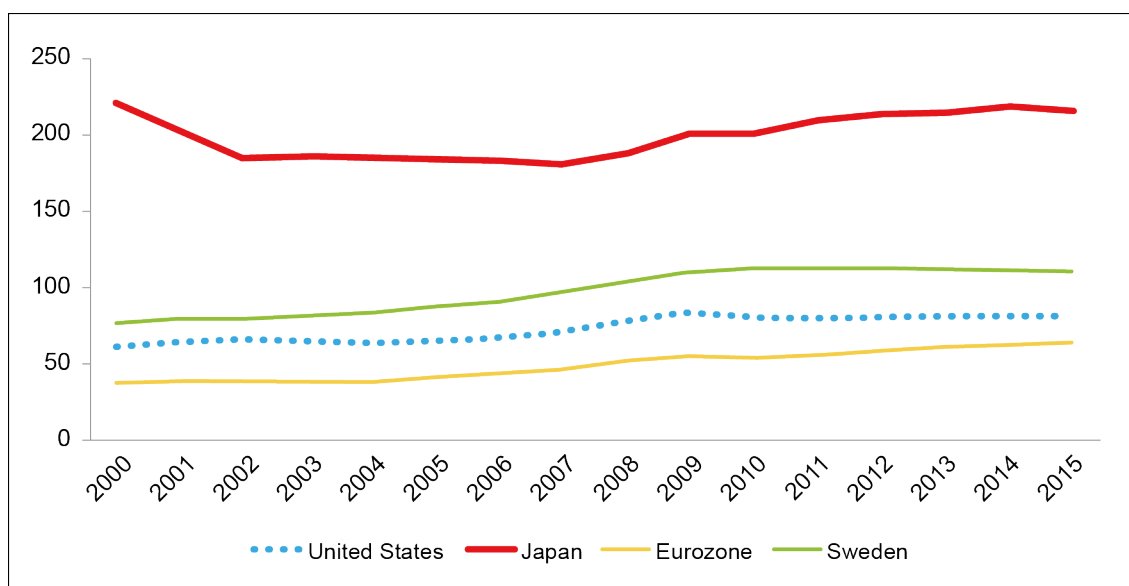
Central bank money (especially reserve deposits) and private sector money (bank deposits) are associated closely through the monetary policy conducted by a central bank. In normal times, a central bank attempts to influence commercial banks' money creation activities and money stock by encouraging (or discouraging) commercial banks to extend loans to the general public. In a recessionary (or expansionary) phase, the central bank attempts to cut (or increase) the short-term market interest rate. The central bank lowers (or raises) the market interest rate by purchasing (or selling) government securities in the open market, or alternatively, by increasing short-term liquidity-providing operations and loans to commercial banks at a lower (higher) interest rate against collateral. The increase (or decline) in liquidity to the interbank market in this manner expands (or reduces) the size of reserve deposits and the monetary base. Bank deposits and money stock will then increase (or decline) as long as commercial banks extend (or contains) new loans to the general public and, thus, create (or reduce) new bank deposits.

Since the global financial crisis of 2008–2009, central banks in advanced economies, such as the eurozone, Japan, Sweden, the United Kingdom, and the US, have adopted quantitative easing or large-scale asset purchases in the face of the effective lower bound on short-term interest rates. Quantitative easing directly increases the size of reserve deposits and the monetary base on a substantial scale. If commercial banks increase bank loans as a result of quantitative easing, an increase in the money stock may expand aggregate demand and, thus, inflation. Alternatively, quantitative easing could increase aggregate demand and money stock by raising various asset prices (such as stocks and real estate) or promoting portfolio rebalancing effects—even if a substantial increase in reserve deposits or the monetary base may not give rise to an increase in the money stock proportionally (McLeay et al. 2014).

3.3 Actual Performance of Bank Deposits in Advanced Economies and Emerging Economies

The performance of private sector money is assessed based on the performance of bank deposits. Bank deposits may rise when economic activities expand as firms and individuals may increase access to bank accounts and increase the number of those accounts. Like central bank money, therefore, bank deposits are measured as a percentage of nominal GDP to examine the trend after excluding the direct impact of economic activities. Figure 6 exhibits the ratios of bank deposits to nominal GDP in the same advanced economies (the eurozone, Japan, Sweden, and the US) for the period 2000-2015. Japan's ratio has remained the highest among the four economies, suggesting that Japan's financial system is bank-dominant with ample deposits held by individuals and firms. About half of households' financial assets have been allocated to bank deposits in Japan, and this ratio has remained roughly the same even after the retail deposit rate dropped significantly to nearly 0% as a result of quantitative easing or yield curve controls (Shirai 2018a, 2018b). The eurozone faces the second-highest ratio, mainly reflecting the large bank deposits held by German individuals. Like Japanese individuals, German individuals are highly risk averse, so about 40% of their financial assets are allocated to cash and bank deposits. In contrast, Sweden faces the lowest ratio, suggesting that the financial system is less bank dominated, and commercial banks are more dependent on wholesale financing (rather than retail deposits).

Figure 6: Private Sector Bank Deposits in Advanced Economies
(% of GDP)

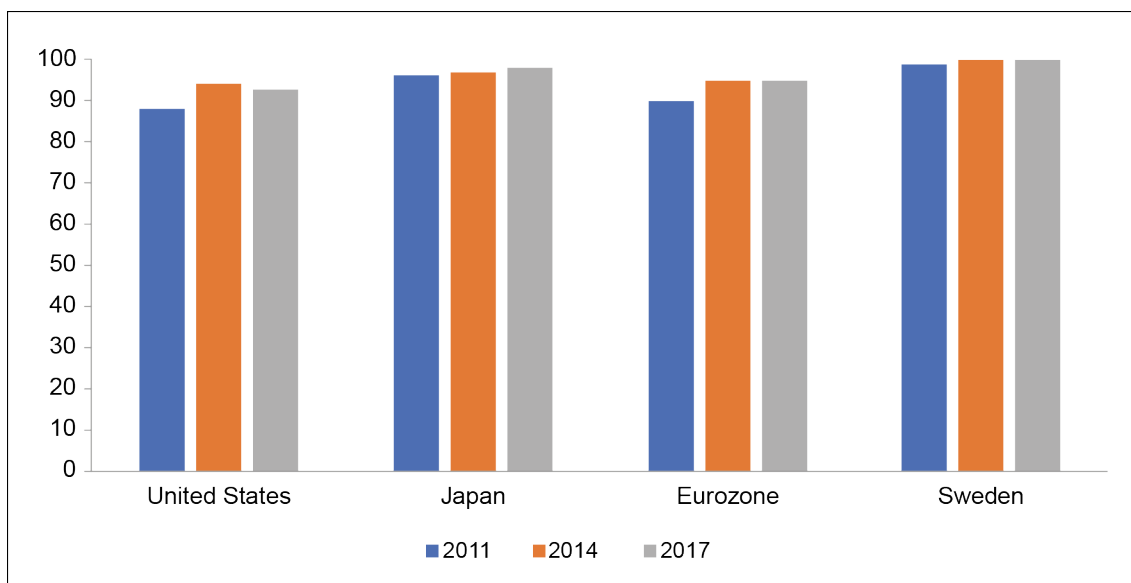


Source: CEIC, datamarket.com, ECB, IMF.

All the four economies have experienced a rising trend with regard to the ratio of bank deposits to nominal GDP, especially after the global financial crisis. This rising trend does not appear to reflect a deepening of the banking system. Figure 7 refers to the percentage of respondents who reported having an account (by themselves or together with someone else) at a bank or another type of financial institution or reported personally using a mobile money service in the past 12 months in the periods of 2011,

2014, and 2017. Figure 7 indicates that these ratios remained roughly the same over the period, suggesting that the banking systems were already well-developed and deepened a long time ago in these economies so that most of the general public already had access to bank accounts and other cashless payment tools. As a result, a large increase in the number of deposits (a sign of banking sector deepening) did not take place during the period surveyed. Namely, the rising trend in the bank deposits-nominal GDP ratio appears to reflect other factors, such as amplified risk averse behavior and the resultant shift from risky assets (such as stocks, investment trusts, and funds) to safer assets. Bank deposit growth may also have happened as part of money creation driven by unconventional monetary easing—although the growth rates of bank deposits (hence, the monetary base) were much smaller than those of reserve deposits in the four economies—suggesting a decline or sluggish money multiplier effect.

Figure 7: Deposit Account Ownership
(% aged 15 years old or above)

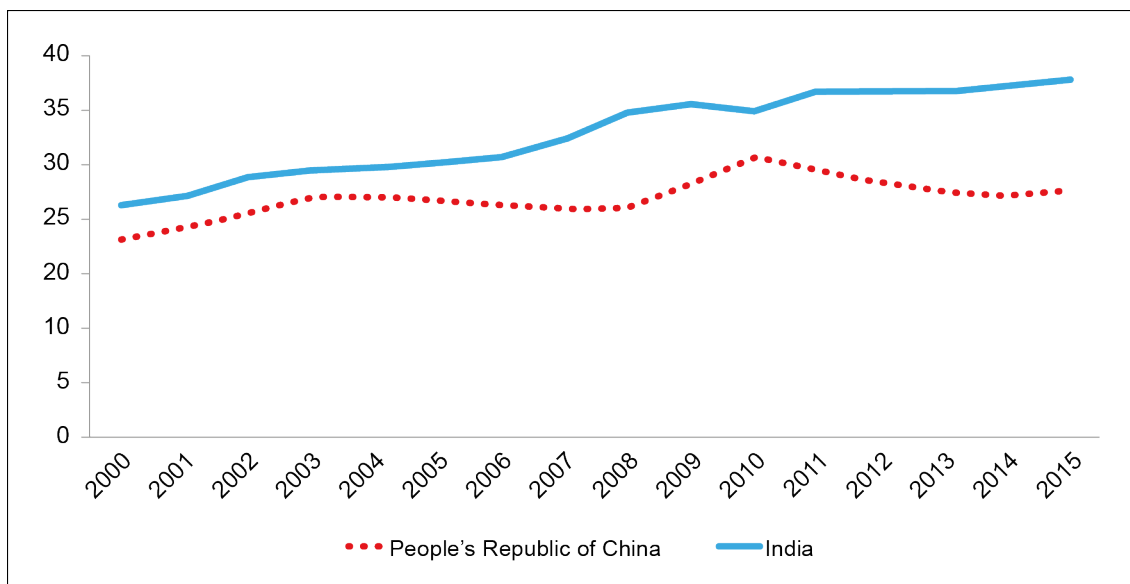


Note: Account ownership refers to the share of the population aged 15 years old or above that have an individual or jointly owned account either at a financial institution or through a mobile money provider over the past year.

Source: World Bank (The Global Findex Database 2017).

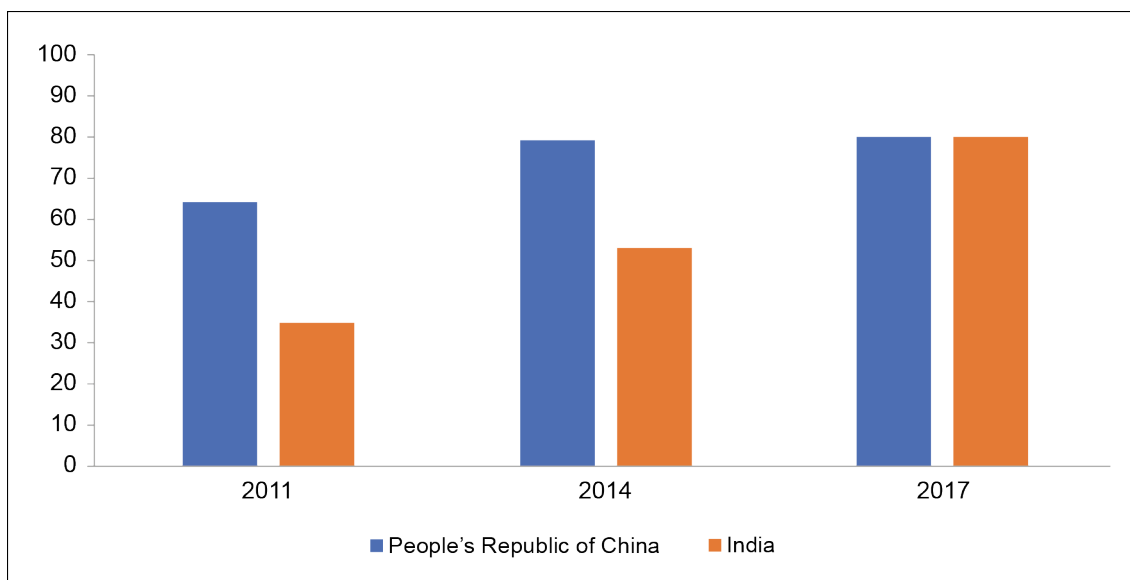
In the meanwhile, emerging economies may have different developments. Bank deposits as a percentage of nominal GDP steadily increased in India over the period 2011–2015. The ratio also increased in the PRC despite fluctuations during 2000–2015 (Figure 8). This may reflect deepening of the banking system in the two economies so that the general public significantly gained access to bank accounts or mobile payment services in 2011, 2014, and 2017 (Figure 9). The increased use of digital wallets using mobile phones may have contributed to an increase in the number of depositors and increased access to the banking system. Given that their reserve deposits–nominal GDP ratios remained the same, an increase in the bank deposits-nominal GDP ratio indicates that money creation activities were greater than those in the advanced economies.

Figure 8: Private Sector Bank Deposits in the PRC and India
(% of GDP)



Source: datamarket.com (taken from the World Bank), IMF.

Figure 9: Deposit Account Ownership
(% aged 15 years old or above)



Source: World Bank (The Global Findex Database 2017).

3.4 Private Sector Money and Digital Tokens

In addition to existing central bank money and private sector money, there is newly emerging private sector money in the form of digital tokens (or crypto assets, crypto currencies, encrypted currencies, or virtual currencies). These tokens are generally issued by independent “miners” (or nodes) based on the DLT, which records transactions between two parties and shares the information among any participants in the DLT network and synchronizes the transaction data in an electronically distributed

ledger in a traceable and unfalsifiable way. The innovative nature of this technology lies in the mechanisms in which the process to verify transactions (such as the payment or transfer of digital coins) is conducted by unknown, independent third parties (namely, nodes) without relying on a central manager or register (such as a central bank or a commercial bank that manages the system). Blockchain is a type of distributed ledger where each transaction between two parties is proven to be true using encryption keys and digital wallets; then, the numbers of the transactions are recorded on a new electronic distributed ledger, which is then connected through a chain (using hash functions) to previous, proven distributed ledgers using the proof-of-the-work process in such a way that makes the falsification of transaction data difficult.

The most famous private sector digital coin is bitcoin, the first digital token based on the blockchain technology introduced in 2008 by Satoshi Nakamoto. There are currently over 2,000 digital coins, whose features vary substantially. These tokens have their own units of account that are universal across countries using the same tokens, with systems that enable instantaneous cross-border transfers of token ownership. Those tokens can be exchanged for some goods and services in many countries.

One of the attractive features of digital tokens is their similarity to cash, since peer-to-peer transactions can be made instantaneously and are available 24 hours a day, 365 days a year (see Figure 1, Table 1). All the transactions are anonymous, like cash, but are technically traceable, in contrast with cash. Unlike cash, meanwhile, digital tokens are digital money, so a positive or negative interest rate can be applied. Although this interest rate-bearing feature makes digital tokens superior to cash, one distinct feature of cash over digital tokens is the relative ease of verifying peer-to-peer transactions. This is partly because cash is designed by a central bank (or a government in the case of coins) in a way that is not easily falsified, and partly because cash recipients (such as commercial banks, shops, and individuals) just need to check carefully whether cash received is authentic, while digital tokens require more complicated verification approaches.

Central banks and regulatory authorities around the world so far do not regard these private digital tokens as “money” and have called for greater caution by the general public in using or investing in them because of the extreme volatility in their values and their limited use as a medium of exchange. Also, consumers and investors are not well-protected since a regulatory framework is almost non-existent. Nonetheless, the DLT has the potential to apply to many different fields, not only for payment and settlement systems but also for promoting trade finance, insurance, and other fintech services; tracking producers of industrial/agricultural products and commodities; and the ownership of real estate and precious metals. As the technology evolves day to day, and various new digital tokens have been issued with diverse features, DLT could conquer technical and legal problems in the future, such as 51% attack and double spending problems; scalability; substantial energy consumption; substantial volatility in the values; vulnerability to cyberattacks; potential anti-money laundering and illegal activities, etc.

According to CoinMarketCap,¹ the size of the market capitalization of existing digital coins is estimated to have reached about \$113 billion by the end of January 2019, of which bitcoin accounted for about 54% of the total market capitalization. The size of digital coins remains much smaller than central bank money and private sector money since their use as a payment tool remains limited. Moreover, money creation is not permitted by digital token exchanges and developers (since a banking license is necessary and no financial authorities have issued a license so far). Thus, they

¹ Data are available from <https://coinmarketcap.com/>.

have generated little threat to both central banks and commercial banks issuing traditional money.

There has been an interesting development by the Swiss Financial Market Supervisory Authority (FINMA). In February 2018, FINMA published guidelines regarding the regulatory framework for initial coin offerings (ICOs). An ICO refers to a mechanism in which investors transfer funds in the form of cryptocurrencies to the ICO organizer and in return receive a quantity of blockchain-based digital tokens that are created and stored in a decentralized form (either on a blockchain specifically created for the ICO or through a smart contract on a pre-existing blockchain). In December 2018, furthermore, the Swiss Parliament permitted the FinTech license for fintech financial services providers (a company limited by shares, a corporation with unlimited partners, or a limited liability company, in addition to the requirement that a company has its registered office and conducts its business activities in Switzerland) to accept public deposits of up to SwF100 million under the conditions that those deposits are not invested and paid an interest rate. FINMA has begun to accept license applications from 2019. This means that fintech companies are not allowed to engage in money creation using digital coins but are given greater opportunities to expand their businesses.

4. CENTRAL BANK DIGITAL CURRENCY PROPOSALS AND PROSPECTS

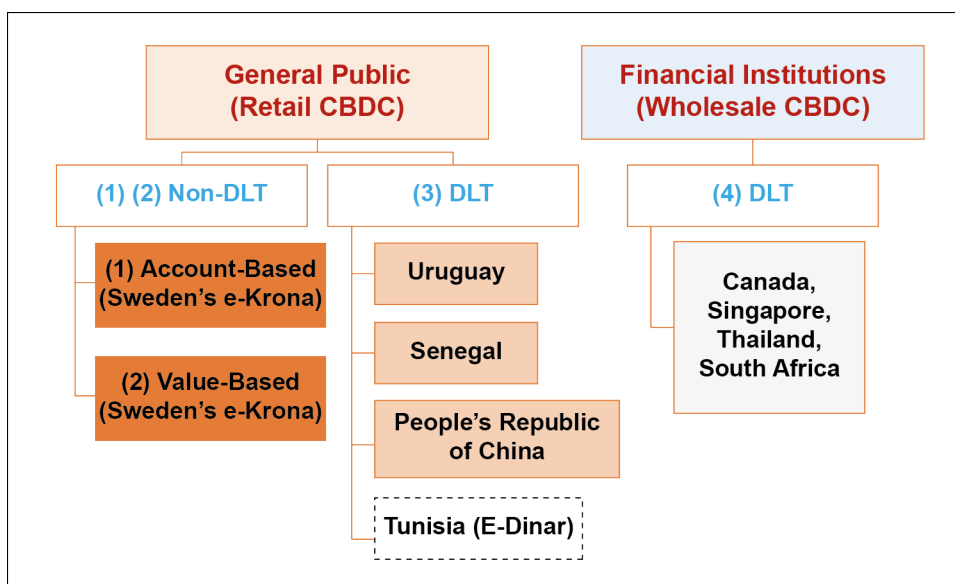
The emergence of private sector digital tokens issued to the general public has prompted intensive debates over whether they could become money in the future. In addition, another heated debate has risen about whether central banks should issue their own digital tokens. The idea of central banks issuing digital tokens—nowadays called central bank digital currency (CBDC) proposals—can be classified into “retail CBDC” (issued for the general public) and “wholesale CBDC” (issued for financial institutions that hold reserve deposits with a central bank). CBDC could be a new interest-bearing liability for central banks.

4.1 Four Proposals on Central Bank Digital Currency

It is interesting to find that the International Monetary Fund (IMF) has begun to examine the potential innovative nature of digital coins (crypto assets) and has supported CBDC proposals more positively. Christine Lagarde, Managing Director of the International Monetary Fund, for example, urged central banks to consider CBDC in November 2018 since they could satisfy public policy goals, including financial inclusion, security/consumer protection, and privacy in payments (Lagarde 2018).

In my view, the ideas on CBDC discussed around the world can be classified into proposals related to “CBDC not based on DLT” and those related to “CBDC proposals based on DLT”. The CBDC proposals could be further differentiated between those targeting the general public (namely, “retail CBDC”) and those targeting financial institutions (namely, “wholesale CBDC”). Figure 10 summarizes all the CBDC proposals by classifying them into the following four types: (1) account-based retail CBDC without DLT, (2) value-based retail CBDC without DLT, (3) retail CBDC based on DLT, and (4) wholesale CBDC based on DLT. The first two proposals are currently being examined by Sweden’s Riksbank. All of these CBDCs are digital currencies, as described in detail below.

Figure 10: Central Bank Digital Currency Proposals



Source: Prepared by the author.

4.2 Motivations Leading to the CBDC Proposals

Before investigating the proposals, it is important to examine the reasons why some central banks have found it important to examine these four proposals. There are mainly six reasons. First, central banks find it necessary to provide safe, liquid payment instruments to the general public—just like central banks have been doing for financial institutions using reserve deposits for a long time. This is relevant to the first two proposals (1) and (2) without recourse to DLT and seriously considered by Riksbank. Given that the large majority of the general public in Sweden no longer uses cash, Riksbank has found it important to provide a safe, liquid payment instrument equally to both the general public and financial institutions for the sake of fairness in a democratic society. This reflects the concerns that private sector issuers may take advantage of their privileged positions, possibly by increasing fees and lending interest rates and misusing the information obtained from tracking transactions if the general public solely depends on private sector money. Also, if a number of private sector issuers or cashless payment providers go bankrupt as a result of systemic financial crises, the general public may suffer substantially without proper payments and settlements systems and encounter large losses. As a result, the payments and settlements systems, as well as the financial systems, may become less stable and safe.

Table 2 indicates that central bank notes in circulation have dropped to around 1% in Sweden as well as Norway, while those in terms of GDP have exhibited a declining trend in Australia, Denmark Sweden, and Norway in selected advanced economies. According to Riksbank’s survey, only 13% used cash for paying their most recent purchase in 2018, down from 39% in 2010. Sweden is more enthusiastic about the idea of retail CBDC than Norway and has already published the first e-krona report in September 2017 and the second e-krona report in October 2018 and announced its intention to experiment with the e-krona project in the foreseeable future in the 2018 report.

Table 2: Cash in Circulation in Selected Economies
(% of GDP)

	Cash to Nominal GDP Ratio (%)				
	2000	2005	2010	2015	2017
Japan	12.8	16.0	17.4	19.4	20.4
United States	5.7	6.0	6.5	7.8	8.2
Eurozone	4.8	6.2	8.3	9.9	9.9
Sweden	4.1	3.8	3.0	1.7	1.3
Norway	3.1	2.6	2.1	1.7	1.5
Denmark	2.8	3.0	2.9	2.9	2.9
United Kingdom	3.2	3.3	3.8	4.0	4.1
Canada	3.2	3.2	3.4	3.7	3.9
Australia	3.9	3.6	3.5	4.1	4.1
Singapore	6.8	6.9	6.9	8.1	9.5
Republic of Korea	3.4	2.8	3.4	5.5	6.2
People's Republic of China	14.6	12.7	10.9	9.0	8.7
India	9.8	11.1	11.7	11.4	10.1

	Cash (in Billion of Local Currency)				
	2000	2005	2010	2015	2017
Japan	67,620	83,773	86,856	103,120	111,508
United States	584	785	980	1,416	1,607
Eurozone	338	521	795	1,038	1,112
Sweden	98	111	105	73	58
Norway	47	52	54	53	48
Denmark	37	47	53	60	62
United Kingdom	34	46	60	76	84
Canada	35	45	57	75	84
Australia	27	35	48	67	74
Singapore	11	15	22	34	42
Republic of Korea	21,425	26,136	43,307	86,757	107,908
People's Republic of China	1,465	2,403	4,463	6,322	7,065
India	2,129	4,082	9,070	15,699	16,974

Source: CEIC, US Federal Reserve of St. Louis, IMF.

Second, some economies—especially in emerging economies—wish to reduce the cost of printing and managing cash and contain the associated crimes by promoting cashless payment tools. The third proposal (retail CBDC based on DLT) is relevant to this motivation. Substantial money has been spent in each economy, not only on direct paper and design fees (spent so as to reduce counterfeits) but also on the personnel and transportation costs needed to handle cash (at central banks, commercial banks, and shops, and at the individual level) as well as on the security fees paid to reduce robbery, tax evasion, and illegal activities, etc. DLT has the potential to reduce cash handling costs since all the transactions can be made using a digital representation of money and are traceable. The informal or shadow economy is large in many emerging economies, so the governments find it difficult to tax economic activities and cope with illegal and unreported activities. Thus, a shift in central bank money from cash

(physical money) to digital currency is one way to shift the economy from being informal-based to formal-based so that the economy becomes more tax-based, transparent, and efficient. DLT enables anonymity, but CBDC might reduce the possibility of executing unreported transactions and crimes.

Third, financial inclusion is another important motivation for some emerging economies regarding retail CBDC proposals based on DLT in recent years. There is still a large number of low-income people or people living in rural areas who are unbanked and without access to commercial banks and the internet and, thus, use cash as their main payment method on a daily basis. Retail CBDC might promote digitization of the economy and, thus, economic and social development.

Fourth, the use of DLT, such as in the third and fourth proposals, may promote a technological environment and foster the fintech sector. Many emerging economies are keen on developing global financial centers in their cities and regard fostering the fintech sector as one of the most promising routes for fulfilling this objective. While those economies may find it difficult to develop banking systems and capital markets that are comparable to those in advanced economies, fintech services are new and innovative, and the general public may be more eager to use them given that the banking system and capital markets are still in the early processes of development. These emerging economies may have a greater chance of success in DLT and associated fintech development, as seen in the recent rapid-growing activities in the Shenzhen area in the PRC.

Fifth, shifting from cash to digital currency through issuing retail CBDC may enhance the effectiveness of monetary policy (such as a negative interest rate policy under the effective lower bound) because of limiting the scope of cash substitution that could emerge to avoid a negative interest rate. This motive could be fulfilled in the case of the first, second, and third proposals.

Sixth, the efficiency and financial stability gains are feasible, especially with regards to the fourth proposal (wholesale CBDC). Wholesale CBDC has the potential to improve the existing wholesale financial systems—including interbank payments and settlement systems, delivery versus payment systems, and cross-border payments and settlements systems—by speeding up and rationalizing the clearing and settlement processes and possibly reducing the associated cost of transactions and cost of developing/upgrading computer systems. The wholesale financial system could be more stable as a result of limiting the chances of data manipulation and removing a single point of failure problems from the system and the resultant disruption to the systems. Moreover, wholesale CBDC may be able to technically broaden the eligible financial institutions that have access to reserve deposits and, thus, improve the efficiency of the wholesale financial systems—such as insurance firms, pension funds, and other nonbank financial institutions that are normally not eligible to have accounts with a central bank.

4.3 First and Second Proposals: CBDC without Distributed Ledger Technology

Sweden's Riksbank has been the only central bank so far that has been actively considering the first two proposals over the past two years under the so-called "e-krona" project. The first proposal (so-called "account-based retail CBDC") is the issuance of a digital currency to the general public in the form of directly providing an account at the Riksbank. This is similar to retail bank deposits issued by commercial banks since all the receipts and payments of money are recorded in the same way.

The second proposal (so-called “value-based retail CBDC”) is the issuance of a digital currency for which the prepaid value can be stored locally on a card or in a mobile phone application (digital wallets).

All the transactions of both e-krona proposals are *traceable* since an underlying register enables the recording of all transactions and identification of the rightful owner of the digital e-krona (Table 3). This technical feature is regarded as important among central banks to preventing money laundering and criminal activities. Under the value-based system, a register examines whether a payer has the sufficient amount of e-krona to transfer, and all cards and digital wallets must be registered so that both payers and payees can be identified in the same manner that users of private sector bank cards and “Swish” (a fast mobile payment system) can be identified. Thus, transactions under the two proposals are *non-anonymous* because all transactions are identified. One exception of non-anonymity is the case of a prepaid e-krona card, where e-krona are already stored and, thus, can be used as cash and handed over from one user to another. This is allowed as long as the payment amounts to less than €250 (to be lowered to €150 by 2020), as set by the European Union (EU), on the condition that there is no suspicion of money laundering or terrorist financing according to the legislation on money laundering.

Table 3: Features of Central Bank Digital Currency Proposals

				General Public	Anonymous	Traceable
Account-Based	Non-DLT	Retail	Sweden	0	x	0
Value-Based	Non-DLT	Retail	Sweden	0	Δ	0
Digital Token	DLT	Retail	Uruguay	0	0	0
Digital Token	DLT	Wholesale	Canada, Singapore, South Africa, Thailand, Eurozone-Japan	x	0	0
				Peer-to-Peer	24 Hours/365 Days	Interest Rate
Account-Based	Non-DLT	Retail	Sweden	x	0	0
Value-Based	Non-DLT	Retail	Sweden	Δ	0	Δ
Digital Token	DLT	Retail	Uruguay	Δ	0	0
Digital Token	DLT	Wholesale	Canada, Singapore, South Africa, Thailand, Eurozone-Japan	Δ	0	0

Source: Prepared by the author.

For the first and second proposals to be practically implementable for online purchases or in physical shops, Riksbank has stressed the need to develop e-krona payments and a settlement platform for the general public that contains the underlying register for e-krona by interacting with a number of other systems and entities, including commercial banks and other firms. Riksbank plans to experiment with the second proposal first since a value-based CBDC is classified as e-money in Sweden’s existing financial regulation and, thus, is consistent with the mandate of promoting a safe and efficient payments system so that experimentation can be legally feasible in the current legal framework. On the other hand, the first proposal is more complicated since Riksbank may need the Parliament to revise the existing central bank act (Sveriges Riksbank Act) in order to provide Riksbank with the clear mandate to issue an account-based retail CBDC. Riksbank may need to prepare for drawing up proposals for the amendments before conducting any experimentation.

Most of the central banks, including Norway's Noregs Bank, have not expressed interest in these Swedish proposals so far. This is mainly because of concerns that commercial banks may suffer a loss in retail deposits from their accounts to those of a central bank and, thus, lose the financing sources of loans needed to extend credit to firms and individuals. This concern, however, can be mitigated if a central bank pays a lower interest rate to the general public (and financial institutions) than commercial banks do to their retail customers. Another concern is that bank runs may be exacerbated in the event of a crisis by a shift in deposits from commercial banks to the central bank, thereby deepening banking crises. In addition, central bank notes in circulation have continued to rise in most countries except for Sweden and Norway, although those in terms of GDP have dropped in some economies as mentioned before. Thus, there is no urgent reason for other central banks to examine the possibility of account-based and value-based CBDC proposals at this stage.

As for monetary policy, it is possible for Riksbank to technically impose a positive or negative interest rate on the first and second e-krona proposals. In Sweden, however, such an interest rate can be applied to account-based e-krona from a legal standpoint but not to value-based e-krona since the latter is regarded in legal terms as "e-money" and, thus, should be a non-interest-bearing instrument according to the E-money Directive.

4.4 Third Proposal: Retail CBDC Based on Distributed Ledger Technology

Under the third proposal (retail CBDC based on DLT), CBDC has the features of anonymity, traceability, availability 24 hours a day and 365 days a year, and the feasibility of an interest rate application (Table 3). The proposal is relatively popular among central banks in emerging economies, mainly because of the motivation to take the lead in the rapidly emerging fintech industry, to promote financial inclusion by accelerating the shift to a cashless society, and to reduce cash printing and handling costs. Some countries, including Ecuador, India, Israel, Uruguay, Lithuania, the Marshall Islands, Tunisia, and the PRC, have expressed interest and/or conducted experiments in some cases—although enthusiasm at the Reserve Bank of India appeared to have waned in 2019.

4.4.1 Cases of Countries That Have Considered or Experimented with the Third Proposal

Ecuador

The Central Bank of Ecuador, which adopted the US dollar as legal tender in 2000, was a frontrunner in terms of issuing retail CBDC (called "dinero electrónico") in 2014 as an additional payment instrument supplementing the US dollar. The central bank allowed users to open accounts with their identification numbers and transfer money between US dollar and digital token accounts via a mobile app. The government pressed for this initiative as it could save the cost of replacing old US dollar notes with new ones (about \$3 million) and, thus, contribute to economic growth and reducing poverty. However, the retail CBDC initiative turned out to be unsuccessful because of the limited number of users using retail CBDC to purchase goods and services or make payments. Hence, the initiative was terminated by de-activating the underlying accounts in 2017. This reflected the fact that many citizens trusted the US dollar more than the new digital token.

Uruguay

The first and sole practical experiment conducted so far in the world was the case of the Central Bank of Uruguay in 2017–2019 as a six-month pilot study on instantaneous payments and settlements systems using retail CBDC (called “e-Peso”). Using 20 million pesos and converting them to digital currency, the project involved about 10,000 mobile phone users (not necessarily required to connect to the internet), 15 enterprises (such as shops and gas stations), ANTEL (a state-owned telecommunications provider), and a few fintech firms and payment solutions providers. No commercial banks were involved in this study. Users were required to download an app from the website of the national payments company Red Pagos to create a digital wallet and then register it by entering their personal information and creating a PIN code to have access with no charge. Each user (or firm) could charge up to 30,000 pesos (200,000 peso) with e-pesos in the digital wallets, which could then be used to pay bills, receive payments, or transmit money in an easy and secure way so that the e-pesos were secured in the digital wallets even if the phones or the passwords for the digital wallets were lost. All the transactions were anonymous, traceable, and safe so that double-spending and falsification were prevented. The pilot study was completed without any technological difficulties, and the Central Bank of Uruguay concluded that issuing retail CBDC benefited from lower costs, financial inclusion, the prevention of crime and tax evasion, and customer protection, although the experiment was performed on a limited scale. No clear initiatives for actual implementation have been announced.

Lithuania

The Bank of Lithuania (Lithuania’s central bank) examined the retail DLT-based CBDC proposal in 2018 by involving domestic and foreign fintech firms as part of initiatives to develop the fintech industry. The central bank has examined issuing a collector coin using DLT since 2018. Since Lithuania has adopted the euro as legal tender, the central bank is not allowed to issue retail CBDC for wider use as legal tender. Thus, it announced a plan to issue digital collector coins along with physical collector coins commemorating the 200th anniversary of independence from the Russian Federation in 2018. While the central bank holds the view that financial institutions should not engage in crypto asset services, the first international blockchain center in Europe was established and the central bank announced its plan to create a blockchain sandbox platform service (so-called LBChain) in 2018 with the expected launch in 2019. The issuance of the first collectible digital coin to the general public for limited use is likely to happen in 2019. The digital coins can be exchanged among people and also exchanged for euros at the central bank.

People’s Republic of China

The People’s Bank of China (PBOC), the central bank of the PRC, established the Institute of Digital Money in 2017 and has been examining the possibility of issuing CBDC along with the renminbi through commercial banks in a so-called two-tiered system. Yao Qian of the PBOC wrote a report (Qian 2018) in Chinese in 2017 that a digital currency could be integrated into the existing banking system, with commercial banks operating digital wallets for the retail CBDC and the general public able to conduct peer-to-peer transactions like with cash. The report indicated that the digital coins would use a distributed ledger in a limited way to periodically check the ownership and that the ownership of digital coins could be verified directly by the issuing central bank. The report concluded that blockchain technology is not suitable for this purpose due to scalability problems. There are several reasons why the two-tiered system is prioritized in the PRC. First, it is relatively easy to replace cash

since the PBOC supplies cash to the general public on demand through commercial banks. Second, the existing banking system is unlikely to be overturned, so commercial banks have incentives to provide CBDC to the general public—if a deposit rate paid by a central bank is lower than the interest rate paid by commercial banks (Qian 2018). The PBOC has not yet announced any clear plans to conduct a practical experiment.

Tunisia

Tunisia's initiative was promoted directly by the government, so it may not be accurate to regard the initiative as a CBDC initiative. Tunisia took the lead in issuing retail DLT-based digital tokens for its government initiative. La Post—a Tunisian governmental financial institution, but not categorized as a bank—has issued a blockchain-based digital token called “e-Dinar” (a digital version of the Tunisian dinar) since 2015 as a part of the government's e-Tunisia initiative, with support from a Switzerland-based software company and local fintech firms. This is so far the first and only successful case of a digital coin being issued by a governmental body or a central bank in the world. The digital tokens are currently listed on global crypto asset exchanges and can be used in Tunisia to transfer funds, pay for goods and services online, pay for salaries and bills, and manage official identification documents with limited costs—using virtual accounts and transferring funds between virtual accounts and a postal account, and between different virtual accounts, etc. New digital tokens are issued in a decentralized manner through the proof-of-stake process by miners—the process developed to cope with bitcoin's energy-intensive proof-of-work process that requires a large number of calculations—with simple mechanisms that validate a new block.² The issuer also claims that the number of tokens could be sufficient for all residents across the globe despite the maximum number set. The anonymity of transactions is maintained. So far, the digital token appears to have not yet been actively utilized to the extent envisaged in Tunisia.

The Marshall Islands

Another initiative led by a government is in the Marshall Islands, where the US dollar has been the official currency as legal tender since 1982, and no central bank exists. In 2018, the government floated the idea of introducing its own blockchain-based digital token called “sovereign” (SOV) as second legal tender supplementing the US dollar. The parliament passed the Sovereign Currency Act in February 2018 to authorize the issuance. The digital token is to be issued in a decentralized manner by third parties through initial coin offerings (ICOs) with the cap set to 24 million tokens in order to avoid inflation, with support from a fintech startup company in Israel. The main motivation behind this initiative is to prepare for a scheduled decline in grants provided under the US Compact Trust Fund (established by the US government to compensate Marshallese citizens affected by nuclear tests conducted near the country) after 2023 and acquire new revenue sources. Thus, the issuing of ICOs by the government is being considered as an additional revenue source. Nevertheless, the IMF warned vehemently about the issuance of the SOV since it might elevate the anti-money laundering activities through a sole domestic bank existing in the country that already faces the risk of losing its last US dollar correspondent banking relationship with a US-based bank as a result of heightened due diligence by banks in the United States (IMF 2018). The introduction of the SOV may incur reputational risk due to the risk

² In the proof-of-stake process, every node can stake a portion of their held crypto assets in the network. Since this is like storing crypto assets as collateral, those assets cannot be used. If a transaction is bad, the staker (the node that offers crypto assets) would face a decline in its stake. If a node stakes a greater amount, the longer they leave the stake in the network, the greater its chances of being chosen to validate a new block and receive rewards (an interest rate of up to 0.65% per day).

of deteriorating relationships further with foreign banks and the greater risk of money-laundering and terrorist financing. Moreover, criticism on the retail CBDC proposal has emerged and intensified in the Parliament because of the risk of losing the country's reputation after the passage of the Sovereign Current Act. However, Hilda Heine, the President of the Marshall Islands, managed to survive a no-confidence vote (split 16-16 votes) in November 2018, so the government plans to issue the SOV after satisfying the requirements imposed by the IMF, the US, and Europe.

Venezuela

Venezuela is the only country that has issued a government-sponsored digital coin. The digital coin (called the “petro”) was issued in 2018 and is backed by a barrel of oil from the country's substantial oil reserves. The digital coin is complementary to the bolivar as legal tender. The main purpose of issuing a digital coin is to circumvent the financial sanctions imposed by the US on the grounds of corruption and human right violations and to obtain funds from abroad by attracting foreign investors in the face of severely disrupted economic and financial conditions—not targeting the general public. US President Donald Trump has reacted to this initiative by prohibiting transactions using the digital coin. The government has already required distributors of oil products and air carriers to set up digital wallets used to pay and receive funds in petro in 2018 and plans to use the digital coin in its oil exports in 2019. Due to insufficient information, it is not clear whether the digital coin has actually been issued and is functioning. Some media report that investors in the petro have only received petro certificates, not digital coins.³

4.4.2 Viewpoints of Advanced Economies on Retail CBDC Based on DLT

In sharp contrast to emerging economies, central banks in advanced economies—including the Federal Reserve, Bank of Japan, Bundesbank, European Central Bank, and Swiss National Bank—are not enthusiastic about DLT-based retail CBDC (for example, see Cœuré [2018]). This reflects the fact that existing retail payments and settlements systems have become more efficient, faster, and available for 24 hours a day and 365 days per year, so there is no strong case for promoting the proposal, and the potential benefits from using retail CBDC may not be as large as previously thought. Second, the use of cash is not yet declining in many advanced economies (see Table 2) with the exception of Sweden and Norway. Third, almost all citizens are banked in advanced economies, so financial inclusion is not an urgent issue that should be tackled by a central bank. Fourth, many central banks do not wish to create competition between central bank money and private sector money and impose hardships on the existing banking system or amplify the resultant financial stability risk. Finally, central banks in advanced economies are generally more cautious on retail CBDC than those in emerging economies, perhaps because of fear of losing reputation in case of unsuccessful implementation of the initiative. Limited public interest and support for the proposal is also another factor discouraging these central banks from actively considering the proposal.

For these reasons, central banks in Australia, Denmark, and Norway, whose cash in circulation as a percentage of GDP has been dropping as shown in Table 2, have not made a decision to promote retail CBDC at this stage after carefully examining the pros and cons over the retail CBDC proposal and feasibility. Their retail payments and settlements systems are already highly efficient, immediate, and convenient, so they prefer existing private-sector money issued by traditional financial institutions Bank of

³ For example, see the report released in 2018, <https://coinhub.news/cs/article/bitcoincom-maduros-promotion-of-the-petro-yet-to-yield-results>.

Israel 2018; Mancini-Griffoli et al. 2018). The central bank in Israel also issued a report in November 2018 regarding retail DLT-based CBDC (called “e-shekel”) and concluded that the actual implementation should be postponed until other major central banks in advanced economies take the lead, although several potential advantages were identified. The Federal Reserve also does not support the retail CBDC idea (called “Fedcoin”) proposed by Koning (2014, 2016). Under the proposal, the digital token will be supplied on demand along with cash and reserve deposits, and their conversion can be undertaken at par to each other by the Federal Reserve Banks. The total amount of central bank money will remain unchanged since Fedcoin will be created (or destroyed) by destroying (creating) cash or reserve deposits.

4.5 Fourth Proposal: Wholesale CBDC Based on Distributed Ledger Technology

The fourth proposal (wholesale CBDC) is the most popular of the four proposals among central banks because of the potential to make existing wholesale financial systems faster, inexpensive, and safer. The Bank of International Settlements (BIS) also shares the view that wholesale CBDC could potentially benefit the payments and settlements system (Bech et al. 2018).

Some experiments have been already conducted or examined by central banks since 2016—such as those in Canada (called “CADcoin” under Project Jasper), Singapore (Project Ubin), Japan-Euro Area (Project Stella), Brazil, South Africa (Project Khokha), and Thailand (Project Inthanon). Among these central banks, those in Canada, Singapore, South Africa, Thailand have experimented with the proposal by involving a number of private sector financial institutions, fintech firms, consultants, and/or technology firms. The main purpose of these experiments was to promote the central bank’s understanding of the DLT systems and their applicability in the existing wholesale financial markets, such as real-time gross settlement systems, delivery versus payment systems, cross-border interbank payments and settlements systems, etc.

The two frontrunner central banks are the Bank of Canada and Monetary Authority of Singapore, which launched a series of wholesale CBDC initiatives in 2016–2017 in the areas of interbank payments and settlements systems (real-time gross settlement systems) and delivery versus securities systems, etc. Both Canada and Singapore have concluded that their experiments successfully transferred digital tokens on a distributed ledger in real time and in reasonable volumes. Nevertheless, these central banks have not taken further steps toward actual implementation because of the view that the current technology has not yet been sufficiently advanced to cope with the issues related to the protection of privacy. Also, these central banks have the view that the process of verifying transactions could be faster and most cost-efficient if the verifier can be centralized (either through a group of selected commercial banks or a central bank), but then this approach would end up being similar to the existing centralized system (not necessarily becoming superior to the existing system). In addition, their current wholesale payments and settlements systems are already efficient enough, so no strong advantages can be expected from the CBDC initiative.

Subsequently, the Bank of Canada, Bank of England, and Monetary Authority of Singapore worked jointly together with some financial institutions based on Project Jasper and Project Ubin to assess whether wholesale CBDC could enhance cross-border payments and settlements by improving the access, speed, and transparency of payments. The three central banks published a joint report in November 2018 and concluded that further work on implementation and policy

challenges would be required by both industry and regulators despite significant room expected for improvement in the cross-border payments space.

Regarding securities clearing and settlement systems, the Deutsche Bundesbank and Deutsche Börse jointly developed a DLT-based securities settlement platform that enables the delivery-versus-payment settlement of digital tokens and securities. Meanwhile, the Federal Reserve has not shown strong interest in issuing wholesale CBDC, mainly because of the view that the financial system is already efficient and sufficiently innovative.

5. CONCLUSIONS

This paper took an overview of the concepts and features of central bank money and private sector money. Their actual performance was also examined by focusing on selected advanced economies and emerging economies. So far, central bank money has been sufficiently provided. Private sector money (mainly bank deposits) are growing and much greater than central bank money. Meanwhile, digital coins, such as bitcoin, can be considered as newly emerged private sector money. While their use as alternative payment tools remains limited currently, greater attention has been paid to the emergence of digital coins because of the underlying DLT embedded in the digital coins that could enable a decentralized verification of transactions while maintaining attractive features similar to cash. Some central banks and commercial banks have expressed unease about the emergence of digital coins and their popularity partly, because of the high volatility in their values. Their concerns may also reflect the potential loss of users from cash and bank deposits to the fintech firms that develop the digital coins. However, the size of the newly emerged private sector money remains limited, so it is likely to take time before such digital coins are a threat to commercial banks and central banks.

Meanwhile, some central banks have examined the potential application of DLT and issued their own digital coins to the general public or financial institutions under the so-called “central bank digital currency” proposals. However, no central banks so far have found strong advantages of issuing their own digital coins at this stage because of several technical constraints. One isolated move is noticeable in the case of Sweden’s Riksbank, which has been considering the issuance of deposit accounts or prepaid payment tools to the general public in the face of declining use of cash—just like all central banks issue deposits to financial institutions. While this movement has caught a lot of attention among some central banks, other central banks have shown little interest in considering similar initiatives because of the potential adverse impact on commercial banks by promoting a shift of retail deposits from commercial banks to a central bank. Given that technology has been progressing fast in the settlement and payment areas, as well as DLT, it is possible that central banks may increase their interest in retail and wholesale CBDC proposals based on DLT and consider actual implementation seriously in the near future.

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