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We have been living through a period of rapid technological change even before the COVID-19 pandemic. Nowhere was this more evident than in the financial sector, which before 2020 was experiencing genuinely revolutionary advances across digital payments platforms, cryptocurrencies, and financial technology (FinTech) more generally. Our present moment has only accelerated these trends. The global health crisis has driven forward adoption of digital and contactless payment systems and almost all economic exchange is conducted at a few physical steps removed or entirely online.

This timely research report provides an overview of innovation in Central Bank Digital Currencies (CBDCs) as one important part of this evolution. CBDCs enter a complex institutional environment that would have been unimaginable just a decade or two ago. A central bank that wishes to launch a digital currency now does so in competition not just with other fiat currencies maintained by other central banks, but also in competition with a complex ecosystem of cryptocurrencies and private digital currencies. On the one hand, ‘open’ cryptocurrencies like Bitcoin and Ether operate outside the jurisdiction and direct control of the state or any single entity. On the other hand, we see the possibility of corporate or consortium-managed digital currencies like the Facebook-led Libra digital currency offering further competition to fiat currencies.

This suddenly competitive environment raises enormous questions. The control of money by central banks has been one of the key features of twentieth century political economy - governments have long relied on the fact that they print the money which they both tax and spend. That monopoly over money may be disappearing, and indeed may already have disappeared. CBDCs enter this new landscape to compete with innovation in the private sector. CBDCs have significant implications for monetary and fiscal policy, but also international governance, geopolitics and trade. Policymakers have only begun thinking about these complicated and highly significant issues - this report should push them along.
Cryptocurrencies have garnered much attention promising to disrupt the world of payments, banking systems and global trade. Cryptographic security as well as blockchain distributed ledger technology underpins this form of digital currency. The vaunted advantages of cryptocurrencies include efficiency, greater security and (in some jurisdictions) banking the unbanked. For these reasons, as well as the perceived need to counter the rise of cryptocurrencies, governments and their central banks have become acutely interested in the potential to issue their own form of digital currency – Central Bank Digital Currency (CBDC). An important distinguishing feature of a CBDC is that they would be legal tender – endorsed by the relevant authority.

This report provides an overview of CBDCs, contextualising them in the world of digital currencies, the technology that underpins them and how central banks traditionally operate. It also discusses some of the current and potential impacts digital currencies are having relevant to the development of CBDCs. We begin by outlining the similarities and differences between the traditional forms of money and digital currencies. We explore the role of central banks in the economy and how digital currencies may fit in. We then review the current state of play in the development of CBDCs, paying particular attention to the Reserve Bank of Australia (RBA), The European Central Bank (ECB), the People’s Bank of China (PBoC) and the United States Federal Reserve.

A well-known and undesirable feature of cryptocurrencies is volatility. This has provided central banks, who generally have the responsibility to smooth large fluctuations in macroeconomic activity, with further reason to investigate the potential of CBDCs. The private sector has also recognised this undesirable feature responding by developing “stablecoins”. Facebook’s Libra is probably the most notable – which in April 2020 was recalibrated (Libra 2.0) following regulatory concerns about the first iteration.

Private sector activity, such as Libra, has accelerated research into CBDCs in many countries – not just the US. It has also resulted in new legislation and regulation. The drive to digital transformation resulting from the COVID-19 pandemic has also added impetus to its exploration. To date there have been different attitudes and progress from central banks reflecting political-economic priorities and features of the nations they represent.

In 2014, PBoC launched a project on Digital Currency/Electronic Payments (DCEP) with the aim of partially digitising China’s existing monetary base, or cash in circulation. The PBoC appears to be most advanced in the CBDC development, framing legislation for China’s digital currency in late 2019 and trials underway in 2020. The PBoC started pilots in 2020 across four cities (Shenzhen, Suzhou, Chengdu and Xiong’an). While the European Central Bank is increasing its work on a Euro CBDC and the Netherlands central bank has signalled that it wants to ‘play the leading role’ in CBDC development. In Australia, the RBA is leaning towards a wholesale CBDC (designated the ‘e-AUD’). The PBoC is exploring both wholesale and retail CBDC. While the ECB’s position it is not yet clear, ECB reports and other publicly available sources hint at the ECB’s intentions and actions to improve the efficiency of its present digital payment system and explore CBDCs as part of the solution. The US Federal Reserve (the Fed) has appeared to actively resist CBDCs but emerging, credible competition from private sector issued currencies and COVID-19 appear to have stimulated the US Fed to accelerate its research into CBDCs.

The potential for CBDCs to change the way we transact is difficult to gauge now. There is much activity along several different dimensions as well as a reticence amongst many central authorities to adopt this new form of money quickly. No doubt, many money market participants will be looking to learn from China’s imminent planned implementation. It is conceivable that entities that trade with China will experience CBDCs first-hand prior to their own country’s adoption.
1.0 CENTRAL BANKS IN THE ECONOMY

To understand the potential of CBDCs, it is necessary to first review the role and activities of central banks. In this section we:

• define what central banks are and explain their role in the economy
• introduce the relationships between central banks and the government

Supplementary information on monetary policy approaches and instruments and objectives are provided in an appendix.

This report has been prepared by RMIT University for CPA Australia, as an introduction to Central Bank Digital Currencies (CBDCs), cryptocurrencies, and their underpinning technologies, including blockchain. Cryptocurrencies like Bitcoin and Ethereum’s Ether have garnered much attention in the world of finance, promising to disrupt the world of payments, banking systems and global trade. Many people think cryptocurrencies could one day take the place of ‘conventional’ money. The advantages of cryptocurrency include anonymous transactions, greater security than traditional banking, no intermediary when transferring money, and a currency value that cannot be manipulated by the government. For these reasons, governments and their central banks have become acutely interested in digital currencies, either exploring cryptocurrency forms for their use, or centralised digital currencies as counter or defence against the rise of cryptocurrencies.

This report is intended for readers who may have some, or little, familiarity with cryptocurrencies and blockchain. In exploring the nature and implications of CBDCs, we:

• discuss the traditional roles and activities of central banks
• introduce blockchain technology and cryptocurrencies as well as explore their advantages and disadvantages
• provide a brief overview of digital money
• review current activities of four key central banks.
1.1 CENTRAL BANK – DEFINITION AND ROLE

A central bank, as distinct from a commercial bank, is a financial institution that is established by the government and given privileged control over the production and distribution of money and credit for a nation or a group of nations. A central bank is defined for the most part by its function in an economy.

The Bank of International Settlement (BIS)\(^1\) defines a central bank as follows:

“A Central Bank is the bank in any country to which has been entrusted the duty of regulating the volume of currency and credit in that country.”

Nobel Prize-winning Economist Paul Samuelson wrote:

“Every Central Bank has one function. It operates to control economy, supply of money and credit.”

In modern economies, the central bank is typically responsible for the formulation of monetary policy and the regulation of banks and other financial institutions in its jurisdiction. A central bank does not deal with the public directly, rather it performs its functions with the aid of commercial banks. Its core functions usually include: acting as the ‘bank of issue’ for domestic currency; formulating and carrying out monetary policy; serving as a banker and financial adviser to the government; managing reserves of domestic cash and foreign currency; acting as lender of last resort in the banking system; and acting as a clearinghouse for settlements and transfers between commercial banks. It may also have ancillary functions such as promoting and developing the banking system, developing specialised financial institutions, and collecting and disseminating statistical data.

\(^1\)BIS is an international financial institution that fosters global financial cooperation, works with global central banks to achieve monetary and financial stability and, also acts as a bank for central banks.
1.2 THE RELATIONSHIP BETWEEN CENTRAL BANKS AND GOVERNMENT

The relationship between a government and its central bank varies from country to country. In many economies, including Australia, the RBA is constituted and operates as an independent body (in a similar way to the judiciary) with the government as its primary owner and funder. In others, the nexus between government and the central bank is different – for example, the PBoC is funded and directed by the government, although it operates with some degree of independence. The ECB is jointly owned and funded by its 19-member national central banks, and the central bank of Japan is a publicly listed corporation.

For this report, we will focus on the role of central banks in money management and monetary policy. As the agent of monetary policy, currency and price stability have become the major objectives of many central banks. For example, the main objective of European Union monetary policy action by the ECB is to maintain price stability. The secondary role of the bank is to aid general economic policies of the member states, including but not limited to, full employment and balanced economic growth. The PBoC has a dual mandate of maintaining price stability and promoting growth.

The RBA conducts its monetary policy action on behalf of the federal government with three objectives\(^2\): the stability of the currency of Australia, the maintenance of full employment in Australia and the economic prosperity and welfare of the Australian people. Australia’s monetary policy seeks to achieve these aims by managing inflation, through manipulating interest rates and the money supply.\(^3\)

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\(^1\) As prescribed by the Reserve Bank Act 1959, Section 10(2) and Section 10B(3) define powers and objectives with regard to the payments system and financial system and Section 11(1) of the Act covers the need to consult with government on monetary and banking policy (Reserve Bank of Australia (2020)).

\(^2\) See Appendix for more details on monetary policy – inflation rate targeting, interest rates, and the money supply.
2.0 DISTRIBUTED LEDGER TECHNOLOGY, BLOCKCHAIN AND DIGITAL CURRENCIES

The emergence of cryptocurrencies and other digital currencies as potential competitors to conventional money and payment systems has motivated many central banks and governments to investigate CBDCs. Blockchain and Distributed Ledger Technologies (DLTs) underpin the major cryptocurrencies.

Having briefly reviewed the role of central banks, in this section we:

- define what central banks are and explain their role in the economy
- define blockchain and DLTs
- introduce the key features of blockchain and DLTs that motivate their use in digital currencies, including cryptographic trust and smart contracts
- introduce applications of blockchain technology
- distinguish between fiat currency, types of digital currency, cryptocurrencies and stablecoins
- introduce the most prominent cryptocurrencies and their attributes of concern to central banks.

2.1 DLT AND BLOCKCHAIN

Blockchain and DLT are technologies that have drawn considerable interest from many sectors in the global economy.

**DLT** refers to the technology that supports a decentralised record of activities shared across many computers in different locations. DLT includes a set of network protocols and infrastructure that allow computers (nodes) in different locations to propose and validate transactions and update ledgers in a synchronised way across a widely distributed network. Compared to centralised databases, DLTs can provide higher degrees of transparency, security and ‘trustworthiness’.

Centralised, or server-based networks typically maintain a master ledger that is the one authoritative or “true” point of reference. This master ledger is then periodically, centrally updated and shared across the network. While centralised database systems generally have some degree of security protection, one has to trust that the organisation in control over the system keeps the data safe. In other words, if the centralised database is attacked, data security may be compromised.

By contrast, a distributed ledger network is comprised of many nodes. Each node maintains a complete, authoritative copy of a ledger. The ledger can only be updated when consensus is reached among the nodes (or a specified proportion of them) that a change is valid. If consensus is reached and changes are validated, the ledger contained in each node is updated simultaneously, without the need for a central, validating administrator. The inherent trustworthiness of this multi-party consensus mechanism is one of the most important and appealing features of distributed ledger networks. In a decentralised system with consensus validation, such as a payment system, no third party can access or change your information. The transactions are quick, cost-effective, transparent and (if set up that way) anonymous and there is no central point of failure.
2.1.1 BLOCKCHAIN AND CRYPTOGRAPHIC ‘TRUST’

Blockchain is a type of DLT. In a blockchain, transactions are recorded sequentially in ‘blocks’. When a block is filled, it is sealed with a cryptographic signature known as a ‘hash’ that is generated by an algorithm and based on the data in the block. A new block is then started, and the new block will begin with that same hash (signature) from the previous block to ensure that there has been no manipulation of the encrypted information. When that next block is filled, it is sealed with its own cryptographic hash, which is included in the first record of the next new block and so on, forming a chain of blocks – hence the term blockchain.

It is important to note that a blockchain is an append-only ledger. That means that blocks can only be added and removing or altering a transaction retrospectively from a blockchain becomes difficult. Altering a record in a blockchain retrospectively requires a change to the hash information of all the blocks that came after the transaction one intends to alter and consensus approval by the nodes participating in the network that the change is valid. It is the global consensus mechanism and near impossibility of changing records retrospectively that ensures trust in the data, making blockchain technology attractive for a range of applications.

There are two main designs of blockchains: ‘public’ or ‘permissionless’ blockchains; and ‘private’ or ‘permissioned’ blockchains. Public blockchains allow anyone with internet access and a mobile device to participate in the network. They are described as permissionless because participants do not need to seek permission to become part of the network. Popular blockchains such as Bitcoin, Ethereum, Litecoin, Dash, and Monero are public (and permissionless) in this way. They are also described as ‘open’ blockchains. By contrast, private (permissioned) blockchains provide only authorised members with access to data. In other words, network participants must have obtained permission from an administrator to access data and perform transactions. Private blockchains are useful for banks, insurance providers, governments, and other institutions that deal with data subject to data privacy regulations or other compliance requirements. Many central banks are currently researching both blockchain and non-blockchain DLTs as the platform for possible implementation of digital currencies, such as CBDCs.
2.2 SMART CONTRACTS

Smart contracts are an application of blockchain technology that is central to many blockchain applications involving money and payments. Smart contracts are central to many existing and proposed alternative payment systems and as such are drawing the attention of central banks, either as a threat or a complement to conventional, centralised payment systems.

A smart contract is a digitised agreement between two parties, where the conditions of the agreement such as payment terms, liens, confidentiality, and even enforcement, are written in the form of computer code. Smart contracts are recorded on a blockchain ledger and are effectively self-executing. In other words, when the terms of the contract are met and validated by the network, the contract is executed automatically.

In this way, smart contracts do not require intermediaries. Instead, a decentralised consensus mechanism on a blockchain replaces intermediaries in transactions between contracting parties. In other words, contracting parties can now deal directly with one another without banks, without offline registries or exchanges and (potentially) without lawyers (Raskin, 2017). Potential advantages of smart contracts, therefore, include automation, cost reduction, speed, reliability, and transparency. Smart contracts have the potential to lower transaction costs, reduce fraud loss, and lower arbitration and enforcement costs. Smart contracts are often described as “trustless”, meaning that transacting parties need not trust each other in the real world, so long as they trust the blockchain protocol underpinning their contracts.

Smart contracts differ from conventional, intermediated contracts in the following ways:

- Smart contracts are immutably recorded and programmed on the blockchain distributed ledger and cannot be altered - If “rectification” is required, there should be a reconstruction of a new contract which either reverses or modifies the previous contract.5
- The entire lifecycle of a smart contract, from formulation to execution, occurs online.
- The lifecycle need not at any point involve any entity other than the contracting parties since the payment can occur directly from one party’s ‘account’ to the other party’s ‘account’ (e.g. bitcoin wallet to bitcoin wallet).
- Contract performance is automated and is carried out following programmed instructions.

5Norton Rose Fulbright (2019)
Smart contracts;

- are well-suited to transactions such as regular, prescribed payments or transferring of title to assets (real or financial)
- make ‘programmable money’ possible
- enables programmable currency instruments that bear and pay interest
- can direct how policy instruments such as grants or social security payments are spent, potentially making these policies self-enforcing
- facilitate interoperability across different blockchains. This function is useful for inter-border CBDC transactions as demonstrated by the collaboration between the Monetary Authority of Singapore’s “Project Ubin” and the Bank of Canada’s “Project Jasper” (Jasper & Ubin, 2019).

Smart contracts can be used by the government to automatically target a certain demographic group. Unlike other existing methods, smart contracts are self-executing in accordance with written computer codes. For example, if the government wants to send $500 to all citizens aged 70 and above, when the inflation rate exceeds a pre-specified level (e.g., 5%), a smart contract will automatically execute the transaction and transfer the $500 directly to these citizen’s bank account without needing them to fill out a form or having to wait for the authorities to process transactions.

In 2018, Australia’s Commonwealth Bank and CSIRO’s Data61 unit launched a pilot running smart contracts that create “programmable money” for targeted payments made by the National Disability and Insurance Scheme (NDIS). This system is planned to integrate with Australia’s “New Payments Platform” (NPP), allowing direct payments to NDIS participants for specific purposes in real-time (Rimba et al., 2018)

DLT, blockchains and its smart contract function are rapidly evolving technologies and there is not yet a consensus on which of these technologies are best suited for use in CBDCs.

*Please see section 4.1 for more details on NPP.*
2.3 FIAT CURRENCY VS DIGITAL CURRENCY, CRYPTOCURRENCIES, AND STABLECOINS

**Fiat currency** is money issued by a government, typically through the agency of its central bank, in the physical form of notes and coins. A fiat currency's legitimacy is derived from the authority of the government that declares it to be legal tender. When a government declares a currency to be legal tender, it means that all people and organisations are required, by law, to accept it as a means of exchange within the government’s jurisdiction. Fiat currency gives central banks greater control over the economy as they can control the quantity of currency printed and influence its supply via various monetary policy tools, as previously explained.

**Digital currency** is the blanket term used to describe ‘electronic’ money. It includes both virtual currency and cryptocurrency, can be regulated or unregulated and, as distinct from fiat money, can be issued by anyone with the means to do so.

**Cryptocurrency** is a form of digital currency that is typically blockchain-based. Cryptocurrencies use decentralised controls and complicated cryptography to ensure high security in the creation of the currency and verification of transactions. It is argued that the level of encryption security achievable makes cryptocurrencies impossible to counterfeit. Bitcoin is the first and most widely recognised example of a cryptocurrency, although many more cryptocurrencies have entered the market since Bitcoin’s inception.

Many central banks around the globe are considering introducing digital currencies as complements to notes and coins, or even as eventual replacements for them.

The CBDC concept is still in its infancy, and several central banks have proposed definitions of CBDCs that differ partly:

According to Ward & Rochemont (2019) of the BIS:

“CBDC is not a well-defined term. It is used to refer to a number of concepts. However, it is envisioned by most to be a new form of central bank money. That is, a central bank liability, denominated in an existing unit of account, which serves both as a medium of exchange and a store of value [...] This mix of new and already existing forms of central bank money makes it challenging to precisely define what a CBDC is. In fact, for purposes of analysing what may change, it is easier to define a CBDC by highlighting what it is not: a CBDC is a digital form of central bank money that is different from balances in traditional reserve or settlement accounts.”

The Bank of England (2020) described CBDC as an electronic form of money that:

1. Can be accessed more broadly than reserves,
2. Potentially has much greater functionality for retail transactions than cash,
3. Has a separate operational structure to other forms of central bank money, allowing it to potentially serve a different core purpose, and
4. Can be interest bearing, under realistic assumptions paying a rate that would be different to the rate on reserves.

Finally, Galloway et al. (2020) of the RBA has defined CBDC as:

“…possibly issued on a blockchain platform, would be a digital version of money which is a liability of the central bank rather than a commercial bank. Similar to cash and commercial bank deposits, a CBDC would be denominated in the sovereign currency and convertible at par with other forms of money.”
For this report, we will consider CBDCs in the context of digital fiat currencies issued by central banks, represented in the greyed area in figure 1 below:

*Figure 1: The Money Flower: A taxonomy of money.*


### 2.4 MAJOR CRYPTOCURRENCIES AND THEIR ATTRIBUTES

What Bitcoin and other cryptocurrencies have in common is that they are forms of digital currency that have been designed as alternatives or competitors to fiat money and centralised, state-controlled payment systems. However, the idea of a CBDC issued and controlled by a central authority is contrary to the philosophy of cryptocurrencies seeking to move away from centralised money systems. For these reasons central banks are acutely interested in the evolution and spread of cryptocurrencies.

While it is not feasible to present a comprehensive discussion of all the cryptocurrencies, the following provides a review of the three most-transacted digital currencies – Bitcoin, Ether and XRP.
2.4.1 BITCOIN

Bitcoin is a blockchain-based, decentralised cryptocurrency created in January 2009 by the mysterious and pseudonymous developer Satoshi Nakamoto. Bitcoin promises lower transaction fees than traditional online payment mechanisms and, unlike government-issued fiat currencies, is operated by a decentralised network. Bitcoins are neither issued nor backed by any banks or governments.

Despite it not being legal tender, Bitcoin is popular, and it is accepted as a medium of exchange in many places. Bitcoin’s price has been subject to spectacular volatility in recent years and this volatility has resulted in a lack of confidence in Bitcoin as a medium of exchange or as a store of value and raised concerns among central banks as to the viability of cryptocurrencies as CBDCs.

Figure 2: Comparative price movement of Bitcoin vs the Australian Dollar 2013-2020

Source: coindesk.com; RBA; RMIT

1 Nakamoto (2019).
2.4.2 ETHER – THE DIGITAL CURRENCY OF ETHEREUM

Launched in 2015, Ethereum is a programmable blockchain-based software platform with its own Internet browser, coding language and payment system. While Ethereum is sometimes compared directly to Bitcoin, its native cryptocurrency Ether (ETH), is a direct competitor to Bitcoin.

Ethereum is the infrastructure, the platform, and the operating system while Ether is the currency. ETH is like Bitcoin, in that it is purely digital, fully decentralised outside any state control. An important distinguishing feature of Ethereum platform compared to the Bitcoin blockchain is that it allows for the operation of smart contracts, and therefore programmable money and payments.

**Note:** The Reserve Bank of Australia has issued a statement that it is considering running a CBDC program on the Ethereum network.

2.4.3 XRP – THE DIGITAL TOKEN OF RIPPLE

‘Ripple’ is an alternative platform to Ethereum. XRP is the principal currency used on this platform, with the capability to facilitate payments like any currency or card. Unlike Bitcoin or Ethereum, Ripple does not operate on a blockchain network per se. Ripple has its own patented technology – the Ripple Protocol consensus algorithm (RPCA) – to verify transactions.

Ripple and XRP enjoy the trust of many banks as a model for CBDCs because it is highly centralised and is based on a permissioned network where only certain network nodes can validate transactions, as opposed to decentralised and permissionless Bitcoin and Ether (Takashima, 2018; Chase & MacBrough, 2018). Ripple also allows the creation of new currencies and Ripple developers can decide the timing and quantity of supply in a similar way to current central bank operations.

**Note:** France’s central bank, Banque de France, has openly discussed Ripple/XRP as a possible platform for Europe’s central digital currency.
2.4.4 STABLECOINS

In response to concerns about the price volatility of Bitcoin and other cryptocurrencies, ‘stablecoins’ were created to instil stability and foster confidence in cryptocurrencies. This can be done by three main methods:

1. Backing stablecoins by fiat currencies or commodities that have purchasing power (e.g. US Dollar or gold). An example is Gemini dollar, a stablecoin built on the Ethereum network, issued by Gemini (a New York trust company) and pegged 1:1 to the U.S. dollar.

2. Backing stablecoins by other cryptocurrencies. An example is MakerDAO’s token (DAI). According to MakerDao (n.d.) while DAI is pegged 1:1 with the USD, it is collateralised with Ether.

3. Issuing seigniorage style stablecoins that are not backed by any asset but tied to an algorithm. This model uses autonomous algorithms designed to govern the stablecoin’s money supply. This can be in the form of a smart contract controlling the coin supply and based on the demand, the algorithm will automatically change the supply of the coins to keep the price stable.

In these ways, stablecoins, although largely unproven thus far, promise greater stability in value than standard cryptocurrencies. For this discussion of CBDCs, we will only focus on stablecoins backed by fiat currencies. In theory, the stablecoin concept could potentially develop into a global stablecoin by pegging it to a basket of fiat currencies which would further reduce volatility and increase cross-border settlement efficiency – this is the premise that underpins Facebook’s Libra (Libra Association, 2020).
The BIS G7 Working Group Report on Stablecoins\(^8\) warns that global stablecoins (GSCs) like Libra present systemic risks and pose challenges to monetary sovereignty:

“GSCs could have significant adverse effects, both domestically and internationally, on the transmission of monetary policy, as well as financial stability, in addition to cross-jurisdictional efforts to combat money laundering and terrorist financing. They could also have implications for the international monetary system more generally, including currency substitution, and could therefore pose challenges to monetary sovereignty. GSCs also raise concerns around fair competition and anti-trust policy, including in relation to payments data. These risks, which are of a systemic nature, merit careful monitoring and further study. Both benefits and risks of GSCs may affect some countries more significantly than others, depending on the state of development of their existing financial and payment systems, the stability of their currencies and their level of financial inclusion, among other factors.”

Suffice to note here that while stablecoins might be backed by fiat currencies and may achieve global usage and price stability akin to that of fiat currency, stablecoins in their own right are still not fiat currency claimable on the balance sheet of a central bank, simply because they are not issued by central banks.

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**Cryptocurrencies as Fiat Currencies? An emerging view at law**

An interesting question to ask is “are cryptocurrencies legally equivalent to fiat currency?” So far, we have considered the scenario where cryptocurrency as fiat currency only when the legal tender status is conferred on it by a government or monetary authority. Recently, courts have been called upon to make determinations as to the legal standing of cryptocurrencies as mediums of exchange or stores of value. In a recent (unpublished) decision, the Commercial Court of Nanterre in France found that “Bitcoin is an intangible asset with an exchange value, equivalent to fiat money at law” (emphasis added) (Benhamou, 2020). This, along with a January 2020 UK High Court decision\(^9\) recognising digital currency as property, and a February 2020 NSW District Court decision\(^10\) that acknowledges digital currency as a store of value, the legitimacy of digital and cryptocurrencies is gaining credence from a legal and economic standpoint.

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\(^8\)Bank for International Settlements (2019).

\(^9\)Bailii (2020).

\(^10\)Austlii (2020).
3.0 CENTRAL BANK DIGITAL CURRENCIES – OUTLOOK

Having reviewed various forms of digital currencies and placed CBDCs in the context of digital currencies and cryptocurrencies, we turn our attention to how CBDCs currently fit into the global economic landscape. In this section we:

• chart the rise of interest in CBDCs
• consider different forms of CBDCs
• present potential advantages and disadvantages of CBDCs.

3.1 CENTRAL BANKS AND THE RISE OF INTEREST IN CBDCS

Widespread discussion of CBDCs emerged around 2014 with central banks exploring the question about whether cryptocurrencies would compromise the authority of fiat currency and/or eventually replace it altogether as a medium of exchange. The Bank of England was one of the first organisations to initiate a global discussion on the prospects for the introduction of a CBDC in 2014 (Broadbent, 2016). In the same year, China launched a project on Digital Currency/Electronic Payments (DCEP) with the aim of partially digitising China’s existing monetary base or cash in circulation. Since then, there has been research within individual countries and collaborations between countries to investigate numerous aspects of issuing CBDCs. The Bank of Canada launched its ‘Project Jasper’ to understand how DLT could transform the wholesale payments system. The central bank of Uruguay announced a test issuance of digital Uruguayan pesos. The Monetary Authority of Singapore launched ‘Project Ubin’ to test methods of conducting cross-border payments using CBDC.

The Republic of the Marshall Islands issued the Sovereign Currency Act of 2018 that introduced a new blockchain-based currency called the ‘SOV’. These are only a few from a very long list of projects underway among governments and central banks.11

Central banks concern over the possibility of a ‘global digital currency’ bypassing monetary authorities has stimulated research and experiments in CBDCs. A National Bureau of Economic Research (NBER) paper also argued that in light of private organisations developing digital currencies which could potentially be adopted by the wide population, “scenarios in which the central bank does not produce any form of digital currency may be associated with a number of salient risks, including macroeconomic instability (Bordo & Levin et al., 2017).”

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11 For a more comprehensive list of CBDC projects, see Appendix.
More recently, the COVID-19 pandemic has increased the attention on CBDCs, as banknotes and coins are perceived to be a vector of virus transmission. Many businesses around the globe now actively discourage payment by physical cash, giving further concern to governments and central banks that consumers may demand alternative, digital means of payment. The US Democrat draft bill for COVID-19 of 23 March 2020 introduced the concept of a Digital Dollar even though it was later removed in the Final Bill.

Benoît Cœuré, Head of the BIS Innovation Hub, remarked in his 17th April 2020 speech that:

“The current discussion on central bank digital currency also comes into sharper focus. Whether Covid-19 will accelerate the demise of cash is an open question. But already, it highlights the value of having access to diverse means of payments, and the need for any means of payments to be resilient against a broad range of threats.”

Facebook’s Libra

While central banks were thinking about cryptocurrencies, it took a private sector development to spur them on in their exploration of CBDC:

- In December 2018, Bloomberg reported on Facebook developing a stablecoin pegged to the US dollar.
- In May 2019, the US Senate Banking Committee (2019) wrote an open letter to Facebook requesting details on its cryptocurrency project.
- In June 2019, Facebook released its first white paper on its cryptocurrency ‘Libra’, to be built on a Libra Blockchain (Libra Association, 2019). Libra would be used by Facebook’s 2 billion-plus users and be stored on Facebook’s e-wallet named Calibra.
- The Libra project initially included venture capital firms, credit card companies Visa and Mastercard and disruptive technology giants, including Uber. However, some firms subsequently withdrew from the Libra project citing various reasons (e.g., Visa).

Libra White Paper Version 1.0 designed Libra as fully backed by a basket of major currencies and US Treasury securities to minimise volatility. Facebook’s stated motivation for Libra is an endeavour to use large-scale innovation to promote financial inclusion, compliance, and competition and reach the 1.7 billion-plus people who are either unbanked or underbanked around the world. Facebook positioned Libra as a ‘global, digitally native currency that brings together the attributes of the world’s best currencies: stability, low inflation, wide global acceptance, and fungibility’ (Libra 1.0, p7) and while left unspoken, bypassing central banks.

Central banks globally expressed strong concerns that Libra will interfere with monetary sovereignty and monetary policy. These concerns placed Facebook under intense public scrutiny. Shortly after the release of Libra’s whitepaper, a U.S. House lawmaker called on Facebook to halt development on its new cryptocurrency and for Facebook’s executives to testify before Congress. Moves were made in July 2019 to ban Facebook from the finance industry (Smith, 2019). In the same week, German news magazine Der Spiegel reported that Germany would deny access to Libra and other ‘private’ currencies (Rosenbach, 2019).

Amidst the intense political pressure and in the wake of data privacy concerns surrounding Facebook’s operations, some of the original supporters of Libra, including PayPal, Visa and Mastercard, withdrew from the project Libra (Association, 2020). This led to a “Libra 2.0” whitepaper released in April 2020, stating that the Libra network will be “designed to be a globally accessible and low-cost payment system – a complement to, not a replacement for, domestic currencies” (Libra 2.0, p10). Libra would no longer be pegged to multiple fiat currencies but will use single currency stablecoins instead, separating it from the ‘official’ fiat money system.

12Libra Association (2020)
There are also developing collaborations across borders: the leaders of six major central banks (Britain, the ECB, Japan, Canada, Sweden and Switzerland) and the BIS are undertaking joint research on digital currencies. Boar et al. (2020) conducted a BIS survey published in January 2020 pointing out that:

“Most central banks are still working to understand the implications for their jurisdiction and a significant minority, representing a fifth of the world’s population, look likely to issue a CBDC very soon.”

Motivations and applications for CBDCs are likely to differ between economies. The promises of blockchain and DLT platforms to help solve long-standing challenges in banking and payments system efficiency, payments security and resilience, financial inclusion motivate their research. The potential disruption to developed economies’ advanced infrastructure provides a rare opportunity to catch up to or leapfrog developed economies.

**Example: Tunisia**

In 2015, Tunisia became the first country in the world to issue a blockchain-based national currency called the “eDinar”, based on a platform developed by Swiss software firm Monetas. The eDinar’s distribution and issuance are managed by the government-owned Tunisian postal service La Poste Tunisian (LPT). Monetas CEO Johann Gevers commented on the launch (Thepaypers, 2015).

“The Monetas deployment in Tunisia is the first application for a full ecosystem of digital payments. With the La Poste Tunisienne Android application powered by Monetas, Tunisians can use their smartphones to make instant mobile money transfers, pay for goods and services online and in person, send remittance, pay salaries and bills, and manage official government identification documents.”

Countries also need to consider the implications and repercussions of international trade. A CBDC used as an international means of exchange could improve the efficiency of cross-border payment systems, which are currently costly, slow, and opaque.
3.2 WHOLESALE OR RETAIL CBDC

Most central banks separate CBDC implementation into two segments:

1. **Wholesale CBDCs** – digital fiat money for use between financial institutions, central banks and government departments; and

2. **Retail CBDCs** – digital fiat money issued for the general public.

Wholestate CBDCs can potentially improve payments, securities settlement, cross border transactions and reduce counterparty credit and liquidity risks. Currently, wholesale CBDCs appear to be more popular among central banks due to the potential to make existing wholesale financial systems more efficient while reducing transaction costs and improving security. Wholesale CBDC projects to date include Canada’s Project Jasper, Singapore’s Project Ubin, Japan-Euro Area’s Project Stella and Thailand’s Project Inthanon.

Retail CBDCs appear to be more popular amongst emerging economies. In many developing economies there is already a level of acceptance of digital or virtual money, established through systems of payments and remittances via mobile phone credit. Just as many developing nations in the 1990s and early 2000’s moved to cellular phone networks and bypassed landline infrastructure, digital currencies can promote financial inclusion by accelerating the shift to a cashless society where physical cash distribution and payment infrastructure is poor or unreliable.

They can also reduce cash printing and handling costs, for example, China’s digital RMB (Digital Currency Electronic Payment) and Eastern Caribbean Central Bank’s CBDC (referred to as the DXCD). A key challenge posed by retail CBDCs for most central banks is that central banks traditionally do not manage individuals’ accounts and thus lack the experience and infrastructure to do so.

The motivation for CBDC is not simply to digitise retail money as most money transactions already occur digitally. It is no small challenge to design a perfect retail CBDC which is cash-like, enables efficient transmission of monetary policies, has a seamless interface during all payment transactions, is highly secure, and allows for effective law enforcement in the areas of money laundering and data privacy.

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13 This is evidenced by central banks from emerging market economies such as Tunisia, Cambodia, East Caribbean, Bahamas, China, etc. already launching pilot projects for retail CBDC while no advanced economies had launched retail CBDC at the time of writing.
3.3 POTENTIAL ADVANTAGES OF CBDCS

More generally, there are several advantages and disadvantages of CBDCs. Major advantages include:

**More efficient payment systems**

CBDCs can decrease costs and enhance the efficiency of payment systems especially in geographically challenged countries or developing countries where payments infrastructure is not robust or well-developed (Bank for International Settlements, 2019). Payments do not depend on systems or infrastructure for moving notes and coins that may be slow, unreliable, or corrupt. Payments made and received via a ‘digital wallet’ directly from payer to payee do not rely on bank accounts and clearing systems between banks that introduce delays and additional handling costs.

**Reduction in the physical costs associated with paper money**

CBDC may further reduce the demand for notes and coins for payments, therefore reducing the cost of minting coins and printing notes, associated distribution and transportation costs, secure storage costs, and ATM security and maintenance costs, to name a few.

**Enhanced financial inclusion**

Digital currencies provide a public digital means of payment without requiring individuals to hold a bank account, thereby allowing the unbanked to participate more easily in the payments system. This is one of the key reasons why Facebook proposed Libra – to reach people living without access to any form of identification and excluded from regulated financial services. As noted earlier, payments are typically made and received via a digital wallet owned by an individual and payments are typically direct from payer to payee, without the need for a bank account. In many developing economies remittances are already being made via transferring phone credit. Cryptocurrencies, CBDCs and secure digital wallets promise greater security and interoperability between systems. Notably, a minimum level of digital infrastructure is required to realise this advantage which is not the case in some countries.

**Increase stability and lower barriers to entry for new firms in the payments system**

Where there is an increasing concentration of payment systems in the hands of a few, very large companies (for example, major banks, Paypal, Apple Pay, Google Wallet, Alipay and WeChatPay), having a CBDC can enhance resilience and stability of the payments system and increase competition in the sector by lowering barriers to entry for new firms.
Easier to track money in an economy

Notes and coins are anonymous, untrackable and untraceable – since CBDCs will be operating online only with data stored digitally, central banks (and therefore other authorities) will be better able to track money movements. This feature has the potential to help with anti-money laundering, organised crime and terrorism funding. Governments may also be able to raise more tax revenue by reducing the opportunities for tax evasion as CBDCs – due to their traceability – make it harder to operate in the black economy. The technology behind CBDCs make them more transparent and secure because of immutability and append-only databases, hence they are incentive-compatible and consistent in their use.

International trade and finance

The flow of international transactions like international transfers and cross-border trade finance promises to be faster and more secure with CBDCs. CBDCs also promise to reduce international transaction cost, and counterparty risks and the number of intermediaries. The cost of executing international transactions via correspondent banking – when a bank acts on behalf of another financial institution – are expected to decrease significantly.14

Reduced risk of bank runs

In the event of a credible threat of a bank run, some steps could be taken quickly by policymakers to limit potential runs through adding a notice period for large CBDC withdrawals; limiting the balances available for CBDCs for each type of depositor; or imposing fees on large balances of CBDCs, or removing the requirement for banks to convert deposits to CBDCs. Under a stress scenario, such as the threat of a bank run, CBDCs are said to represent a near risk-free option which would be available faster and with less friction than redeeming money as notes and coins.

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14 A report by McKinsey estimates that international transactions via correspondent banking ranges from US$25 to US$35 per transaction (Niederkorn et al., 2016).
3.4 POTENTIAL DISADVANTAGES OF CBDCS

Major disadvantages of CBDCs include:

Potential threats to the banking sector

Given CBDCs enable peer-to-peer payments between secure digital wallet holders, the traditional function of banks of performing intermediary roles will be challenged. In particular, reduced demand for payment services and transaction accounts.\(^{15}\)

Depending on the extent of migration away from conventional deposit accounts, banks and other deposit-taking institutions may experience a significant reduction in this component of their supply of loanable funds. Banks may be pressed to raise deposit rates or access more expensive (and volatile) wholesale funding, weighing on profitability and possibly leading to more expensive or lower provision of credit to the real economy.

Central Bank balance sheets and credit allocation implications

Central bank balance sheets could grow considerably in the event of high CBDC demand. Additionally, the central bank may need to provide liquidity to banks that experience funding outflows. As a result, central banks would take on credit risk and must decide how to allocate funds across banks, potentially opening the door to political interference.

Costs and risks to the central bank

Offering CBDC could be very costly for central banks. Offering a full-fledged CBDC, as they are currently understood, would require central banks to be active along several steps of the payment chain, potentially including interfacing with customers, selecting and maintaining technology, offering digital wallets, monitoring transactions, and being responsible for anti-money laundering (AML) and counter-terrorism funding (CFT) surveillance (Bank for International Settlements, 2018). Failure to satisfy any of these functions because of technological glitches, cyberattacks, or simply human error, could undermine the central bank’s reputation. There are also likely to be extensive costs associated with the start-up of a CBDC, including infrastructure setup costs, running parallel with notes and coins, and education in their jurisdictions.

Data privacy and public fear of surveillance

CBDCs are said to facilitate easier monitoring of payments and linkage to identity. The collection of data may be positive, for example giving better information to the central bank and policymakers on areas to target with monetary or fiscal policy. However, the public may fear that the central bank is monitoring their habits and activities and be (reasonably) concerned about security of data storage, and access to and ownership of their data. A central bank able to view, evaluate, track and trace transactions may be able to prevent some transactions proceeding, or in extreme cases could freeze accounts completely. Some members of society may feel that their freedom and liberty are being restricted. Also, there is fear by some citizens that the government might use the CBDC to track their movements.

\(^{15}\) For a thorough discussion of potential disintermediation effects, see the European Central Bank’s January 2020 Working Paper “Tiered CBDC and the Financial System” (Bindseil, 2020).
3.5 CBDC AND GOVERNMENT POLICY

Policy implications of CBDCs depend on the design of CBDCs and how they are applied. CBDC design considerations are often country- and economy-specific, payments infrastructure efficiency, cash usage and financial inclusion rates differ.

It is not the intent of this report to include all permutations of CBDC designs but we will discuss the major design features currently being considered by central banks.

Smart contracts and monetary policy:

A dimension of CBDCs not yet well-understood is the potential of smart contracts in executing monetary policy. Interest ‘programmed’ on CBDC enhances what interest rate policies can do. If smart contracts on CBDC can be programmed with interest rates, interest rates can then be set to target specific sectors to achieve the required results as opposed to a single blanket policy rate (as is currently available). Monetary policy would be simplified as the central bank would simply use the interest rate paid on certain accounts as its main policy tool.

Interest rate management

As discussed in the appendix, the main monetary policy tool used by central banks is interest rates, manipulated to manage the supply of money in circulation. When inflation and economic growth is low, central banks cut interest rates to stimulate demand in the hope of achieving higher economic growth. When interest rates are extremely low, policymakers start to meet the ‘zero lower bound’ problem of money. When interest rates fall to zero or into negative, it is better for lenders to hold cash rather than lend at negative rates. When this point is reached, central banks can no longer use interest rates to stimulate the economy – this phenomenon is commonly termed a ‘liquidity trap’. If an interest-bearing CBDC is used, then a negative interest rate can be ‘programmed in’ and appropriate policy action implemented quickly and effectively to allow for effective transmission of monetary stimulus in a sharp downturn or financial crisis, potentially avoiding recession, high unemployment and/or deflation.
Quantitative Easing

During and after the Global Financial Crisis, central banks in the US, UK, Europe and Japan purchased assets from the private sector and funded these purchases with newly created central bank money, a policy action known as “quantitative easing” (QE). QE is also being used by the RBA in response to COVID-19’s destabilising impacts on the Australian economy. QE is designed to have the same economic effects as an interest rate cut would. In a low-interest-rate environment, there is little room left for central banks to further cut interest rates to stimulate the economy, and QE is seen to accelerate monetary easing. RBA’s Governor Philip Lowe commented that ‘...as low-interest rates are likely to accompany us for some time, QE is also likely to serve as a tool which central banks will use increasingly” (Lowe, 2019). In a QE program, commercial banks usually serve as the intermediary between non-banks and the central bank to facilitate asset transfers. With a CBDC designed to be accessible universally, central banks can transact directly with non-bank financial institutions as it deems fit and has more direct onward transmission of QE measures.

Cybersecurity, data access and data privacy

CBDC implementation would also need to consider maximising trust through enhanced security over current systems. For example, users would need to have a right to access and share their data as they choose in a structured and standardised format.16 Additionally, users would also need to have the right to dispute the accuracy of their data and to have erroneous data promptly corrected, updated or deleted. Although blockchain-based CBDCs promise greater security and trust, non-blockchain CBDCs might not. Central banks will also need to create precautions and robust cyber-resilience policies to reduce risks from cyberattacks.

*This goes beyond cybersecurity to include data ownership and privacy.
4.0 APPROACHES TO CBDC BY SELECTED CENTRAL BANKS

In Section 3, we introduced and commented on a range of general attributes and considerations about CBDCs. In this section, we take a closer look at four major central banks that have taken steps towards investigating CBDCs – the RBA, the PBoC, the ECB and the US Fed. Each of these central banks manages a very different economy with differing authority, autonomy, and motivations.¹⁷

No two central banks execute monetary policies in the same way even though they may have common goals. There are substantial differences in the economies managed by the central banks and the autonomy that each central bank has. For example, Australia is a small, open, developed economy while China’s economy is the second-largest in the world, varied and still developing. The European Union (EU) operates a single monetary policy for 19 different economies, with each member state having its own local peculiarities. The degree of central bank autonomy in a country reflects the local political system. An idealised view is that central banks should have ‘instrument independence’ but not ‘goal independence’.¹⁸

Instrument independence refers to the central bank’s ability to freely adjust its policy tools in pursuit of the goals of monetary policy, while goal independence refers to the central bank’s ability to determine the goals of policy without the direct influence of a fiscal authority. In the Australian case, the government sets the inflation target for the central bank (goal dependence) but allows the central bank to adjust interest rates and/or other instruments as they deem fit to achieve the target (instrument independence (RBA, 2020)).

¹⁷ see Appendix for a full list of currently ongoing CBDC projects.
4.1 THE RESERVE BANK OF AUSTRALIA’S APPROACH TO CBDC

In late 2018, the RBA established its ‘Innovation Lab’ for new and emerging technologies relevant to its policy and operational responsibilities. The Innovation Lab is also being used to explore the viability of an Australian CBDC either wholesale, retail, or both. In its exploratory work, the Innovation Lab developed a proof-of-concept of a wholesale settlement system running on a private, permissioned Ethereum network, which was announced in December 2019. This proof-of-concept simulated the issuance and exchange of central bank-backed tokens to commercial banks, similar to a wholesale CBDC setup. A wholesale CBDC is viewed favourably by RBA as seen in RBA’s 2019 December’s submission to the Senate Select Committee on Financial Technology and Regulatory Technology.19 The RBA stated that a wholesale CBDC would have the following potential benefits:

1. **Speed, cost and robustness of payments** - A CBDC fully integrated into a blockchain platform could enable payments to be made between participants in real-time and 24/7 without relying on external payment systems.

2. **Atomic transactions** - A CBDC integrated within a blockchain platform could more easily allow for ‘atomic’ transactions. An atomic transaction is ‘all or nothing’, meaning that either all parts of the transaction are executed or none. When applied to delivery-versus-payment, this can reduce settlement risk as payment and corresponding asset can be exchanged simultaneously.

3. **Programmable money** - A CBDC in combination with a smart contract on a blockchain may enable new kinds of ‘programmable money’. This refers to the ability to encode conditions to how money can be spent or transferred, which could be automatically executed, without the need for a trusted third party.

While RBA takes the view that an Australian wholesale CBDC could bring potential benefits, it thinks that there is little need for the adoption of a retail CBDC (designated the e-AUD). The RBA has a portfolio of existing digitisation initiatives in different parts of Australia’s financial system that it considers will collectively achieve the end positives of a retail CBDC but by other means. Examples of these initiatives include:

- **The New Payments Platform (NPP)** was launched publicly in Feb 2018, to provide fast, flexible and data-rich payments to support the needs of Australia’s modern economy:20

NPP is a significant advancement in the Australian payments system with ‘24/7’, no downtime, immediate ‘pay anyone’ facility for customers of financial institutions. Since its launch, NPP payments usage has grown significantly and reached more than 50 per cent of Australian accounts reachable by the ‘pay anyone’ system. More than 4.1 million PayIDs was registered and an average of 1.1 million payments worth $1 billion AUD per day was made in January 2020 (Fitzgerald & Rush, 2020). Monthly NPP volumes have grown to a rate that surpasses that of overseas fast payment systems such as Denmark’s ‘MobilePay’, Sweden’s ‘Swish’ and the UK’s FPS systems, making it a success thus far. Moving forward, the NPP is expected to continue to develop its range of functionality and deliver new payment services and innovations.

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19 Submission to the Senate Select Committee on Financial Technology and Regulatory Technology (Galloway et al., 2020).
Fast Settlement Service (FSS) developed in conjunction with NPP

The FSS is a new infrastructure of Australia’s existing interbank settlement system, the Reserve Bank Information and Transfer System (RITS). FSS is operable by RBA and used by banks and approved institutions to settle payment obligations with each other. The settlement of the transactions between the financial institutions also happens on a 24/7, no downtime basis across their Exchange Settlement Accounts (ESAs) at the RBA, as distinct from the overnight processing by RBA with delays of up to several days within the banks themselves.

These new systems have brought fast payment services to Australians in line with similar initiatives undertaken internationally. For the Australian payments system, the NPP will contribute to improving resilience by providing a new, fast means of making retail payments. Furthermore, since it is a Real Time Gross Settlement (RTGS) system, the NPP can, if required, be used as an alternative to the traditional methods of making wholesale interbank payments through the RITS (Rush & Louw, 2018).

In its 2019 senate select subcommittee submission the RBA articulated its position that it does not see value in pursuing a retail CBDC for Australia but that there is potential for a CBDC to benefit the wholesale financial sector:

“The Bank is not currently considering a CBDC for retail use but notes the availability of a wholesale settlement token based on DLT could allow payment and settlement processes to become more integrated with other business processes. It is not yet clear if there would be demand for a CBDC for wholesale settlement – it is worth noting, for example, that ‘a government-supported digital sovereign currency’ was recently ranked as the least effective of 14 possible policy initiatives for promoting growth in the Australian fintech industry (EY and FinTech Australia 2019).”

Subsequent to the NPP and FSS initiatives, and extending the exploratory work in its Innovation Lab, the RBA announced in early November 2020 that it is partnering with National Australia Bank, Commonwealth Bank, Perpetual, and blockchain software company Consensys, on a proof-of-concept (POC) collaboration to explore more deeply the potential for a wholesale CBDC using DLT. Based on an Ethereum platform, the POC will be used to explore the potential of ‘atomic’ delivery vs payment settlement methods on a DLT. An ‘Atomic Cross-Chain Transaction’ (AC2T) is a distributed transaction that can span multiple blockchains while ensuring that all elements of a transaction are completed across all chains (the atomicity property ensures that either all sub-transactions take place or none of them do). The project will also explore other programmability and automation potentials of tokenised CBDC and other financial assets. Assistant Governor (Financial System) Michelle Bullock said:

"With this project we are aiming to explore the implications of a CBDC for efficiency, risk management and innovation in wholesale financial market transactions. While the case for the use of a CBDC in these markets remains an open question, we are pleased to be collaborating with industry partners to explore if there is a future role for a wholesale CBDC in the Australian payments system."22

The joint proof-of-concept project is expected to be completed in 2020 and report its findings in the first half of 2021.

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21 Submission to the Senate Select Committee on Financial Technology and Regulatory Technology (Galloway et al., 2020).
4.2 THE PEOPLE’S BANK OF CHINA APPROACH TO CBDCS

The PBoC is responsible for carrying out monetary policy and regulation of financial institutions, similar to most other central banks, but it is not independent of the government. It is formally a department of the State Council of China and is one of the 35 member organisations on China’s State Council. The PBoC’s top management is composed of the governor and a certain number of deputy governors who are appointed by the National People’s Congress. The PBoC is funded and essentially run by the Chinese government and its operational autonomy is restricted to technical aspects of monetary policy implementation. This limited policy independence and accountability is a substantial point of difference between the PBoC and the RBA, the US Fed and the ECB.

4.2.1 WHAT HAS PEOPLE’S BANK OF CHINA DONE TO DATE?

The PBoC started its CBDC exploration in 2014 with a specialist research team tasked with examining the technical and regulatory dimensions of CBDCs. After numerous reviews and scoping projects and seminars with Chinese banks and technology companies, the PBoC set up ‘The Digital Currency Research Institute’ for the development of DCEP solutions. The PBoC’s Digital Currency Research Institute also launched a company named Shenzhen Fintech Co. Ltd. in June 2018 with a specific business scope of “fintech-related technological development, technological consulting, technology transfer and technological services, fintech-related systems development and operations maintenance” as part of PBoC’s toolset for launch of China’s DCEP.

In April 2020, China commenced pilot tests, in four cities: Shenzhen, Suzhou, Chengdu and Xiong’an. These pilot projects are internal closed-circuit tests. Another test is planned for Beijing during the 2022 Winter Olympic Games (Wu, 2020).

At the time of writing, the PBoC has not announced a schedule for the eventual launch of DCEP but its key technological partner for DCEP’s development, AliPay has filed more than 80 patents which are believed to be for the technologies developed for DCEP, indicating that the PBoC is probably developing proprietary technology for its DCEP.

As reported by Tang (2019), on 10 August 2019, Mu Changchun, vice-head of the payments and settlement department of the PBOC (2020) said:

“It can be said that a central bank digital currency is on the verge of release”. and “the PBoC’s DCEP would maintain a centralised operating model, as opposed to cryptocurrencies that are decentralised in nature.”

Additionally, during China’s 2020 National Money, Gold, Silver and Security Protection Teleconference held in Beijing, the PBoC said that it would “firmly and unwaveringly advance statutory digital currency research and development.” The PBoC also expressed that the DCEP would be on a “two-tier operating system”, consisting of both wholesale and retail CBDCs.

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23Seven different instruments are listed on PBoC’s website.
24Financial Times (2020).
4.3 THE EUROPEAN CENTRAL BANK’S APPROACH TO CBDCS

The Euro is the second most widely-used currency in foreign exchange trading after the US dollar and is the second most widely held foreign exchange reserve currency (19-21% of global reserve currency) according to the IMF’s Composition of Foreign Exchange Reserves 2019Q3 report (IMF Data, 2019, see charts below). Such widespread global engagement also implies a substantial increase in the number of transactional applications to be considered for the implementation of a CBDC compared to a currency that has less global engagement.

The ECB defines the monetary policy for the whole euro area – a single monetary authority with a single monetary policy aimed at maintaining price stability across the zone. The ECB is independent of EU official bodies and from the governments of the EU Member States. The ECB also has its own budget (ECB, 2020). The ECB’s job of managing monetary policy across 19 countries, each with its own economic peculiarities, is a complicated matter and includes considerations that are markedly different from those of the RBA and PBoC.

Figure 5: World reserves by currency

Source: RMIT, IMF
4.3.1 WHAT HAS THE ECB DONE TO DATE?

The ECB started exploring the feasibility of CBDCs in 2017. A task force has also been instructed by ECB’s President Christine Lagarde in late 2019 to support ECB’s active involvement in the research and development of CBDC to address the demand for faster and cheaper cross-border payments.

In December 2019, ECB’s EUROchain research network, supported by global consulting firms such as Accenture and R3, and with R3’s blockchain platform Corda, designed a semi-anonymous DLT-based CBDC prototype and announced plans to test this prototype (ECB, 2019). The project studied the balance between privacy and compliance procedures while using DLT to drive down the cost of transactions. The ECB proposes a retail CBDC system of ‘tiered remuneration’ that does not disintermediate banks.

Tiered remuneration systems have been used by central banks for some time. The central banks of Denmark, Sweden, Switzerland, and Japan all currently operate tiered systems of interest paid to banks’ reserve deposits held with the central bank, and the Eurosystem Reserve Management Services offers a tiered interest system for foreign central banks and public sector funds. The tiered CBDC system proposed by the ECB would segregate CBDC deposits into two tiers (similar to the current tiered remuneration systems and thus will cause fewer disruptions) instead of the single-tier CBDC which was originally proposed during CBDCs’ first conceptualisation.

The ECB posits that the tiered remuneration scheme solves many of the CBDC-related issues identified in the literature (Bindseil, 2020), in particular, the possible exclusion of commercial banks from the payments system – and the concomitant risk that the burden of facilitating payments would shift entirely to the central bank.

4.3.2 WHAT DOES THE ECB PROPOSE TO DO?

The ECB proposes to accelerate the exploration of CBDCs and to push for higher efficiency in its present digital payment systems. Specifically, in a December 2019 press conference, ECB President Christine Lagarde confirmed that CBDC exploration work will be accelerated, with inputs from the research efforts of individual European nations, to decide on two aspects:

- The purpose of digital currency (cost reduction, disintermediation, financial inclusion); and
- CBDC technicalities.

Lagarde opines that central banks need to be “ahead of the curve” concerning stablecoins and privately issued currencies. She also thinks that existing instant payment systems in the EU should be better utilised. These payment systems include TIPS (TARGET Instant Payment Settlement) launched at end of 2018 that enables instant real-time payments 24/7, and PEPSI (the Pan-European Payment System Initiative), set up by twenty European banks to work on bypassing companies like Visa, Mastercard, Google and Apple in payments settlements. Ms Lagarde further said:

“ECB will continue to assess the costs and benefits of issuing a CBDC that would ensure that the general public remains able to use central bank money even if the use of physical cash eventually declines.”
4.4 THE UNITED STATES FEDERAL RESERVE SYSTEM’S APPROACH TO CBDCS

The United States of America is the world’s largest economy - nominal GDP was valued at US$21.44 trillion in 2019 representing approximately one-quarter of the world’s economic activity (International Monetary Fund, 2020). US dollars are highly transacted holding a unique role within the global economy. This includes being the largest reserve currency and being widely used to facilitate international transactions. US monetary policies (changes in money supply), therefore, can, and do, influence activity in the global financial system. Any change to the system of money supply has the potential to have a global impact.

The Federal Reserve System was established by The Federal Reserve Act of 1913. It is independent of government in funding, policy-making and operational decision making. The US Fed self-funds via interest earned from assets held and does not require approval from the US Congress or the US President regarding its policy and operational decisions. As such it is established to largely insulated from political pressure.

The Fed executes its monetary policies primarily through open market operations (OMO) as determined by the Federal Open Market Committee (FOMC). The FOMC holds eight scheduled meetings a year where economists at the Board of Governors and the Reserve Banks analyse regional, national and international economic and financial conditions and vote on the US’ monetary policy actions. Decisions made by the FOMC have a global impact due to the size of the US economy, the reach of US corporations as well as the wide-spread use of the US dollar.

4.4.1 WHAT HAS THE FED DONE TO DATE?

The Fed, to date, has resisted supporting the development of a CBDC. However, after Facebook’s release of its initial Libra whitepaper (see section 4.4.4), Governor Brainard said in October 2019 that the Facebook Libra project “imparts urgency to the debate over what form money can take, who or what can issue it, and how payments can be recorded and settled.” (Brainard, 2019). In September 2019, US Republican Representative French Hill and Bill Foster asked the Fed if a US CBDC is being considered as they are concerned that “… the primacy of the U.S. Dollar could be in long-term jeopardy from wide adoption of digital fiat currencies” and “it may become increasingly imperative that the Federal Reserve take up the project of developing a U.S. dollar digital currency.”

However, the Fed Chairman, Jerome Powell’s response to Congress, in a letter dated November 20, 2019, reiterated that the Fed is different from other central banks and said that:

“…many of the challenges they (other central banks) hope to address (through CBDC) do not apply to the U.S. and “the characteristics that make the development of central bank digital currency more immediately compelling for some countries differ from those of the US.”

Like the RBA, the Fed is also developing its own real-time payments and settlement service “FedNow” which in their view obviates the need for a US CBDC – at least in the short term.
4.4.2 WHAT DOES THE FED PROPOSE TO DO?

Private and academic groups in the USA (for example, Facebook’s Libra and the Digital Dollar Project) are keenly enthusiastic about a US CBDC in a range of private or private-government cooperative models. Notably, the Fed maintains the stance that a US CBDC should primarily be their responsibility. The Fed has more recently accelerated its CBDC research efforts, motivated now not only by competitive pressure from alternatives but by practical issues arising from stimulus distribution and dissemination of quantitative easing measures undertaken in response to the COVID-19 pandemic.

In April 2020, a Bill was proposed under which the US Congress would authorise the Fed to create “FedAccounts,” or “Digital Dollar Account Wallets,” which would allow US residents and business to access financial services through an app on their phone. There seems to be less appetite for CBDCs in the US, however, we cannot rule out its adoption in the medium to long term as CBDCs become more common.

4.5 OTHER CENTRAL BANKS’ APPROACH TO CBDC

It is worth mentioning what other banks have done. A few other central banks of countries like Japan, Canada, Sweden, Switzerland, Singapore and Ecuador are among a growing list that are actively researching or piloting CBDC programs for wholesale money for use between governments and financial institutions and retail for everyday payments in the economy. Sweden’s central bank is testing its e-kronor, The National Bank of Cambodia has announced its intention to launch ‘Bakong’, while the Netherlands’ central Bank has signalled that it wants to ‘play the leading role’ in CBDC development.

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29 The Digital Dollar Project, launched in 2020, is a partnership between Accenture and the Digital Dollar Foundation (Atlantic Council Global Business and Economics Center and Harvard University Belfer Center) to encourage research and public discussion on the potential advantages of a digital dollar. The Project will develop a framework for potential, practical steps that can be taken to establish a dollar CBDC in an effort to catalyze the discussion around a tokenized U.S. Digital Dollar. Its first whitepaper argued for a tokenised US digital dollar to help maintain the US dollar’s world’s reserve currency status (The Digital Dollar Project, 2020).

5.0 SUMMARY AND CONCLUSIONS

The decision to issue a CBDC and in what form is a complicated matter. Consideration needs to be given to the type of technology to use, its suitability for monetary policy actions, its impact on the banking sector structure and international trade. Some countries have launched pilot simulations, others are reviewing and revising legislation to support the potential issuance of CBDCs. Some are researching the potential implications of competing for CBDC designs while a group of countries that do not see an immediate need to issue CBDC are instead focusing on improving existing payment systems (such as “fast payments”) without issuing CBDCs at all.

Digital currencies in their many forms represent a credible threat to existing payment systems. Central banks have responded to this emerging threat by investigating, developing or implementing digital currencies of their own, so-called CBDCs. Four central banks discussed in this report (the RBA, PBoC, ECB and the Fed) have set resources aside and continue to assess the feasibility of CBDCs. The PBoC is leading major central banks working on CBDCs and is most likely to be the first to launch its digital currency.

Central banks conduct monetary policy to achieve financial stability in the economy, while maximizing economic growth and employment, however, with varying degrees of authority. What distinguishes the PBoC from the RBA, the ECB and the US Fed, is that it is not an independent body. On the other hand, the ECB is proposing a retail CBDC and has already designed a CBDC prototype. The US Fed, while being a more complex organisation, effectively has policy independence and instrument independence.

China is at an advanced stage of the development of a CBDC, and currently conducting pilot tests in 2020 across four cities. Even though the actual launch date is unknown, China is looking into providing both wholesale and retail CBDCs, with an indication that the launch date is very near. In contrast, the US Fed has not advanced CBDC plans at the time of writing and has arguably resisted CBDC adoption. However, the rapid rise of potential, credible competitors to the US Dollar such as Facebook’s Libra seem to have motivated the Fed to consider a CBDC.

Given the advanced level of digitisation of Australia’s financial sector (FSS and NPP), the RBA does not foresee the adoption of a retail CBDC but is exploring avenues for a wholesale CBDC. The RBA has already developed a proof-of-concept model for a wholesale settlement system running on a private, permissioned Ethereum network.

The central banks we have discussed in this paper are all either investigating, prototyping or piloting a centralised operating model for their CBDCs, as opposed to the decentralised, blockchain-based operating models of non-state cryptocurrencies like Bitcoin and Ether. We suggest that through network effects more central banks are likely to explore, develop and adopt CBDC soon. The adoption of CBDCs has potential to improve utilisation of resources in the global economy through decreased domestic and international processing times, reduced transaction costs and increased security and transparency in financial transactions.
AUTHOR PROFILES

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Ashton is an applied econometrician at RMIT University’s School of Economics, Finance and Marketing, specialising in the analysis of credit & financial markets, government policy, the property (including housing) sector and natural resources. Highly sought-after for his insights and perspectives on current economic and social issues, he has published papers in leading international academic journals, as well as written several reports for organisations such as the Australian Securities and Investment Commission and the Australian Tax Office. He has a strong track record of performing economic evaluation for government, industry and academic audiences.

**Aviel Leong**
Aviel is an active researcher at RMIT University with more than a decade of experience in investment analyses and public policy research. She has successfully managed investment portfolios and research projects while working with various investment banks, consultancy companies, and government ministries. Specifically, Aviel has spent extensive time in banking industry research while working in Singapore, Shanghai, U.S., and Australia.

**Dr Tutsirai Sakutukwa**
Tutsirai received his PhD in Economics from Monash University. He is a Lecturer and a policy researcher at RMIT. Prior to his current role, he taught economics at Northern Illinois University (USA), Monash University, La Trobe University and held a senior consulting role at KPMG Melbourne office. His research focuses on applied economics/econometrics that informs policy decisions and on the impact of emerging technologies on economic sectors.

**Associate Professor Stuart Thomas**
Stuart is an established university learning and teaching leader, an experienced senior educator, and an active researcher. He has driven successful strategic initiatives higher education programs in Australia, Southeast Asia and in Europe and provided operational and policy leadership for a suite of undergraduate and postgraduate programs in business. Stuart also has extensive teaching and operational leadership experience in higher education programs delivered in Singapore, Malaysia, Vietnam and Hong Kong. His work has been published in A* and A-ranked international journals, he regularly presents his work at international conferences, and engages with industry leaders.
Monetary Policy – Inflation Rate Targeting, Interest Rates and the Money Supply

The concept of inflation is widely understood. In economics, we define it as a sustained increase in the general level of prices in an economy. Inflation describes an increase in the cost of living as the price of goods and services rise. Inflation rate targeting seeks to set a rate of inflation at a level that does not distort economic decisions in the society – so that firms do not increase the price of their products, while workers do not ask for higher wages. A central bank does this by setting a target rate of inflation, typically within a band and directing its monetary policy action towards achieving that target.

Central banks use interest rates as a tool for managing inflation, to dampen or stimulate economic activity so that the inflation rate is consistent with the target. Interest rates and inflation tend to be inversely related – lower interest rates tend to increase inflation and higher interest rates tend to decrease it. This relationship forms one of the central tenets of contemporary monetary policy: If the rate of inflation is below target, it implies that there is excess capacity in the economy and interest rates are lowered to stimulate economic activity. As interest rates decrease, savings decline, more money is borrowed, and more money is spent. Increased borrowing increases the total amount of money in circulation in the economy. The aims of lowering interest rates are fewer savings, greater money supply, more spending, and higher overall economic activity. When inflation is above the target range it may indicate that the economy is over-stimulated, in which case the typical monetary policy response is to raise interest rates.

As interest rates are increased, consumers tend to save as returns from savings are higher, and to borrow less as loans become costlier to service. With less disposable income available as a result of the increase in the interest rate, consumer spending and business investment slows and inflation decreases. Changes in interest rates take time to affect an economy, therefore central banks typically look to inflation forecasts when deciding what is a desirable interest rate today.

Interest rate management tools available to Central Banks include interest rate setting, open market operations (OMO), and (less commonly) adjusting the reserve requirement ratio.

Interest Rate Setting:

Interest rate setting involves the direct setting of short-term interest rates. In Australia, the RBA sets the official cash rate. The rate is increased if inflation expectations are higher than the target range or decreased if inflation is expected to persist below the target rate.

Example: Australia’s inflation target is to keep annual consumer price inflation between 2 and 3 per cent, on average, over time. The measure of consumer price inflation used is the percentage change in the Consumer Price Index (CPI). The CPI measures price level changes – occurring over time – in retail prices of an unchanging basket of goods and services that represents the spending pattern of Australian households. The CPI is considered a suitable measure of inflation to target because it captures price changes for the goods and services that households generally buy.

The ‘basket’ includes items such as food, alcohol and tobacco, clothing and footwear, housing, household contents and services, health, transportation, communication, recreation, education and financial and insurance services. Indexes are compiled and published for each State capital city, plus Darwin and Canberra. The national index is constructed as the weighted average of the indexes for each of the eight capital cities.
Open Market Operations (OMO):

A central bank will typically hold a stock of its government’s treasury bonds. OMO allows the central bank to buy or sell treasury bonds in the open market. The logic of this process is simple: to lower interest rates the central bank buys bonds in the open market, and by paying for them from its cash holdings with cash it injects cash into the economy, increasing the supply of money. This increase in money supply results in a decrease in the price of money in the economy (the interest rate). Conversely, if the central bank sells bonds, it decreases the money supply by removing cash from the economy, reduced supply pushes interest rates higher.

Reserve Requirements:

Many central banks (for example, the RBA, the US Fed) carry regulatory responsibility for deposit-taking banks and other financial institutions in their domestic economy. Banks are typically required to maintain some level of holdings in cash and ‘near cash’ or marketable securities, including reserve deposits with the central bank.

Example:

The Reserve Requirement Ratio set by the US Federal Reserve is the level of cash reserves a bank must hold relative to its deposit liabilities. By adjusting the reserve ratios applied to deposit-taking institutions, the central bank can effectively increase or decrease the amount these facilities can lend. To illustrate: if the reserve requirement is 5% and the bank receives a deposit of $500, it can lend out $475 of the deposit and is required to hold $25, or 5%. If the reserve ratio is increased, the bank is left with less money to lend out for each dollar deposited. This reduction in available loanable funds reduces the supply of money circulating in the economy.

Successful inflation rate targeting by the central bank seeks to anchor economic agents’ expectations to low levels of inflation – that is, when the society believes that the actions of the central bank are correct, inflation rates stay within the target range.
<table>
<thead>
<tr>
<th>CBDC Type</th>
<th>Country</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>Australia – e-AUD</td>
<td>RBA’s Innovation Lab developed a proof-of-concept of a wholesale settlement system running on a private, permissioned Ethereum network, which was announced in December 2019 and opined that Australia’s current payment systems are sufficient and has no need for e-AUD (retail CBDC) for the moment.31</td>
</tr>
<tr>
<td>W&amp;R</td>
<td>The Bahamas – Sand Dollar</td>
<td>Pilot since 2019 December targeting to improve “financial inclusion and access …, [to reduce] the size of legitimate but unrecorded economic activities … [to strengthen] national defences against money laundering and other illicit ends, … to deliver government services through digital channels, thereby improving tax administration and increasing the efficiency of spending”.32</td>
</tr>
<tr>
<td>W&amp;R</td>
<td>Brazil – DFC</td>
<td>General research in 2018 on Digital Fiat Currency (DFC) seeking to improve “the efficiency of the monetary function… the level of financial inclusion; and the general user experience - translated into lower &quot;friction&quot; and greater consumer protection”.33</td>
</tr>
<tr>
<td>W&amp;R</td>
<td>Cambodia – Project Bakong</td>
<td>Pilot Project Bakong launched in 2019 January aims to “increase access to quality formal financial services, reduce the financial exclusion of women”. In January 2020 National Bank of Cambodia (NBC) announced that it is preparing to launch a CBDC in 2020, the central bank was developing &quot;the national payment gateway for Cambodia&quot; as a blockchain-based, peer-to-peer platform with its own specially designed cryptocurrency.34 35</td>
</tr>
<tr>
<td>W</td>
<td>Canada – Project Jasper</td>
<td>Research on wholesale CBDC in 2017 which &quot;enabled a better understanding of the roles and responsibilities of the operator of a DLT wholesale payment system, its participants and the central bank.&quot;36</td>
</tr>
<tr>
<td>W&amp;R</td>
<td>China – DCEP</td>
<td>Extensive ongoing research, legislation laying, proprietary technology patents lodged; special companies set up; pilot projects testing work to create digital alternative to cash with targeted ‘reveal’ in 2022 Winter Olympics.37</td>
</tr>
<tr>
<td>R</td>
<td>Denmark</td>
<td>Research in 2017 December finds it &quot;difficult to see what CBDC would be able to contribute that is not already covered by the payment solutions which exist today… the potential benefits of introducing CBDC in Denmark are not assessed to match the considerable challenges that this introduction would present&quot;38</td>
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<thead>
<tr>
<th>CBDC Type</th>
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<tbody>
<tr>
<td><strong>W&amp;R</strong></td>
<td><strong>Eastern Caribbean – DXCD</strong></td>
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<tr>
<td></td>
<td>Ongoing Pilot Project of digital version of the EC dollar (DXCD) since March 2019; aims to assess “potential efficiency and welfare gains that could be achieved: deeper financial inclusion, economic growth, resilience and competitiveness in the Eastern Caribbean Currency Union (ECCU)” and address “high cost of current payment instruments and banking services”.39</td>
</tr>
<tr>
<td><strong>R</strong></td>
<td><strong>Ecuador – dinero electrónico</strong></td>
</tr>
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<td></td>
<td>Project of CBDC dinero electrónico (DE) in 2014 legislation which gave the state monopoly in issuing electronic money but was decommissioned in 2017 possibly due to insufficient adoption.40 41</td>
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<tr>
<td><strong>R</strong></td>
<td><strong>ECB – E-euro</strong></td>
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<td></td>
<td>Numerous researches conducted; In 2019 ECB designed a semi-anonymous DLT-based CBDC prototype, provided a proof of concept and announced plans to test the prototype. In 2020 January ECB’s research paper proposed a concrete retail CBDC system of tiered remuneration.42 43</td>
</tr>
<tr>
<td><strong>W&amp;R</strong></td>
<td><strong>France – ECB CBDC</strong></td>
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<td></td>
<td>Research report documented the benefits, costs, difficulties, and risks associated with the potential implementation of a wholesale and retail CBDC. Ongoing operational experiment - Banque de France called for applications for an interbank settlements CBDC experiment in March 2020.44 45</td>
</tr>
<tr>
<td><strong>CB</strong></td>
<td><strong>Hong Kong – Project Inthanon – LionRock</strong></td>
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<tr>
<td></td>
<td>Hong Kong partnered with Thailand to research cross-border CBDC, leveraging DLT to increase efficiency in Cross-Border Payments in May 2019. The paper concluded that the CBDC could reduce transaction costs significantly and are moving to trialling a blockchain-based, cross-border payments network to facilitate trade settlement. The DLT-based proof-of-concept has been developed with 10 participating banks from both countries.46 47</td>
</tr>
<tr>
<td><strong>R</strong></td>
<td><strong>The Marshall Islands – SOV</strong></td>
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<tr>
<td></td>
<td>The Republic of the Marshall Islands’ legislature passed a law making ‘SOV’ a blockchain-based currency, the new legal tender of the Marshall Islands in 2018 and in 2020, the Marshall Islands partnered with major blockchain start up Algorand to provide SOV with speed, scalability, security as well as required compliance controls and will be circulating alongside the USD which is used as the official currency in the country.48</td>
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<table>
<thead>
<tr>
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<th>Notes</th>
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</thead>
<tbody>
<tr>
<td>W/CB</td>
<td>Singapore – Project Ubin</td>
<td>Working groups, multi-year project to explore the use of Blockchain DLT for clearing and settlement of payments and securities.49</td>
</tr>
<tr>
<td>W&amp;R</td>
<td>Sweden – E-krona</td>
<td>Pilot testing block-chain powered e-krona will continue until February 2021.50</td>
</tr>
<tr>
<td>CB</td>
<td>Thailand – Project Inthanon</td>
<td>Thailand partnered with Hong Kong to research cross border CBDC, leveraging DLT to increase efficiency in Cross-Border Payments in 2019. The paper concluded that the CBDC could reduce transaction costs significantly and are moving to trialling a blockchain-based, cross-border payments network to facilitate trade settlement. The DLT-based proof-of-concept has been developed with 10 participating banks from both countries (see footnote 48). <a href="https://www.bot.or.th/English/PressandSpeeches/Press/2019/Pages/n3962.aspx">https://www.bot.or.th/English/PressandSpeeches/Press/2019/Pages/n3962.aspx</a>; <a href="https://www.bot.or.th/English/FinancialMarkets/ProjectInthanon/Documents/Inthanon-LionRock.pdf">https://www.bot.or.th/English/FinancialMarkets/ProjectInthanon/Documents/Inthanon-LionRock.pdf</a></td>
</tr>
<tr>
<td>R</td>
<td>United Kingdom</td>
<td>One of the earliest central banks to research CBDC; Issued numerous research projects with the latest in 2020 studying opportunities, challenges and design of CBDC.51</td>
</tr>
</tbody>
</table>

R = retail CBDC; W = wholesale CBDC; CB = cross-border CBDC

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ACRONYMS

AML: Anti Money Laundering
ATM: Automated Teller Machine
BIS: Bank of International Settlement
CB: Central Bank
CBDC: Central Bank Digital Currency
CTF: Counter Terrorism Financing
CPI: Consumer Price Index
DAI: MakerDAO’s token
DCEP: Digital Currency/Electronic Payment
DLT: Distributed Ledger Technology
DXCD: Eastern Caribbean Central Bank Digital Currency
ECB: European Central Bank
ESA: Exchange Settlement Accounts
EU: European Union
FOMC: Federal Open Market Committee
FSS: Fast Settlement Services
GDP: Gross Domestic Product
GSCs: Global stablecoins
IMF: International Monetary Fund
NBER: National Bureau of Economic Research
NPP: New Payments Platform
NSW: New South Wales
OMO: Open Market Operations
PBoC: People’s Bank of China
PICs: Privately Issued Currencies
QE: Quantitative Easing
RBA: Reserve Bank of Australia
RITS: Reserve Bank Information and Transfer System
PRCA: Ripple Protocol Consensus Algorithm
RTGS: Real-Time Gross Settlement
SOV: Sovereign
TIPS: TARGET Instant Payment Settlement
UK: United Kingdom
US: United States
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