



Central Bank Digital Currency: The Series, Vol.1

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# Central Bank Digital Currency (CBDC): The Fundamentals

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## Abstract

This paper is the first in Payments Canada's series exploring the implications of central bank digital currency (CBDC) in a Canadian context. This paper aims to explore the motivations for CBDC issuance as they pertain to Canada and how retail and wholesale CBDCs will work in conjunction with current central bank liabilities. The paper outlines the differences between CBDC, cryptocurrency and conventional bank notes, as well as discusses emerging CBDC use cases.

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## Why CBDC?

Central Bank Digital Currency (CBDC) is a digital liability of the central bank that can be used as a payments instrument. Many central banks around the world are examining ways to maintain and improve use and effectiveness of retail currency, driven by declining cash use and credible threats to monetary sovereignty by cryptocurrencies, stablecoins and other reserve currencies. These efforts have been catalyzed by the COVID-19 pandemic and the further decline in the use of cash. The increased pace of CBDC development around the world has also raised concerns about a greater risk of displacement of the national currency by a foreign reserve currency as a unit of account for domestic and cross-border use.

## CBDC in Canada

The Bank of Canada's current focus<sup>1</sup> is on the retail use of a CBDC as a complement to banknotes. A CBDC is being developed as a contingency plan, recognizing that any solution would require significant time to design and deploy.

The Bank of Canada has identified two possible scenarios for the contingent effort:

- The rise of alternative digital currencies that have the potential to be used widely as a unit of account, which could undermine the Bank's ability to maintain a stable method of payment and store of value for fiat money through monetary policy; and/or,
- The possibility that cash could no longer be considered a ubiquitous form of payment and a competitive offering to commercial bank card, paper and electronic payments in the future.

## Alternative digital currencies

On the first driver, alternative digital currencies that could potentially disrupt central bank monetary dominance include:

- "Traditional" unbacked cryptocurrencies and assets, such as Bitcoin and Ethereum, as well as stablecoins backed by assets and fiat currencies. However, indications are that these digital currencies are making minimal headway into retail payments in Canada.<sup>2</sup> Indeed

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<sup>1</sup> [Contingency Planning for a Central Bank Digital Currency, Bank of Canada, February 2020](#)

<sup>2</sup> [What can Bitcoin tell us about the future of retail payments with digital currencies? Insights from merchant use and perceptions. Payments Canada. August 2020](#)

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the top ten unbacked digital currencies [Bitcoin (BTC), Ethereum (ETH), Chainlink (Link), Bitcoin Cash (BCH), Litecoin (LTC), Polkadot (DOT), Cardano (ADA), Bitcoin SV (BSV), EOS(EOS) , Monero (XMR)] only represent a market capitalization of US\$376bn and therefore low probability of being disruptive at the current time;

- Utility coins, such as Ripple’s XPR, although these are primarily targeting cross-border wholesale uses rather than domestic retail payments;
- Platform-linked digital currencies and stablecoins, most notably Facebook-led Libra,<sup>3</sup> that have the potential to harness large ecosystem footprints to drive domestic and international retail payments.
- Emerging online platforms that use fiat currency and have the potential to create closed loop ecosystems. These comprehensive platforms could offer extensive consumer and business payment services, as well as lending and investment facilities that could attenuate the impact of central bank monetary transmission through the commercial banks. Internationally, Alipay<sup>4</sup> and WeChat Pay<sup>5</sup> are examples of the large ecosystem players.
- CBDCs that are developed by other jurisdictions. Depending on regulation and policies of the issuing central bank, users in other countries could potentially have access to a digital central bank liability of a reserve currency without the friction associated with transporting cash or accessing another currency through commercial financial institutions (FIs). This can optimize the cross-border payments process as CBDC can harness emerging international rails like that under development by Libra.<sup>6</sup> However, this also raises the prospect of a “dollarization” process where the domestic fiat currency ceases to be the dominant unit of account.<sup>7</sup>

## Declining cash use

Payments Canada research shows that, although still substantial at the physical point-of-sale (POS), cash use is dropping rapidly. Between 2008 and 2018, the annual number of cash transactions (volume) fell by over 57 percent and the value of cash transactions declined by over 51 percent.<sup>8</sup> In that same ten year period, debit and credit cards (the nearest POS substitutes)

<sup>3</sup> <https://libra.org/en-US/white-paper/#cover-letter>

<sup>4</sup> <https://intl.alipay.com/>

<sup>5</sup> <https://pay.weixin.qq.com/index.php/public/wechatpay>

<sup>6</sup> <https://thepaypers.com/expert-opinion/the-american-central-bank-digital-currency-plan-quiet-powerful-imminent-1244416>

<sup>7</sup> [A Survey of Research on Retail Central Bank Digital Currency. IMF Working Paper WP/20/104. June 2020](#)

<sup>8</sup> [2019 Canadian Payment Methods and Trends. Payments Canada.](#)

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grew 63 per cent and 153 per cent, respectively, in volume. This trend has been exacerbated by the COVID-19 pandemic and the accompanying increase in use of electronic methods suggest the effects may be permanent.<sup>9</sup>

Declining cash use and the associated consumer embrace of digital payment channels<sup>10</sup> are also motivating the development of CBDC internationally. Sweden, for example, is presently pilot-testing the “E-krona” as a response to cash volume falling to account for less than two per cent of retail POS transactions.<sup>11</sup>

## Why is central bank money important?

Central bank money has many functions; however it primarily acts as a monetary policy transmission mechanism controlled by the central bank in order to sustain general economic growth. The central bank is a welfare motivated institution, meaning that they look out for the financial well being of the general population rather than being profit driven like issuers of private currencies and commercial bank deposits. This plays a role in establishing the trust placed by the public onto central bank money.<sup>12</sup> Central bank money also has a higher stability relative to commercial bank deposits. For instance, private credit from an FI is accompanied by a certain degree of credit risk, whereas central bank money is credit risk free. This is particularly significant during periods of financial stress, such as recessions, where commercial bank money is at higher risk of default.

Central bank money embodies three primary functions:

- Unit of account: money acts as a common yardstick to measure and compare value. This means it must be widely adopted among parties who are likely to transact. Central bank currency like the Canadian dollar acts as an effective unit of account because most payments users in Canada use it to transact and compare value. Governments, in particular, bolster the use of the currency by requiring taxes to be paid in the national currency.

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<sup>9</sup> [COVID-19 pandemic dramatically shifts Canadians’ spending habits. Payments Canada. May 2020](#)

<sup>10</sup> [Payments in a digital world. Speech by Christine Lagarde. European Central Bank. September 2020.](#)

<sup>11</sup> [BIS Papers No 101 Proceeding with caution – a survey on central bank digital currency. January 2019](#)

<sup>12</sup> <https://www.bankofcanada.ca/wp-content/uploads/2020/05/sdp2020-2.pdf>

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- Store of value: currency notes are a liability of the central bank just as corporate bonds are a liability (debt) of a corporation. However, unlike other investments and assets, central bank money is backed by the government itself and so cannot be subject to default in a conventional sense. It is therefore considered the safest form of liability. Beyond this, in most leading economies, the central bank has independent authority over monetary policy, such as the setting of interest rates, which further stabilizes the value of fiat currency and its use as a store of value.
  - Medium of exchange: central bank money is accepted widely in the transaction of goods, services and investments. This contributes to its relevance and usability, as well as establishing it as a unit of account.

Because a CBDC would be exchanged at par with physical notes and commercial bank deposits as fiat currency, it would continue to fulfill the functions of money as described.

### **CBDC versus cryptocurrency**

Cryptocurrencies/assets such as Bitcoin and Libra are issued by private entities that are governed by decentralized processes. Cryptocurrencies serve the functions of money - unit of account, store of value, medium of exchange. Cryptocurrencies are a specific class of assets called crypto assets and not all crypto assets are seen to act as money but rather as speculative investments and usually regulated as such. For instance, crypto assets in the form of initial coin offerings (ICOs) or investment funds, such as yearn.finance, DFI.Money (YFII), or FTX, are more akin to equity investments in companies or projects and not viewed as money. However, there are cases of cryptocurrency acting as currency. For instance, Japanese authorities passed the Virtual Currency Act in March 2017 making the cryptocurrency Bitcoin legal tender in Japan. In Canada, the legal view on Bitcoin is different and Bitcoin does not enjoy the status of legal tender.<sup>13</sup> General public adoption, by both consumers and merchants, of cryptocurrencies such as Bitcoin is, overall, limited.<sup>14</sup> This limited adoption of cryptocurrencies can also be linked to existing price volatility creating uncertainty in their roles as stores of value. CBDCs, being tied to existing fiat currencies with extensive trading in Forex markets and tight central bank control on their value in the near term, would be better able to fulfill the functions of money.

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<sup>13</sup> <https://www.globallegalinsights.com/practice-areas/blockchain-laws-and-regulations/canada>

<sup>14</sup> For more insights on consumer and merchant use of Bitcoin in Canada, see <https://www.payments.ca/about-us/news/latest-bitcoin-sentiment-tracker-study-explores-merchant-side-bitcoin-retail> and <https://www.payments.ca/about-us/news/new-research-shows-curiosity-and-investment-potential-are-key-drivers-bitcoin>

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Some digital currencies may have their exchange value managed by backing the cryptocurrency with reserves (or a basket of reserves) of fiat currencies and can be seen as a more stable store of value. These are referred to as “stablecoins”. The proposed Libra currency, as well as existing stablecoins like Tether<sup>15</sup> and USDCoin,<sup>16</sup> are examples. Other decentralized cryptocurrencies, such as Bitcoin<sup>17</sup> and Ethereum,<sup>18</sup> are not backed by any assets and currently experience significant exchange volatility against major fiat currencies due in part to limited market liquidity and trading volumes. Certain cryptocurrencies act as utility coins for a specific purpose or platform; BinanceCoin<sup>19</sup> and XPR<sup>20</sup> (Ripple’s native currency) are examples of cryptocurrencies that serve alternative purposes such as general transaction facilitation or fee reduction instruments .

Crypto-assets are exchanged and recorded via DLT, using generally immutable and cryptographically protected mechanisms such as blockchains. These distributed ledgers may be public or private for inspection and may have permissioned or permissionless access for validating transactions.

Unlike crypto-assets and currencies, CBDCs are issued by a domestic monetary authority, usually a central bank. Like notes and coins, they are backed by the monetary stabilization policies of the central bank and ultimately the credit-worthiness of government debt securities. As a utility coin, CBDCs preserve par “unity”<sup>21</sup> with notes and commercial bank money. A token-based CBDC in Canada would likely be tracked on a private, permissioned blockchain.<sup>22</sup>

### **CBDC versus banknotes**

As either a token or account, CBDC will require security to avoid double-spending (the digital equivalent of counterfeit) and, in the case of tokens, facilitate tracking.

Because a CBDC will be digital in nature instead of physical, it would require a digital ledger to record ownership or account balances. This may be a centralized or decentralized model. A

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<sup>15</sup> <https://tether.to/>

<sup>16</sup> As of writing, the two largest stablecoins by market cap. See <https://cryptoslate.com/cryptos/stablecoin/>

<sup>17</sup> <https://bitcoin.org/en/>

<sup>18</sup> <https://ethereum.org/en/>

<sup>19</sup> <https://www.coindesk.com/crypto/binance-coin>

<sup>20</sup> <https://ripple.com/xrp>

<sup>21</sup> See e.g. [A Uniform Currency in a Cashless Economy, Bank of Canada, March 2020](#)

<sup>22</sup> [Bank of Canada, Designing a CBDC for universal access, Staff Analytical Note, June 2020](#)

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centralized model would offer the issuer (i.e. a central bank) with more visibility and control over transactions as they would authorize individual transactions. A decentralized model would offer the user (i.e. the consumer using CBDC) control as transactions would be verified through proof-of-stake (PoS) or proof-of-work (PoW) processes.<sup>23</sup> Additionally, use of CBDC would rely upon electronic user connection to an online or offline ledger to make and receive transfers. This connection could be through a dedicated device (a universal access device (UAD<sup>24</sup>)) or through other channels (e.g., mobile phone, computer) using a CBDC service provider. CBDC could also potentially provide a digital record for transactions, which could support public safety objectives around tax evasion, black market/illegal activities, money laundering and terrorist financing.<sup>25</sup>

Many of the primary challenges associated with CBDC arise from the inherent difficulty in providing a digital product that emulates cash in terms of cost, portability, accessibility, privacy and ubiquity.

## CBDC as a central bank liability

Currently, the central bank has two primary forms of liability that are used in the Canadian economy:

- Wholesale settlement balances held at the central bank for discharging payment obligations between large FIs; and
- Retail banknotes that can be used directly by Canadian consumers and businesses for the same purpose - discharging financial obligations with finality.

CBDC refers to digital variants of these forms of central bank money.

## Wholesale CBDC

In the case of wholesale, where settlement balances are already digital accounts maintained at the central bank, CBDC generally refers to a digital asset, such as a coin or token. A wholesale token would be a digital asset that could be purchased and exchanged bilaterally between banks and serve as payment and/or collateral for settlement obligations, particularly for settlement of securities and derivatives. This is in contrast with current account-based central bank settlement, where obligations are discharged through book transfers between wholesale accounts.

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<sup>23</sup> See [Gervais et al \(2016\) On the Security and Performance of Proof of Work Blockchains](#)

<sup>24</sup> [Bank of Canada. Designing a CBDC for universal access. Staff Analytical Note. June 2020](#)

<sup>25</sup> [Costs and benefits to phasing out paper currency. Rogoff, K.. Harvard University. 2014](#)

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A wholesale CBDC could take on the role of existing central bank reserves in terms of wholesale settlement accounts. Ownership of the wholesale token could be recorded in a centralized manner or through a decentralized private permissioned distributed ledger with notary nodes. This approach was explored in Project Jasper, which evaluated the use of wholesale CBDCs and distributed ledger technology (DLT) for settlement of payments and securities in the Canadian context.<sup>26</sup> While the project demonstrated that a DLT approach was capable of settling payments and securities obligations, the benefits of a wholesale CBDC over existing settlement infrastructures are not well-established and most central banks, including Canada's, remain in an exploratory phase.<sup>27</sup>

## Retail CBDC

In the retail case, CBDC refers to a digital version of “cash” that can be implemented in various ways, some of which will be explored further in this series<sup>28</sup>. Like cash, a retail CBDC would be a central bank liability held directly by consumers and businesses. It would be transferred between users “directly” via an electronic connection to a common ledger (centralized or decentralized) to settle payment obligations. It is assumed that retail CBDC would take on several attributes currently associated with physical bank notes, such as resiliency and universal accessibility. This can also include privacy or anonymity of transactions. Central banks must understand the tradeoff that comes with anonymous transactions. If central banks were to have full visibility of transactions, this could lead to a reduction in illicit transactions that are typically made with cash and provide data for more informed monetary policy decisions. However, the need for privacy of data is rising in importance for end-users and a non-anonymous CBDC design could reduce overall adoption.

It is important to distinguish a retail CBDC from other forms of digital money already familiar to users. After all, most employees are paid electronically and use cards and electronic funds transfers for almost all of their payments. It may be tempting to conclude that money is already digital. However, these digital payments are not a liability of central bank; rather, they represent either a claim on a commercial bank in the case of chequing accounts (sometimes called

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<sup>26</sup> [New Report from Payments Canada, the Bank of Canada, TMX Group, Accenture and R3 Proves that Distributed Ledger Technology Can Enable Equity Settlement. Press Release. Payments Canada October 2018](#)

<sup>27</sup> [Central bank digital currencies. BIS: Committee on Payments and Market Infrastructures: Markets Committee. March 2018](#)

<sup>28</sup> In the context of retail CBDC, “cash” refers to the segment of central bank liability that can be accessed by individuals and organizations that are not FIs.

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“b-money”)<sup>29</sup>, a credit facility, which is a claim on the user (e.g., a credit card purchase), or money stored in digital wallets and virtual or physical store cards (sometimes called “e-money”). This distinction has important implications for user risk, accessibility, competition and other key areas.

## CBDC use cases and advantages

CBDC may lend itself to numerous use cases as a general-purpose retail product or as a wholesale offering. On the wholesale side, a primary application involves tokenized payment-versus-delivery (PvD) of similarly tokenized securities and derivatives, a promising example of the potential of distributed ledger solutions. A wholesale CBDC could also facilitate cross-border interbank settlement as well as cross-border tokenized asset transfers and currency exchange (i.e. payment-versus-payment (PvP)). An always-available exchange mechanism reduces counterparty risk associated with payment systems and central bank hours/days of operation.

CBDC can also support wholesale liquidity. For example, direct end-user exchange of CBDC would free up collateral held in payments systems to control counterparty risk associated with claims-based deferred settlement payments (e.g. ACSS payments).<sup>30</sup>

Retail use cases are numerous. First, CBDC could serve as a substitute or complement for physical banknotes and their “...many disadvantages such as physical insecurity, forgery, lack of hygiene and other practical inefficiencies”,<sup>31</sup> including storage and limitations of physical exchange. Cash also imposes a significant cost on the consumer who must generally access FI services to access it, the merchant who must expend considerable time reconciling notes and must pay deposit fees, and the system that must produce, distribute and redeem it.

A retail CBDC also offers a competitive alternative to commercial FIs and other market-driven payment solutions. According to a recent Bank of England working paper, “with a lower entry hurdle to becoming a transactions verifier in a distributed system than to becoming a member bank in a tiered system, we would expect more intense competition in the provision of payment services.”<sup>32</sup> The digital nature of a retail CBDC also allows it to serve as a platform for driving competition as new entrants (i.e. fintechs) enter the payments space. Competition in account

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<sup>29</sup> e.g. [The Rise of Digital Money](#), International Monetary Fund, 2019

<sup>30</sup> [The Macroeconomics of Central-Bank Issued Digital Currencies](#). BIS. February 2019

<sup>31</sup> <https://www.verdict.co.uk/central-bank-digital-currencies-cbdc/>

<sup>32</sup> [The Macroeconomics of Central-Bank Issued Digital Currencies](#). BIS. February 2019 p. 11

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provision as digital wallet holders or CBDC account providers - both FI and non-FI - compete against conventional commercial bank chequing accounts.<sup>33</sup>

A prominent retail use case concerns disbursements. Much of the recent discussion of retail “digital dollars” - particularly during the pandemic in the U.S.<sup>34</sup>- has focused on friction experienced by governments and other large payors as they attempt to disburse benefits and payments via cheques and direct deposits. Despite efforts and some successes,<sup>35</sup> the COVID-19 pandemic has also demonstrated the frictions associated with commercial bank disbursements that come with fragmented consumer payment behaviour. CBDC would provide another channel for rapid and universal transfers to individuals.

A retail CBDC could also provide flexibility to bolster government policy initiatives. It enables better traceability and tracking of illegal and parallel-market activity. It could also, in principle, be used to reinforce policy interest rates established by the central bank by offering more flexible end-user interest scenarios, including negative rates (i.e. a cost for holding CBDC) to counteract the “zero lower bound problem” where cash becomes an attractive investment to avoid interest charges.<sup>36</sup>

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<sup>33</sup> [The Macroeconomics of Central-Bank Issued Digital Currencies. BIS. February 2019](#)

<sup>34</sup> [Digital Dollars for All. Wall Street Journal. April 6, 2020](#)

<sup>35</sup> [Canada’s Emergency Response Benefit: bringing Canadians safe and secure payments during a time of crisis. Payments Canada. April 2020](#)

<sup>36</sup> [CBDC and Monetary Policy. Staff Analytical Note 2020-4. Bank of Canada. February 2020.](#)