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MONEY AND CENTRAL BANK DIGITAL CURRENCY

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Abstract

This study reviews the concepts and features of both central bank and private sector money and focuses on them in selected advanced and emerging economies. As a newly emerged form of private sector money, digital coins (cryptoassets) such as bitcoin have garnered much attention because their underlying distributed ledger technology enables decentralized verification while maintaining features similar to cash. Some central banks have expressed unease about digital coins because of their high volatility. However, digital coins are limited in their use as a payment tool. Thus, it is likely to take time before digital coins are a threat to commercial and central banks. Meanwhile, some central banks have examined the potential application of distributed ledger technology 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 to this because of several technical constraints. Given that the technology has progressed quickly, it is possible that central banks may increase their interest in digital currency proposals based on distributed ledger technology. 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

Contents

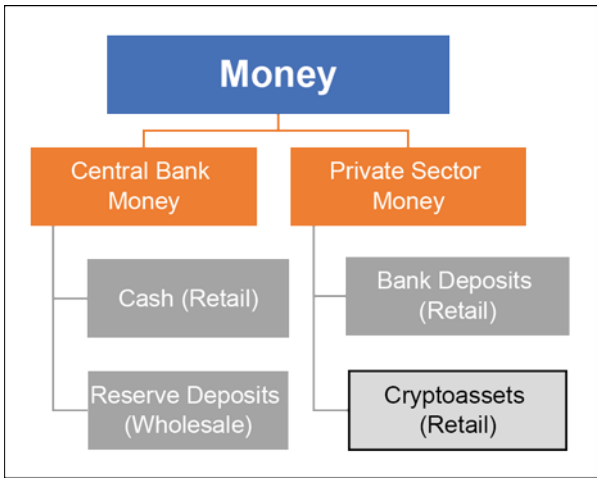
1. INTRODUCTION

Money is a financial instrument functioning as a medium of exchange, a unit of account, a store of value, and a standard of deferred payment. Its role as a medium of exchange allows efficient transactions of goods and services, bypassing an inconvenient barter system. The unit of account enables the value of all goods and services to be expressed in common criteria, thereby easing the comparison of goods and services and facilitating their transactions. The store of value refers to any asset whose value can be maintained in the future, thereby enabling financing spending at a later date. In addition to these three basic functions, the standard of deferred payment is an additional important function of money since it enables purchasing goods and services in the present 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, i.e., 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) and distribute them through commercial banks. While coins are issued mostly by the government to supplement central bank notes, in many cases, they are also distributed to the general public by a central bank 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 money to designated financial institutions, mainly commercial banks, in the form of reserve balances or current account balances, i.e., reserve deposits. In addition, Sweden's central Riksbank has been investigating issuing deposit accounts to the general public (this initiative is described later as part of the central bank digital currency [CBDC] proposals).

The coverage of money now also includes private sector money (Figure 1), which has increasing importance in our daily lives and corporate sector activities. The most important private sector money is bank deposits, which can be used to make payments using automated teller machines (ATMs), internet banking, and/or debit cards. Bank accounts can also be used to pay credit card companies by allowing them to debit payments. Developments in digital wallets and cashless devices that enable payments through smartphone apps have enabled faster and more efficient retail payments.

Figure 1: Classification of Money



Source: Prepared by the author.

In addition, new types of private sector money based on distributed ledger technology (DLT) have emerged over the past decade. These are called digital coins, cryptoassets, cryptocurrencies, encrypted currencies, or virtual currencies. The first and most famous example is bitcoin, which has garnered considerable attention globally because of its potential to serve as a new payment tool and, thus, become part of private sector money. Central banks and governments across the globe have not regarded these digital coins 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 them. Some central banks have also experimented with issuing their own digital coins, i.e., CBDC, along with the Swedish initiative to issue potential bank accounts to the general public.

This paper reviews the concepts and definitions of money by differentiating between central bank and private sector money, as well as shedding light on their developments; it also summarizes recent CBDC proposals. The paper is comprised of five sections. Section 2 clarifies the concepts and features related to central bank money and focuses on the performance of cash and reserve deposits in four selected advanced economies (the eurozone, Japan, Sweden, and the 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 CBDC proposals. Section 5 concludes.

2. CENTRAL BANK MONEY 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 to fulfill the four functions described earlier. Cash used to be the most important means of payment. 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 payment and settlement through monitoring the movements of reserve deposit balances. The amount of cash is 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 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 divided into *required reserves* (the amount set under the statutory reserve 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, which 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 that on excess reserves.

Both cash and reserve deposits are the safest and most liquid financial instruments held by commercial banks, and together constitute *reserve money* (base money or the monetary base [M0]). Cash is regarded as legal tender by governments 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 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 between Cash and Reserve Deposits

While both cash and reserve deposits constitute central bank money, they have different features (Table 1). For example, reserve deposits are *digital currency*, which is available in digital form, in contrast with physical, visible cash. Moreover, cash is used mainly by the general public (thus called "retail central bank money"), is available around the clock, and is usable anywhere within an economy where the legal tender status prevails. In contrast, reserve deposits are available only to designated financial institutions, such as commercial banks (thus called "wholesale central bank money"). 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 enable faster and more efficient transactions.

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	○	○	×	○	○	×
	Reserve Deposits	×	×	○	×	△	○
Private Sector Money	Bank Deposits	○	×	○	×	△	○
Private Sector Money	Digital Tokens (Cryptoassets)	○	○	○	○	○	○

Source: Prepared by the author.

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 they cannot be monitored by the issuing central bank. In contrast, all transactions based on reserve deposits are *traceable* by the order of their time sequence, since they are a digital representation of money that records all footprints. Reserve deposits are *non-anonymous*, since information such as the ownership of money in respective accounts and the amounts transferred from one account to the other is fully available to the central bank via a registry. In addition, cash provides a *peer-to-peer* settlement form, while central bank-intermediated reserve deposits are non-peer-to-peer settlements. Because of its 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 associated security and personnel costs and payment services by commercial banks, shops, firms, and individuals.

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

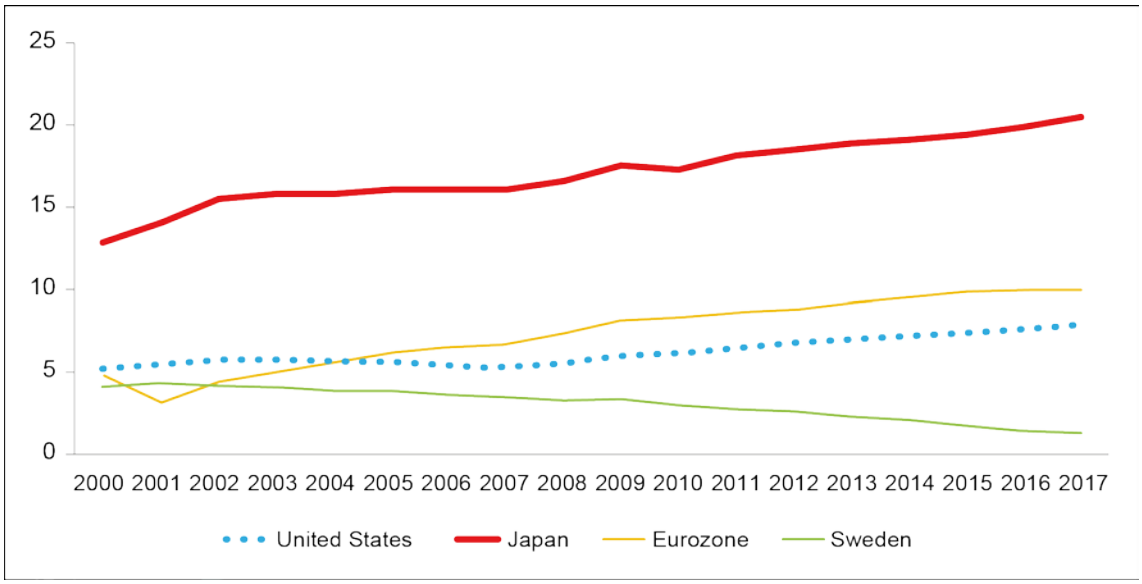
is an interest-rate-free instrument, while a positive or negative interest rate can be applied to reserve deposits. It is known that a negative interest rate can be a monetary policy tool under the effective lower bound, as has been adopted, for example, by the European Central Bank (ECB), the Bank of Japan, and Swedish Riksbank. A central bank can apply a negative interest rate to excess reserves, which can be more effective if commercial banks pass the increased costs on to their retail bank deposits. This is likely to happen when the general public no longer uses cash, i.e., mainly uses private sector money or bank deposits and, thus, is unlikely to substitute it for bank deposits in order to avoid a negative interest rate.

2.3 Performance of Central Bank Money in Advanced and Emerging Economies

Central bank money performance 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 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). Sweden's ratio of cash to nominal GDP has declined steadily since 2008, suggesting that it is the most cashless society in the world.

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



GDP = gross domestic product.

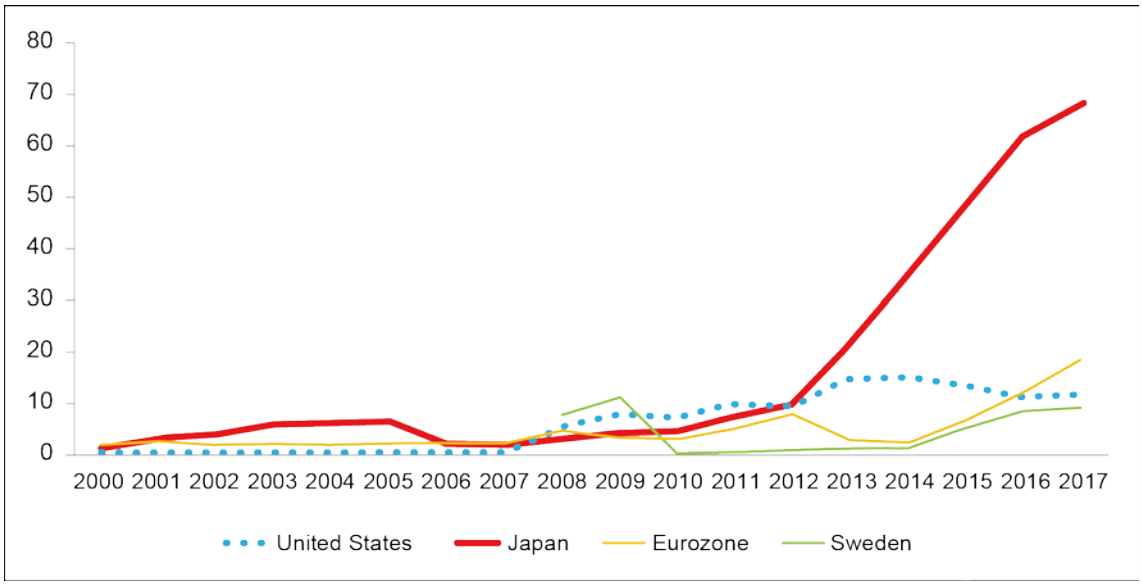
Source: CEIC, US Federal Reserve of St. Louis, International Monetary Fund.

It is interesting that the Swedish cash–nominal GDP ratio continued to drop even after a negative interest rate policy was adopted on the repo rate, i.e., the rate of interest at which commercial banks can borrow or deposit funds at the central bank for 7 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.

In contrast, the cash–nominal GDP ratios have risen over time in the eurozone, Japan, and the US. These trends were maintained after massive unconventional monetary easing, i.e., quantitative easing in the three economies and the negative interest rate policy in the eurozone and Japan. Japan's cash–nominal GDP ratio has been always higher than those of the eurozone and the US, suggesting that cash is more frequently used in Japan as a means of exchange and store of value. This may reflect that Japanese 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 longstanding low interest rate dating from when the Bank of Japan implemented a series of monetary easings after the collapse of the stock and real estate bubbles in the early 1990s (see Shirai 2018a, 2018b, for details). It is also interesting that cash is growing rapidly 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.

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



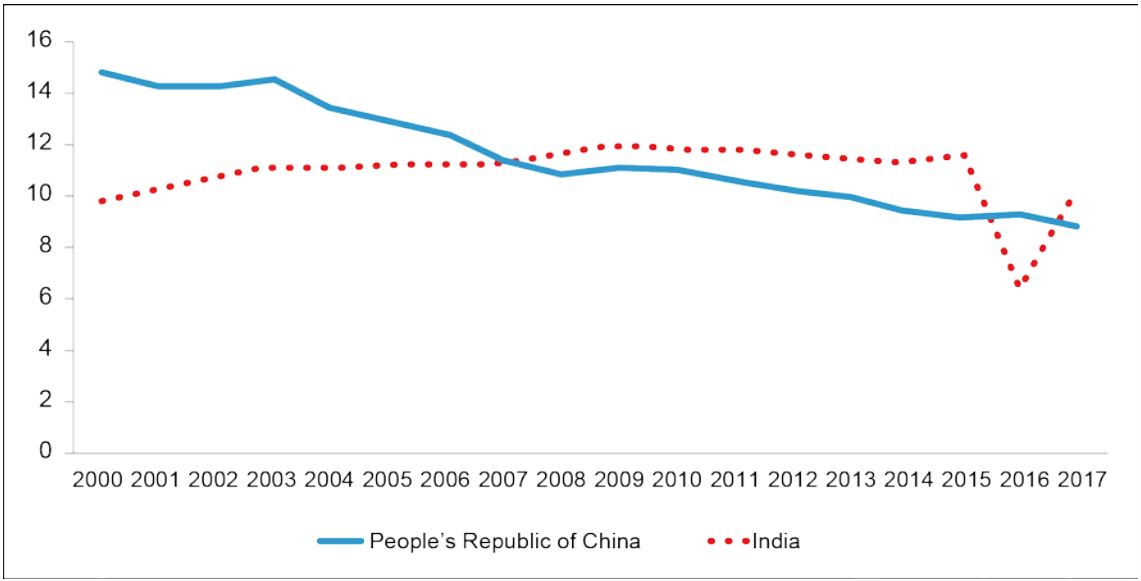
GDP = gross domestic product.

Source: CEIC, Bloomberg, US Federal Reserve of St. Louis, Riksbank, International Monetary Fund.

Regarding reserve deposits, Figure 3 exhibits the ratios of reserve deposits to nominal GDP for the period 2000–2017 in the same four economies. These ratios in the four economies rose after the global financial crisis of 2008–2009, perhaps reflecting the quantitative easing tool adopted in the presence of the effective lower bound. The US currently faces a decline in the ratio because the Federal Reserve has begun to reduce 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 of outstanding reserve deposits reached the maximum of around $2.8 trillion. 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 tapering. From 2019, a full reinvestment strategy will be maintained so that the size of ECB's balance sheet remains the same. Sweden adopted quantitative easing in 2015–2017 and has since continued to engage in a full reinvestment strategy to maintain its government bond holdings. Currently, therefore, the Bank of Japan is the only central bank among advanced economies to continue asset purchases a nd, thus, expand reserve deposits and the balance sheet, although the pace of net purchases dropped substantially following a shift from the monetary base control to the yield curve control in September 2016.

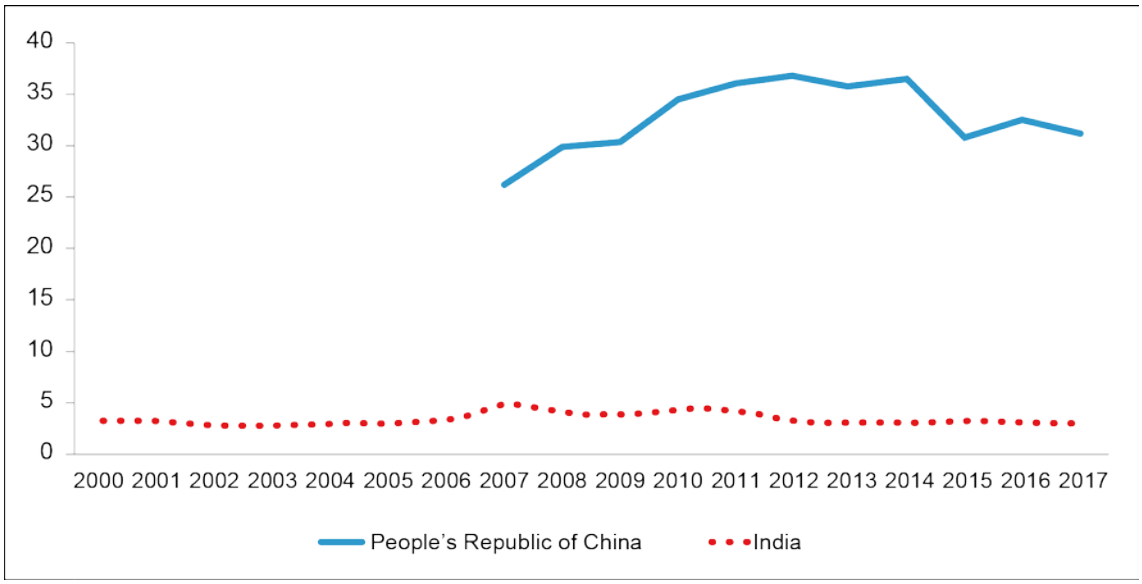
Figure 4: Cash in Circulation in the People's Republic of China and India
(% of GDP)



GDP = gross domestic product.
Source: CEIC, People's Bank of China, International Monetary Fund.

In the case of emerging economies (India and the PRC), Figure 4 shows their cash–nominal GDP ratios for the period 2000–2017. The ratios in the two economies have not risen as occurred in the eurozone, Japan, and the US, even though the amount of cash in circulation has grown rapidly in line with nominal GDP, reflecting transaction demand. In particular, a declining trend in the ratio in the PRC is noticeable, which likely reflects a shift in the general public's money 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 will be pointed out. 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 severely disrupted 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); this makes sense, since the central banks have not conducted quantitative easing like those in advanced economies (Figure 5).

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



GDP = gross domestic product.
Source: CEIC, People's Bank of China, International Monetary Fund.

3. PRIVATE SECTOR MONEY 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 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 per depositor). Similar to reserve deposits, bank deposits are *non-anonymous*, and transactions are *traceable* since the issuing commercial banks can trace all transactions by their time sequence, 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 the PRC, India, Japan, the Republic of Korea, Singapore, Sweden, Switzerland, Turkey, and the UK.

The size of bank deposits is generally much larger than that 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 is 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 differ 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 deposit, repos, and securities with a maturity of less than 5 years held by non-bank 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 it (credit cards are not included since they are loans).

3.2 Monetary Policy Relating Private Sector Money with Central Bank Money

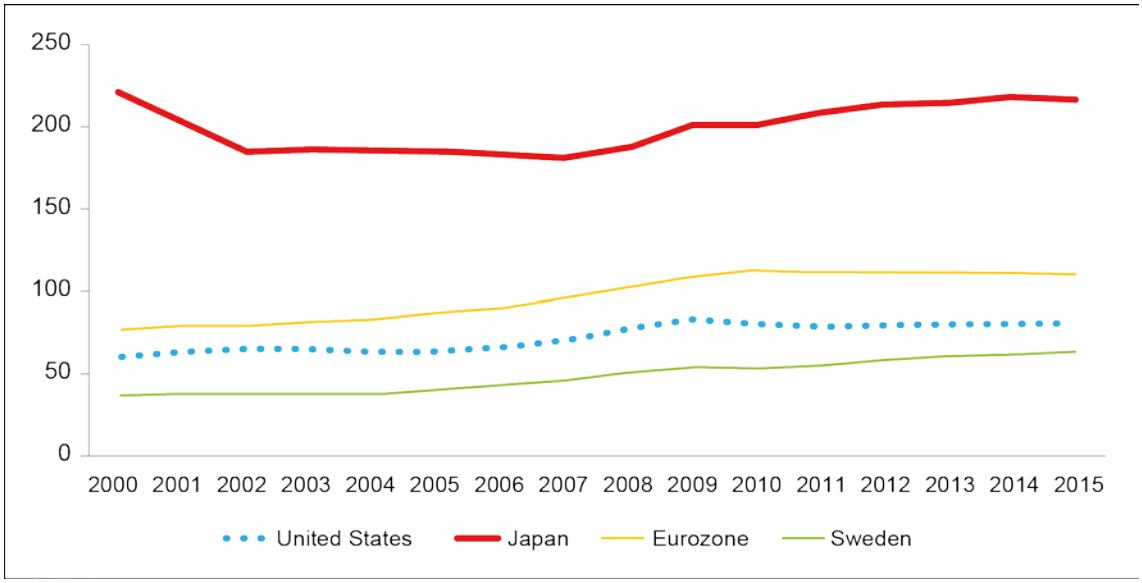
Central bank money, especially reserve deposits, and private sector money (bank deposits) are associated through central bank monetary policy. In normal times, a central bank attempts to influence commercial banks' money creation activities and money stock. In a recessionary (or expansionary) phase, the central bank attempts to cut (or increase) the short-term 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 resulting increase (or decline) in liquidity to the interbank market 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 contain) 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 UK, 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. 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 augment the money stock proportionally (McLeay et al. 2014).

3.3 Performance of Bank Deposits in Advanced Economies and Emerging Economies

The performance of private sector money is based on bank deposits, which may rise when economic activities expand, as firms and individuals may increase the number of and access to bank accounts. As with central bank money, 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 its 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 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.

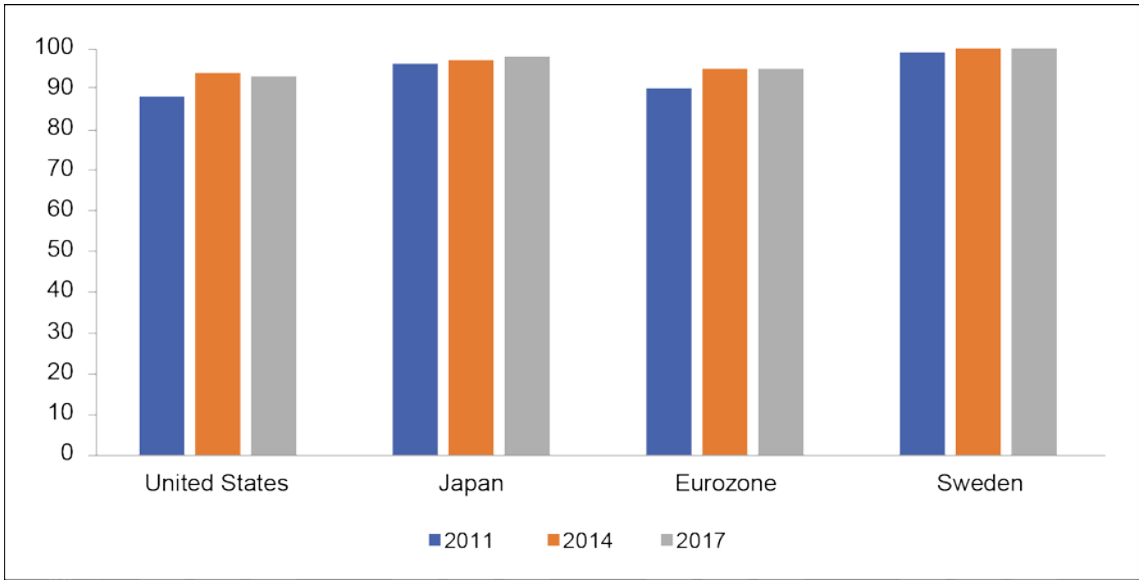
Figure 6: Private Sector Bank Deposits in Advanced Economies
(% of GDP)



GDP = gross domestic product.
Source: CEIC, datamarket.com, European Central Bank, International Monetary Fund.

All 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 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 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 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 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 periods 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 away from risky 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.

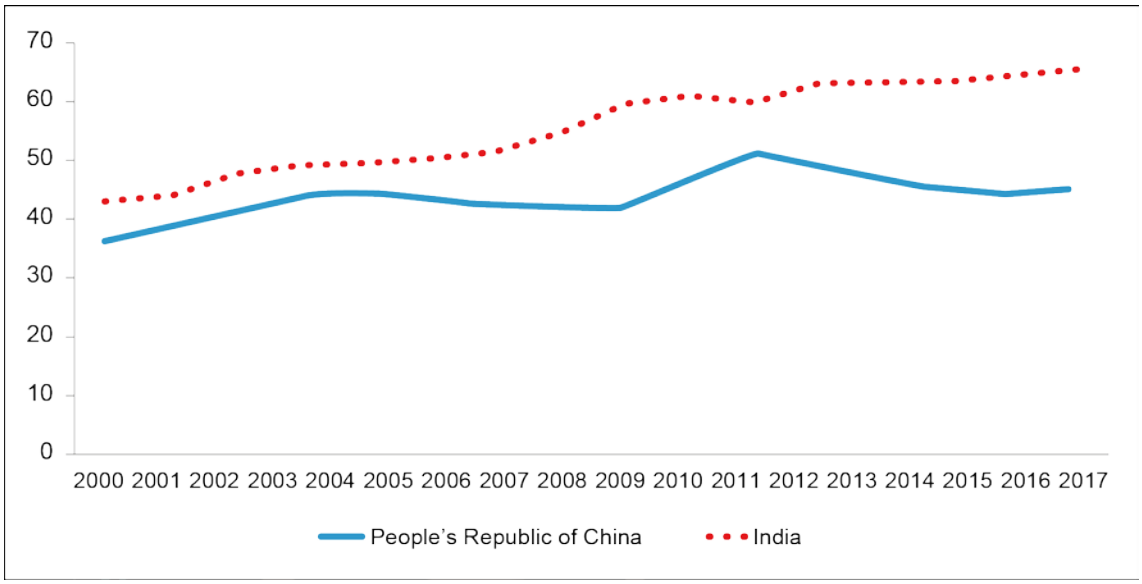
Figure 7: Deposit Account Ownership
(% aged 15 years old or above)



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

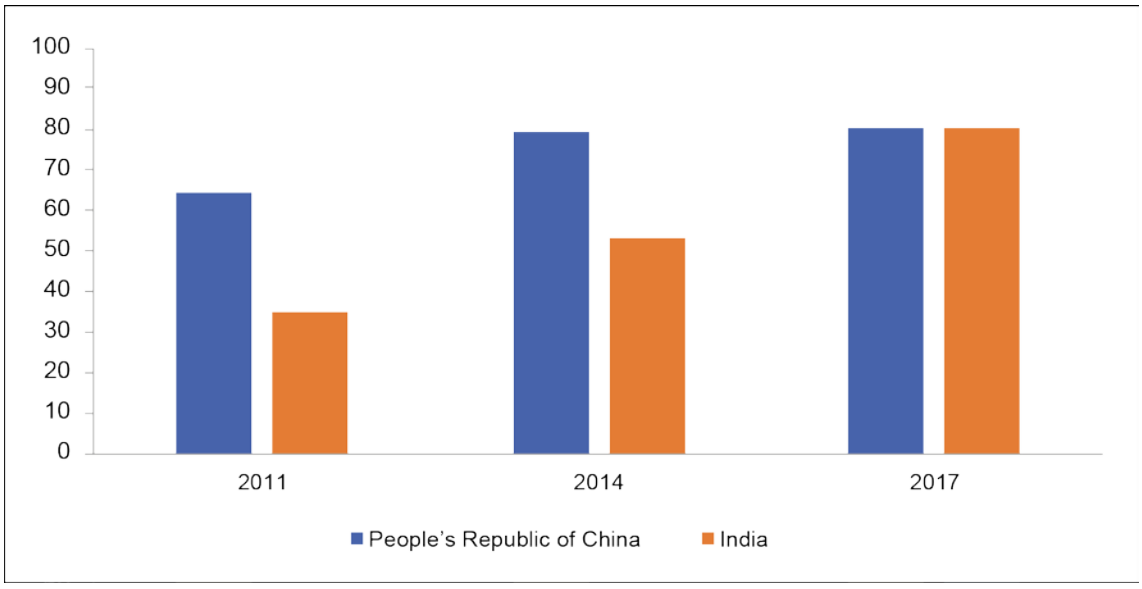
Emerging economies may have different developments. Bank deposits as a percentage of nominal GDP steadily increased in India from 2011 to 2015. The ratio also increased in the PRC despite fluctuations during that period (Figure 8). This may reflect deepening of the banking system in the two economies 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)



GDP = gross domestic product.
Source: datamarket.com (taken from the World Bank), International Monetary Fund.

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 cryptoassets, cryptocurrencies, encrypted currencies, or virtual currencies). These tokens are generally issued by independent "miners" (or nodes) based on DLT, which records transactions between two parties, shares the information among network participants,

and synchronizes the data electronically in a traceable and unfalsifiable way. The innovative nature of this technology lies in the way transactions (such as the payment or transfer of digital coins) are verified by unknown, independent third parties (namely, nodes), without relying on a central manager or register (such as a central bank or a commercial bank). 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 such that data falsification is difficult.

The first and most famous private sector digital token based on the blockchain technology is bitcoin, introduced in 2008 by Satoshi Nakamoto. There are currently over 2,000 digital tokens, 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, 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. The size of digital tokens 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

[1] Data are available from https://coinmarketcap.com/.

authorities have issued one so far). Thus, they 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 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 fintech financial services providers (companies limited by shares, corporations with unlimited partners, or limited liability companies, in addition to the requirement that companies have registered offices and conduct business activities in Switzerland) to accept public deposits of up to SwF100 million under the conditions that those deposits are neither invested nor 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

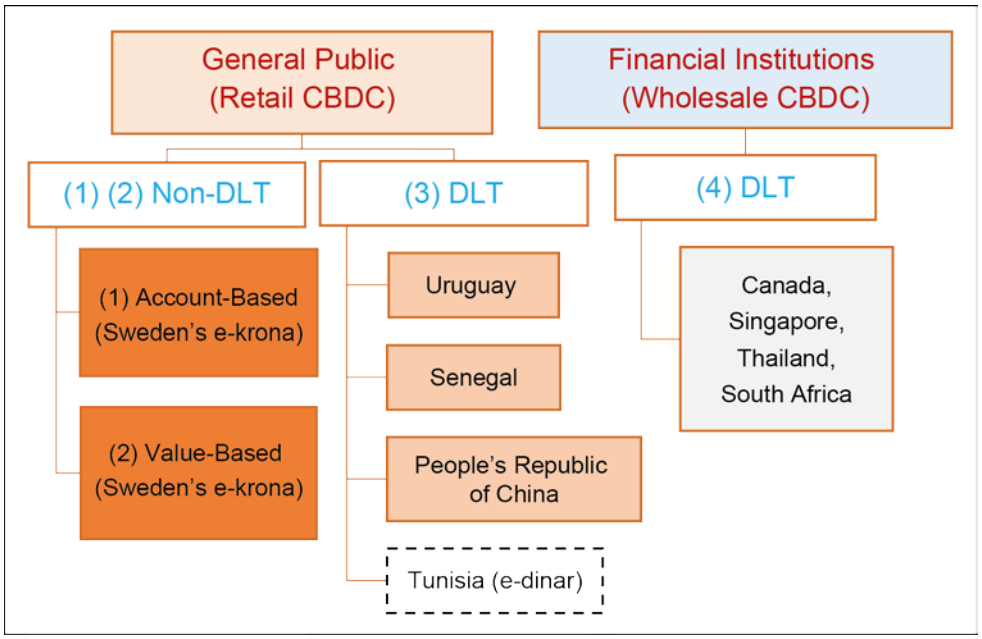
The emergence of private sector digital tokens issued to the general public has prompted intense debate over whether they could become money in the future. In addition, another heated debate has risen about whether central banks should issue their own digital tokens. The idea of central banks issuing 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 that the International Monetary Fund (IMF) has begun to examine the potential innovative nature of digital coins and has supported CBDC proposals. Christine Lagarde, Managing Director of the IMF, for example, urged central banks in November 2018 to consider CBDCs, since they could satisfy public policy goals, including financial inclusion, security/consumer protection, and privacy in payments (Lagarde 2018).

The ideas on CBDC discussed around the world can be divided into proposals that are based on DLT and those that are not. CBDC proposals can be further differentiated between retail CBDC and wholesale CBDC. Figure 10 classifies all the CBDC proposals 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 these CBDCs are digital currencies, as described in detail below.

Figure 10: Central Bank Digital Currency Proposals



CBDC = central bank digital currency, DLT = distributed ledger technology.
Source: Prepared by the author.

4.2 Motivations Leading to the Central Bank Digital Currency Proposals

Before investigating the four proposals, it is important to examine their import for some central banks.

4.2.1 Safe Liquid Payments

Central banks find it necessary to provide safe, liquid payment instruments to the general public, just as 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 which are being seriously considered by Riksbank. Given that most of the general public in Sweden no longer uses cash, Riksbank has found it important to provide a safe, liquid payment instrument 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 exploit 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 several private sector issuers or cashless payment providers go bankrupt as a result of systemic financial crises, the general public may incur improper payment and settlement systems and encounter large losses. As a result, the payment and settlement 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 in Norway, while those in terms of GDP have exhibited a declining trend in Australia, Denmark, Sweden, and Norway. According to Riksbank's survey, only 13% of Swedish citizens used cash for their most recent purchase in 2018, down from 39% in 2010. Sweden is more enthusiastic about 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 future in the 2019 report.

Table 2: Cash in Circulation in Selected Economies

	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 billions 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

GDP = gross domestic product.

Source: CEIC, US Federal Reserve of St. Louis, International Monetary Fund.

4.2.2 Promoting Cashless Payments

Some economies, especially emerging ones, wish to reduce the cost of printing and managing cash and contain the associated crimes by promoting cashless payment. The third proposal (retail CBDC based on DLT) pertains to this motivation. Substantial money has been spent in each economy, not only on direct paper and design fees (spent to reduce counterfeits) but also on the personnel and transportation costs needed to handle cash, as well as on security fees. 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, making 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 formalize the economy so that it becomes more tax-based, transparent, and efficient. DLT enables anonymity, but CBDC might reduce the possibility of executing unreported transactions and crimes.

4.2.3 Financial Inclusion

Financial inclusion is another important motivation for some emerging economies regarding retail CBDC proposals based on DLT. There are still many 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. Retail CBDC might promote digitization of the economy and, thus, economic and social development.

4.2.4 DLT and Fintech

The use of DLT, as in the third and fourth proposals, may promote a technological environment and foster fintech. Many emerging economies develop global financial centers and regard fintech as one of the most promising routes for 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 activities in the Shenzhen area in the PRC.

4.2.5 Retail CBDC

Shifting from cash to digital currency through issuing retail CBDC may enhance 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.

4.2.6 Efficiency and Financial Stability

The efficiency and financial stability gains are feasible, especially with regards to the fourth proposal. 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 single-point-of-failure problems from the system. Moreover, wholesale CBDC may be able to improve efficiency by technically broadening account eligibility to financial institutions that normally do not have access to reserve deposits, such as insurance firms, pension funds, and other non-bank financial institutions.

4.3 First and Second Proposals: CBDC without Distributed Ledger Technology

Sweden's Riksbank has been the only central bank so far to actively consider the first two proposals over the past 2 years under the e-krona project. The first proposal, i.e., 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. The second proposal, i.e., 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 owner identification (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 sufficient 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*, with the exception being a prepaid e-krona card, where e-krona are already stored and can be used as cash. This is allowed if the payment amounts to less than €250 (to be lowered to €150 by 2020), as set by the European Union, on the condition that there is no suspicion of money laundering or terrorist financing.

Table 3: Features of Central Bank Digital Currency Proposals

				General Public	Anonymous	Traceable
Account-Based	Non-DLT	Retail	Sweden	○	×	○
Value-Based	Non-DLT	Retail	Sweden	○	△	○
Digital Token	DLT	Retail	Uruguay	○	○	○
Digital Token	DLT	Wholesale	Canada, Singapore, South Africa, Thailand, eurozone-Japan	×	○	○
				Peer-to-Peer	**24 Hours/ 365 Days**	**Interest Rate**
Account-Based	Non-DLT	Retail	Sweden	×	○	○
Value-Based	Non-DLT	Retail	Sweden	△	○	△
Digital Token	DLT	Retail	Uruguay	△	○	○
Digital Token	DLT	Wholesale	Canada, Singapore, South Africa, Thailand, eurozone-Japan	△	○	○

DLT = distributed ledger technology.

Source: Prepared by the author.

For the first and second proposals to be practical, Riksbank has stressed the need to develop e-krona payment and a settlement platform for the general public by interacting with several 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 payment system so that experimentation can be 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 a clear mandate to issue an account-based retail CBDC. Riksbank may need to draw up proposals for the amendments before conducting any experimentation.

Most of the central banks, including Norway's Norges Bank, have not expressed interest in these Swedish proposals, mainly because of concerns that commercial banks may lose retail deposits to the central bank and, thus, their financing. 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. Another concern is that bank runs may be exacerbated in the event of a crisis. 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 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, i.e., retail CBDC based on DLT, CBDC has the features of anonymity, traceability, availability 24 hours a day and 365 days a year, and the possibility 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 the PRC, Ecuador, India, Israel, Lithuania, the Marshall Islands, Tunisia, and Uruguay have expressed interest and/or conducted experiments in some cases, although enthusiasm from the Reserve Bank of India appears 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 in 2014. The central bank allowed users to open accounts with their identification numbers and transfer money between US dollars 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). However, the retail CBDC initiative turned out to be unsuccessful because of the limited number of users, and underlying accounts were deactivated in 2017. This reflected the fact that many citizens trusted the US dollar more than the new digital token.

Uruguay

The practical experiment conducted was the case of the Central Bank of Uruguay 6-month pilot study in 2017 on instantaneous payments and settlements systems using retail CBDC. Converting 20 million pesos to digital currency, the project involved about 10,000 mobile phone users, 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 national payments company Red Pagos to create a digital wallet and then register it for no charge. Each user (or firm) could place up to 30,000 pesos (200,000 pesos for firms) as 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. 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 benefitted 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

Lithuania's central bank examined the retail DLT-based CBDC proposal in 2018 by involving domestic and foreign firms to develop the fintech industry. Since Lithuania has adopted the euro as legal tender, the central bank is not allowed to issue retail CBDC for wider use. Thus, it announced a plan to issue digital collector coins along with physical collector coins commemorating the 100th anniversary of independence from the Russian Federation in 2018. While the central bank holds the view that financial institutions should not engage in cryptoasset 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 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 yuan through commercial banks in a so-called two-tiered system. Yao Qian of PBOC wrote a report (Qian 2018) 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, as with cash. The report indicated that the digital tokens would use a distributed ledger in a limited way such that their ownership 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 PBOC supplies it 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, provided the deposit rate paid by a central bank is lower than the interest rate paid by commercial banks (Qian 2018). 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 it as a CBDC. 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 version of the Tunisian dinar (the "e-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 cryptoasset exchanges and can be used in Tunisia to transfer funds, pay for goods and services, pay salaries and bills, and manage official identification documents with limited costs, i.e., 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 (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.

Marshall Islands

Another government-led initiative is in the Marshall Islands, where the US dollar has been the official currency 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 a 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 of 24 million tokens in order to avoid inflation, with support from a fintech startup 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 vehemently warned against issuing the SOV since it might steer the anti-money laundering activities through the country's sole domestic bank that already faces the risk of losing its last US dollar-based banking relationship as a result of heightened due diligence by US banks (IMF 2018). Moreover, criticism of the retail CBDC proposal has 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 (a 16-16 split) in November 2018, so the government plans to issue the SOV after satisfying the requirements imposed by the IMF, the US, and Europe.

Venezuela

In Venezuela, the government claims that it has issued a government-sponsored digital coin. The digital coin, called the "petro", was issued in 2018 and is backed by a barrel of

[2] In the proof-of-state process, every node can stake a portion of their held cryptoassets in the network. Since this is like storing cryptoassets as collateral, those assets cannot be used. If a transaction is bad, the staker (the node that offers cryptoassets) would face a decline in its stake. If a node stakes a greater amount, the longer they leave it 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).

oil from the country's substantial 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 rights 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 to pay and receive funds in petros 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 US 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 24 hours a day and 365 days per year, so there is no strong case for promoting the proposal. 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 their reputation in cases of unsuccessful implementation of the initiative. Limited public interest and support for the proposal is also another factor discouraging these central banks.

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 decided to promote retail CBDC at this stage after carefully examining the pros and cons. Their retail payment and settlement systems are already highly efficient, immediate, and convenient, so they prefer existing private sector money issued by traditional financial institutions (Bank of Israel 2018; Mancini-Griffoli et al. 2018). The central bank in Israel also issued a report in November 2018 regarding retail DLT-based CBDC 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 US Federal Reserve also does not support the retail CBDC idea proposed by Koning (2014, 2016).

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

4.5 Fourth Proposal: Wholesale CBDC Based on Distributed Ledger Technology

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

Some experiments have been already conducted or examined by central banks since 2016, such as those in Canada (Project Jasper), Singapore (Project Ubin), Japan-Euro Area (Project Stella), Brazil, South Africa (Project Khokha), and Thailand (Project Inthanon). Among the central banks, those in Canada, Singapore, South Africa, and Thailand have experimented with the proposal by involving several private 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 payment and settlement 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 implementation because of their view that the current technology is not yet able to protect privacy. Also, these central banks believe that the process of verifying transactions could be faster and most cost-efficient if the verifier is 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 with financial institutions based on Project Jasper and Project Ubin to assess whether wholesale CBDC could enhance the access, speed, and transparency of cross-border payments and settlements. 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 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 US 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 conducted an overview of the concepts and features of central bank money and private sector money. Their 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) is growing and is much greater than central bank money. Meanwhile, digital tokens, such as bitcoin, can be considered as newly emerged private sector money. While their use as alternative payment tools remains limited, greater attention has been paid to their emergence because of the underlying DLT 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 their high volatility. 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 CBDC proposals. However, no central banks so far have found strong advantages of issuing their own digital coins 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 garnered a lot of attention among some central banks, others have shown little interest in similar initiatives because of the potential shift of retail deposits from commercial banks to a central bank. Given that technology has been progressing rapidly 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 implementation soon.

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