BANK OF CANADA
BANQUE DU CANADA

Contingency Planning for a Central Bank Digital Currency

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Executive summary

How Canadians use money and make payments is changing in response to new technologies and more demanding expectations from consumers and businesses. People expect money to be safe and available to everyone. In addition, payments are increasingly expected to be fast, efficient and flexible. This is evident from the steady decline in the use of cash as consumers switch to card and electronic payments. At the same time, new alternative digital currencies are being created, with characteristics quite different from those of conventional money.

The Bank of Canada is responsible for preserving the value of money and for supplying Canadians with bank notes (i.e., cash). It is also responsible for overseeing systemically important and prominent payment systems to ensure they are safe and efficient. To effectively carry out those responsibilities, the Bank must be ready to adapt to the changing nature of money and payments in Canada.

The Bank is therefore implementing a portfolio of initiatives designed to prepare for the future of money and payments and to be ready for different possible scenarios that we cannot currently predict. The most important of these initiatives are:

- supporting Payments Canada's Payment Modernization program to improve the speed, reliability, accessibility and end-user experience of our payment systems;
- ensuring bank notes remain available to Canadians who want to use them, including maintaining a distribution model that remains resilient and cost effective; and
- building, as a contingency, the capability to issue a cash-like central bank digital currency (CBDC) to the public, should the need ever arise.

The Bank currently has no plans to launch a CBDC. Rather, the Bank will build the capacity to issue a general purpose, cash-like CBDC should the need to implement one arise. Because it will take several years to build this capacity, the Bank cannot wait until the need is evident before launching preparatory work. Preparing in advance is critical. At the same time, the Bank is preparing for a range of other possible changes to money and payments in Canada as innovation continues.

The Bank will consider launching a CBDC if certain scenarios materialize or appear as if they are likely to. A CBDC could become beneficial or even necessary, if:

- the use of bank notes were to continue to decline to a point where Canadians no longer had the option of using them for a wide range of transactions; or
- one or more alternative digital currencies—likely issued by private sector entities—were to become widely used as an alternative to the Canadian dollar as a method of payment, store of value and unit of account.

In either of these scenarios, a CBDC could be one way of preserving desirable features of the current payment ecosystem, such as universal access to secure payments, an acceptable degree of privacy, competition and resilience. The second scenario in particular would constitute a significant challenge to Canada's monetary sovereignty—our ability to control monetary policy and provide services as lender of last resort. Other scenarios could arise, and the Bank will closely monitor developments in the payment sector to determine whether a CBDC is warranted.

If the Bank were to issue a CBDC, there would be wide-reaching implications for the economy, the financial system and the Bank's operations. Such a decision would therefore be made only after considering alternative policies for achieving our public policy objectives. It would also require careful management of the associated risks, notably:

- potentially adversely affecting the stability of deposit funding for banks or increasing the risk of a bank run; or
- becoming a vehicle for financial abuses, such as money laundering and terrorist financing.

A decision to launch a CBDC would require the full support and approval of the Government of Canada and acceptance by the Canadian public. The design choices made in building a CBDC would be crucial to achieving policy goals while minimizing risks.

Key steps in building capabilities for a CBDC include:

- monitoring and assessing developments in the payment sector;
- engaging external stakeholders to identify further policy objectives and obtain legal authority to issue a CBDC;
- communicating openly with the public and stakeholders to solicit input and raise awareness; and
- increasing technical research, in collaboration with partners from the private and public (e.g., other Canadian agencies and foreign central banks) sectors, to select and test an appropriate technology.

1. Introduction

Over the past few decades, technological advances have enabled consumers to significantly change the way they make payments, moving from primarily paper-based methods, such as cash and cheques, toward digital payments in the form of debit, credit and prepaid cards, mobile payments (e.g., Apple Pay or Google Pay), electronic transfers of funds (e.g., Interac e-transfer) and even some, albeit very limited, use of cryptocurrencies (e.g., Bitcoin, Litecoin, Zcash).[1] Canada has been very much part of this global trend.

As part of our role in the oversight of systemically important payment systems, the Bank of Canada is closely involved in Payments Canada's ongoing Payments Modernization program. This is a multi-year initiative to modernize the existing core payment infrastructure as well as to introduce the new retail Real-Time Rail as a platform for competition and innovation.[2]

In its role as the provider of Canadian bank notes, the Bank is working to ensure the processing and distribution of these notes is as efficient as possible. This will help make certain that cash remains a viable method of payment well into the future, the importance of which will be discussed below.

In addition to these improvements, the Bank has been studying whether there could be a role for a central bank digital currency (CBDC) in the retail portion of a modern payment ecosystem in some circumstances. A retail CBDC is defined as a liability of the Bank of Canada denominated in Canadian dollars that can be held and transferred in electronic form by the general public. Like cash, it would earn no interest and be universally accessible.

The starting point for thinking about a CBDC is the Bank of Canada's mandate to promote the economic and financial well-being of Canadians. The Bank's mandate is fulfilled through its core functions:

- conducting monetary policy to deliver low, stable and predictable inflation;
- promoting the stability and efficiency of the Canadian financial system, including payment systems;
- providing bank notes that Canadians can use with confidence; and
- providing fiscal-agent services to the Government of Canada.

The Bank's ability to fulfill its mandate could be challenged under either of two broad scenarios. First, if the use of bank notes declined to a point where they could not be used for a sufficiently wide range of transactions, then the introduction of a CBDC could be beneficial. Second, if one or more alternative digital currencies threatened to become used widely as an alternative to the Canadian dollar as a method of payment, store of value and unit of account, then a CBDC could be one mechanism to defend monetary sovereignty. If either or both of these situations were to emerge, issuing a CBDC should be one of the policy responses considered as a means of continuing to fulfill the Bank's mandate. Policies related to a CBDC are the main focus of this paper, which is structured as follows. Section 2 characterizes the functions of money in the economy that a digital currency could be designed to fulfill. Section 3 discusses two possible future scenarios and what potential role a CBDC could play in each. Section 4 explains how the Bank would manage some key risks. Section 5 discusses some design features. Section 6 discusses the business model. Section 7 discusses a high-level strategy for our future work on CBDC. Section 8 proposes next steps.

2. Public policy considerations

A monetary system provides the basis for exchange in a market economy. A strong monetary system is underpinned by trust, which rests, among other things, on the credibility of monetary policy, the soundness of the banking system and the rule of law.

The monetary system is a public good provided by a mix of public and private institutions. In our system, most money is created by the private sector in the form of bank deposits. However, money provided by the central bank to individuals (bank notes) and banks (settlement balances) supports the financial system. Confidence in the system is promoted by a range of factors, including the convertibility at par of central bank liabilities (notes and settlement balances) with commercial bank liabilities (deposits). Other policies, such as the provision by the government of comprehensive deposit insurance to retail investors, are also important in bolstering confidence that bank deposits held at one commercial bank can be converted at par into deposits at other banks and into notes issued by a central bank.

In this context, Canadians expect their money to have the following features:

- **Safety**. Money should be a safe store of value that consumers can use with confidence when making payments.
- **Universal accessibility**. Access to money is essential for participation in the economy and must therefore be available to everyone.
- **Privacy**. Canadians are concerned about maintaining an appropriate degree of privacy both in relation to private businesses, such as merchants and payment providers, and in relation to the government. Results from our initial focus group work has emphasized the importance of privacy for users of payment systems. How much privacy should be available, and from whom, is an important public policy issue. A range of policies are already in place to try to ensure that payment instruments of all kinds are not used for illegal purposes and that personal data are protected.
- **Resilience**. Because it is crucial for economic transactions, money needs to be available all the time, regardless of circumstances.
- **Competition and efficiency**. Among other factors, the relatively concentrated nature of Canada's financial system has been cited as contributing to the high level of fees set by credit card networks that are often passed on to merchants. More competition in payments will reduce costs, improve efficiency and service levels, and promote innovation and a wider range of products.
- **Monetary sovereignty**. Having a national currency as the dominant unit of account improves the efficiency of trade and promotes growth of the national economy. It also underpins the central bank's ability to conduct independent monetary policy and act as a lender of last resort to protect financial stability. So, while changes in the mix of payment methods—such as the progressive switch from bank notes to cards—has not challenged monetary sovereignty, widespread use of a payment instrument not denominated in Canadian dollars would seriously put it at risk.

Central bank cash supports all of these features and public policy objectives. As a liability of the central bank with the full backing of the government, central bank cash is the safest form of money. It can still be used in a wider range of transactions despite its declining use by Canadians. Cash is the only truly anonymous payment instrument in the sense that it allows Canadians to make purchases without sharing any personal information. Given its physical nature, cash is an extremely resilient method of payment that can be used for in-person transactions even when the physical infrastructure that other mechanisms rely on is compromised (e.g., because of a power outage). Finally, cash supports competition in the payment ecosystem by providing a low-cost, reliable and ever-present alternative to private sector payment methods.

Privately supplied money meets many of these expectations as well. Retail bank deposits are backed by a government deposit insurance program and a strong regulatory regime. Canada has a high degree of financial inclusion, with about 99 percent of Canadians having bank accounts (Henry, Huynh and Welte 2018). The number of underbanked Canadians, however, is greater than the population of unbanked, often due to high banking fees. While commercial payment service providers (e.g., debit and credit card providers) see transactions on their systems, individual users' personal information is kept private from merchants. Resilience is supported by a focus on security and strong backup systems. Competition in payment services is supported by a range of electronic payment alternatives (e.g., credit cards, debit cards, Interac e-transfer) that may expand further with the development of the Real-Time Rail, as Payments Canada is considering allowing non-bank payment service providers to access the Rail.

3. Possible alternative futures

The Canadian monetary system and the role of bank notes in that framework serve Canadians well. Based on our research to date, there is currently no compelling case to issue a CBDC. The existing system provides Canadians with payment options that they can use with confidence and that offer a high degree of resilience and privacy. However, as technology evolves, conditions may emerge in which a digital form of central bank money, available to all Canadians, could be desirable. This section characterizes two broad scenarios. In neither scenario would the decision to issue a CBDC be automatic. The Bank and the government would still need to weigh public policy objectives and assess the different means to achieve those objectives and manage the associated risks.

Scenario 1: A cashless economy

The use of bank notes in transactions in Canada has declined significantly in recent years. Canadian consumers have made this choice, mainly as a result of the increasing convenience of bank-based electronic methods of payment, notably debit and credit cards. This trend may well continue, supported, for example, by further advances in digital payments such as a successful launch of Payments Canada's Real Time Rail. If significant numbers of merchants were to refuse to accept bank notes and if banks were to begin scaling back their cash-processing services, then this trend would be further reinforced. If these developments were to occur, a tipping point could be reached, and consumers could lose the option of easily making payments using cash. In Sweden, the use of bank notes has fallen to a level that triggered public discussion of a CBDC as a possible option (Sveriges Riksbank 2017, 2018).

It is likely that use of bank notes for transaction purposes will continue to decline in Canada, as payment technology improves and consumers become increasingly comfortable with online commerce and contactless, "tap and go," technology. In 2017, only 33 percent of transactions at the point of sale (or 15 percent by value) were completed using cash. This was down from about 54 percent in 2009.[3] In our 2019 Cash Alternative Survey, 9 percent of respondents said they do not use cash while another 6 percent planned to stop using cash within five years (Huynh, Nicholls and Nicholson forthcoming).[4]

It is not clear that Canada is near a tipping point in cash use, as may be happening in Sweden (Engert, Fung and Segendorf 2019). In Canada, merchants' acceptance of bank notes has been bolstered by credit card arrangements. Credit cards are Canadian consumers' most likely alternative to cash as a result of the premiums (e.g., points programs) offered for using them. From the merchants' standpoint, however, they are the most expensive method of payment to accept. Merchants realize that refusing to accept cash may push more of their customers toward using credit cards, which could entail higher costs, including fees such as interchange fees. Despite this, there are some merchants who have decided that, for them, cash is more expensive and now accept card payments only. The declining use of cash, along with the potential for reinforcing behaviour by merchants and banks, is a complex situation that the Bank will continue to monitor closely. A key issue is to define the minimum acceptable or necessary use of cash.

If the Canadian economy became cashless for transaction purposes, Canada would lose some of the benefits of cash that have been outlined above: safety, universal accessibility, privacy, resilience and competition.[5] How serious would this be?

With regard to **safety**, households would lose access to a method of payment directly backed by the central bank, a trusted public institution. In the present Canadian system, however, cash is not the only safe asset: most retail bank deposits are fully protected from loss by government-provided deposit insurance.[6] But the public might not always perceive such deposits as being as safe as cash. Also, even if there were no bank notes at all, wholesale central bank liabilities would still be convertible at par with commercial bank money, thereby providing implicit backing to retail bank deposits. Despite this public sector support for commercial bank money, there could still be circumstances under which individuals question the safety of their deposits.

With regard to **universal accessibility**, the concern is that a cashless society would make it difficult for some segments of the population to make purchases or receive money. Cash is accessible to people of all ages and income levels. While most adult Canadians have some form of bank account,[7] not all have the ability to use bank-based methods of payment at a reasonable cost. They may face high transaction fees and other limitations or live in areas where banks do not find it profitable to maintain a branch. People who don't have access to banking services—the unbanked and underbanked—are likely to be people who are already disadvantaged—low-income households; people in remote communities, including Indigenous peoples; people living with sight loss or with other physical or mental challenges; new Canadians; and visitors to Canada. Consequently, an important public policy objective should be to ensure these disadvantaged groups in society have acceptable access to payment methods, if the acceptance of cash were to fall below a certain level.

Losing the ability to make payments using cash raises **privacy** concerns (see Garratt and Van Oordt 2019). Canadians would not be able to pay for goods and services anonymously or without that transaction being visible to their bank and other businesses. Data on payments are becoming increasingly important to various social media and commercial entities that are able to monetize the information for profit. This often happens without the knowledge or consent of end-users. Of course, privacy also has a dark side because it can hide illicit transactions such as those associated with money laundering, terrorist financing and tax evasion.

A cashless payment ecosystem could also have less **resilience**. Cash provides a useful alternative if computer systems or electrical power is down. This backup would be lost if cash were to disappear from use.

The disappearance of cash would eliminate a choice available to Canadians who find other payment methods too expensive, thereby reducing **competition** in the payment market. Adequate competition in private sector payments or a new public sector alternative might be needed to avoid higher prices and restricted services.

The Bank of Canada would consider issuing a digital equivalent to cash as a CBDC if it appeared that Canada was moving to a cashless society and the potential adverse consequences, especially for disadvantaged groups, were judged to be significant. Such a CBDC would be designed to have the same characteristics as cash and be usable for a wide set of in-person and potentially even online transactions. It would need to be cost-effective for households to use and for merchants and banks to process. In this scenario, the Canadian public and the government would need to assess whether the potential adverse consequences of a cashless society would be significant enough to justify the creation of a CBDC. As one indication, 46 percent of respondents to our recent Cash Alternative Survey report that the disappearance of cash would be problematic.[8]

If Canada were to move more rapidly toward a cashless society, creating a CBDC would not be the only viable response. This trend could be delayed before advancing too far by optimizing the infrastructure for processing and distributing bank notes to keep their costs favourable. Such work is already well underway and will continue to move forward. There may be other steps that could be taken to maintain cash as an available method of payment. For example, some jurisdictions are considering or implementing laws or regulations to change the definition of legal tender to require acceptance of cash at the point of sale. The benefits and costs of amending the legislation governing legal tender in Canada should be investigated. Research should also examine the implications of cash no longer being used in transactions while it nevertheless remains in circulation as a store of value.

Better oversight of payment service providers in the private sector would help manage adverse consequences of a cashless society. This would be in addition to the Bank's regulatory regime for systemically important and prominent payment systems, which ensures that important national payment systems operate to acceptable standards and meet public policy objectives. The Government of Canada has proposed introducing legislation to implement a new retail payment oversight framework so non-bank retail payment service providers can continue to offer innovation in services while remaining reliable and safe. The framework would require payment service providers to establish sound practices to manage operational risk and to protect users against losing funds. The Bank of Canada would oversee the compliance of payment service providers with operational and financial requirements and maintain a public registry of regulated payment service providers. This regime will also enable increased access to the Bank's balance sheet and to core payment systems, which will help to increase competition in payments.

Further actions are being directed at improving private sector electronic payment systems. This includes Payments Canada's modernization program (including the Real-Time Rail) and other measures to promote entry, consumer choice and competition in the payment system market. Beyond the initiatives that are currently planned, consideration would need to be given to further measures to mitigate the adverse consequences of a cashless society, such as establishing a common digital identity, promoting universal access to cost-efficient bank accounts, strengthening privacy laws and regulations and improving the resilience of private sector payment systems.

Scenario 2: Private digital currencies

With the advent of cryptocurrencies and stablecoins, increasing consideration has been given to the possibility that one or more digital currencies created by private sector entities could play an increasing role in payments.[9]

How likely is this to occur? There is little chance that Bitcoin and other similar cryptocurrencies will play a large role in Canadian payments due to their high transfer costs, lack of scalability and unstable purchasing power. To date, the use of cryptocurrencies to complete transactions is very limited, and our recent Bitcoin Omnibus Survey indicated that about only 5 percent of Canadians currently hold Bitcoin (Henry et al. 2019).

Stablecoins are perhaps a more plausible disruptor. They attempt to maintain a stable value against a currency, commodity or basket of assets, often with partial or full asset backing. This mitigates one issue—high volatility in value—that has obviously restricted the ability of cryptocurrencies to establish themselves as a method of payment, although it is not clear that stablecoins address the other factors that have maintained the dominance of traditional fiat currencies. There are now about 150 stablecoins around the world. Most have had limited uptake so far. However, in 2019, Facebook's proposed Libra highlighted the possibility that a ready-made platform, with an established network of users, could quickly establish a measure of confidence and global footprint. A similar scenario could arise if a CBDC issued by a foreign central bank had extensive cross-border use in Canada.[10]

Other digital products will likely emerge with advances in technology and developments in the market. New products are being launched every month, and it is possible that one could come along that is attractive enough to make it a plausible alternative.

Widespread use of any digital currency could pose issues related to **safety**. Since private digital currencies lack the backing of a central bank or deposit insurance, they are subject to operational and financial risks that neither cash nor bank deposits face.[11] In addition, a private digital currency that lacks a central governance authority will create challenges for regulatory oversight, decreasing the ability of governments to take actions to protect end-users. The threats to safety would be particularly high if multiple private digital currencies were to emerge because it would be difficult for consumers to understand the risks of each digital currency. The need to scrutinize the safety of each digital currency could threaten the basic efficiency of economic transactions.

Moreover, Canada's **monetary sovereignty** would be threatened if a private digital currency not denominated in Canadian dollars were to play a major role in payments in Canada (see Davoodhalhosseini, Rivadeneyra and Zhu 2020; Diez de los Rios and Zhu 2020; and G7 2019). If such a digital currency were to become widely used as a unit of account, it would undermine the Bank of Canada's ability to achieve price and financial stability. This is because:

- households' spending power would depend on the value of a digital currency unit over which the Bank of Canada would have no influence;
- the Bank of Canada's primary tool for monetary policy, the target Canadian-dollar overnight interest rate (and the related cost of borrowing and return on settlement balances at the Bank), would no longer influence prevailing borrowing and lending interest rates and economic activity in Canada; and
- policies related to the role of lender of last resort can only be enacted in the currency supplied by the central bank.

A digital currency issued by a big technology company could undermine competition in the economy as a whole because the company might use its dominant market position in one industry to control payments and competition in other industries. In the case of a large technology company, the issuer would also have an incentive to commercially exploit the data generated through its use, which would reduce **privacy**. It could also undermine **resilience** if transactions became concentrated in a single digital currency because any operational failure could have broad repercussions across the economy and the financial system. **Universal access** could be limited because digital platforms are not easily accessible to everyone or could be actively restricted by private providers.[12]

The Bank of Canada will consider issuing a CBDC if private digital currencies appear as if they will begin to materially erode the public good benefits of the Canadian dollar.[13] In contrast to private digital currencies, a CBDC would be backed by an institution with clear public policy objectives and accountability and the full weight of public trust behind it.

A CBDC is not the only policy response available should this scenario materialize, and the appropriate mix of policy responses would depend on the factors that gave rise to the demand to use the alternative currency. Regulations governing private digital currencies could mitigate some of their negative aspects. Such regulations would need to ensure that private digital currencies that are important to the Canadian economy observe acceptable standards, including for soundness, operational resilience, privacy, data protection and fair competition. In general, the principle of *same activities, same risks, same regulations* should apply to private digital currencies to ensure they meet the same high standards as existing payment systems. Private digital currencies that cannot meet these standards should not be allowed to play a role in the Canadian economy. Given the global scope of many of these private digital currencies, the regulatory response also needs to be globally coordinated. The Bank of Canada is collaborating with the Financial Stability Board to identify gaps in existing regulatory frameworks and work toward an acceptable degree of harmonization.[14]

In addition, improving existing payment systems will reduce the likelihood that Canadians will turn to private digital currencies. The Bank supports the efforts of Payments Canada to improve Canada's conventional core payment systems through the Payments Modernization program. But this work will need to continue and be extended as payments and money continue to evolve. For example, improved cross-border payments are a goal of many private digital currencies. As a result, central banks and other authorities globally have work underway to identify and address the impediments to faster and cheaper cross-border payments.

4. Managing the risks

Banking system fragilities

A CBDC would be designed to limit its attractiveness as a competitor for bank deposits.[15] To achieve this, it would resemble cash in its attributes and would not earn interest. This would mitigate adverse financial stability consequences that might arise if banks needed to resort to more expensive and fragile forms of funding to replace funding from deposits.[16]

The Canadian banking system is well-capitalized and resilient so the effects on financial stability of a mild shift from deposits into a CBDC would be modest. Retail deposits are an important source of inexpensive and stable funding to Canadian banks, but they are only one of many funding sources. If some outflow from bank deposits into a CBDC were to occur, banks could increase their use of other funding sources and take steps to retain deposits by offering customers a better value proposition (e.g., higher interest rates, improved services). Banks will need to be prepared to take these steps whether or not a CBDC is issued because other developments are likely to increase competition for deposit funding and payment services in Canada. These developments include:

- payment system modernization,
- new policies on access to consumer data, and
- new competition from technology-focused financial companies.

The ability to convert deposits into cash or deposits of another bank underpins confidence in normal times. But in extremely rare events, it can allow bank runs, which can destabilize individual banks or, in the worst case, the entire banking system. The availability of a CBDC could, in certain circumstances, make such runs easier and therefore more likely.

There are several mitigating factors to consider when examining the potential for a CBDC to increase the chance of bank runs. Bank runs driven by retail depositors have been rare in Canada, given the strength of the banking system and related regulations. The incentive to run is limited, given the degree of protection provided to retail deposits through effective regulation and oversight, open bank resolution and deposit insurance. But this is not guaranteed to be successful under all circumstances, as experience elsewhere has shown. To date, the incidence of retail runs does not seem to have increased globally despite developments that make it easier to withdraw money at any time, such as automated teller machines, internet banking and faster retail payment systems. Moreover, large sophisticated depositors already have many tools to move their money quickly out of banks, including buying treasury bills or moving to other domestic or offshore banks.

A destabilizing run from deposits into a CBDC is unlikely to happen, but the Bank of Canada would need to be prepared. The Bank would stand ready to provide liquidity to any sound institution suffering deposit outflows of this kind. The Bank already has a range of liquidity facilities to undertake the role of lender of last resort, a traditional function of central banks.

Further research is necessary to more fully understand the implications of a CBDC for the Canadian banking system, the effects of different CBDC design choices and any policies necessary to preserve the stability of bank deposits, and any other unintended consequences.

If flows into and out of a CBDC turned out to be larger and more volatile than expected, this would also raise two main issues for the Bank's monetary policy operating framework and balance sheet. First, an increase in the sum of cash and CBDC balances would trigger an increase in the size of the Bank's balance sheet. The necessary asset purchases would require the Bank to reassess its operating procedures to avoid taking a dominating role in the market for Government of Canada securities. Second, a CBDC might lead to a large increase in the daily volatility of the Bank's balance sheet. This re-emphasizes the need for liquidity facilities to sterilize these movements to avoid threatening the Bank's ability to implement monetary policy.

Financial system abuses

While a degree of privacy is a core attribute of money, it would almost certainly be unacceptable for a CBDC to provide a cash-like degree of anonymity. For example, if a CBDC were implemented as a public, permissionless blockchain, it could be a vehicle for abusive transactions, facilitating money laundering, terrorist financing, criminal activity and tax evasion. So, a CBDC could be designed to implement a form of privacy rather than cash-like anonymity, allowing it to satisfy anti-money laundering, anti-terrorist financing and other regulations that require disclosure of certain kinds of private information. Further investigation will be needed to determine the arrangement that could achieve this, including technology and governance. However, our initial research indicates that it would be possible to achieve both a high degree of privacy and well-controlled disclosure of information, for example, only with the presentation of a court warrant (Darbha and Arora, forthcoming). **Any acceptable design for a CDBC will need to include controls that ensure adherence to current laws while offering a sufficient level of privacy**.

5. Broad adoption: Design is key

A CBDC should be designed to promote public adoption and use. In addition, government support (for example, by making any needed legislative changes) would also be required. Wide adoption does not mean most transactions use the CBDC, but it would require that most Canadians were willing to hold it and use it for at least some transactions.

The technical design of such a CBDC will take several years and involve in-depth interaction with stakeholders and the public. But some analytical work has already helped to inform the design and potential adoption of a CBDC.[17] There are important trade-offs among public benefit, popular adoption and political viability that will need to be managed in design decisions. For example, a CBDC that provides very strong privacy protection could create anti-money laundering and terrorist financing concerns.

Along with the legal and regulatory landscape, business model ecosystem, and execution strategy, technology has a vital role to play in creating a system that supports the policy objectives described above. For further information, see Shah et al. (2020). The final technical design would need to support the following attributes:

- **Cash-like**. The technology would need to enable person-to-person transfers with immediate settlement, offer a great deal of privacy (not anonymity), have very high resilience in the event of infrastructure failure and be universally accessible.
- **Relevant in an increasingly digital world**. Usable online, the technology would be safer from theft and illicit use than cash. It could be designed to be adaptable as new types of electronic transactions (e.g., machine-to-machine payments or the internet of things) become possible.
- **Universal accessibility**. The system should be designed to be extensible as interfaces used by consumers (smartphones, smartwatches, personal computers, internet of things, etc.) evolve and provide a dedicated universal access device (UAD) to support access (financial and digital inclusion) and resilience. For further information, see Miedema and Minwalla (forthcoming).
- **Payment of interest**. The cash-like CBDC envisioned would pay no interest. However, the payment of interest is technically feasible, especially for designs that connect to users over a network.[18] It would be more challenging for a de-

networked UAD because the system would need to know the rates of interest and transaction times. A number of possible remedies would require further research.

- **Payment safety and resilience**. In times of normally functioning infrastructure, a CBDC system could be designed to achieve very high levels of reliability. In the event of infrastructure failure, such as of electrical power and cellular networks, the UAD concept forms the basis of extreme resilience because it does not require a network or an electrical grid. (It requires a battery, but this can be long lasting.) If an even greater degree of resilience is required, this could be achieved by a system that is entirely distinct from other payments infrastructure, except for the need to transfer between commercial bank money and a CBDC. Resilience against cyber attacks would be another important aspect of design. While a CBDC would be a high-value target for cyber attacks, the security tool kit is rich to guard against this type of risk. Security would need to be a core aspect of the design from the outset. For further information, see Minwalla (forthcoming).
- **Privacy in payments**. Preliminary work suggests that it could be feasible to create a highly private money that also enables compliance with regulations that require disclosure of information, such as anti-money laundering rules. For more information, see Darbha and Arora (forthcoming). Cash-like anonymity would not be a policy objective because such a CBDC would be extensively used in illicit activity and would not respect anti-money laundering regulations.
- **Integration with existing payment systems**. A CBDC would interoperate with existing payment systems. At a minimum, connections to other payment systems would allow end-users to move in and out of a CBDC. In some designs, existing payment networks could also provide payment and transfer services for a CBDC.

A successful CBDC would need wide public adoption and government support. In fact, to meet the policy objectives of providing universal access and improving resilience, acceptance of the CBDC would need to be near complete. The product would therefore need to be competitive relative to alternative methods of payment in terms of access, convenience, safety, versatility, portability, ease of use and cost. Unique features in terms of being risk-free, functioning off-line and being available to everyone will help drive public demand relative to private sector services. This will require careful design and implementation choices. The decreased use of cash shows that, under many conditions, Canadians value convenience over other core features such as privacy, safety and resilience. CBDC design, however, must still place important emphasis on these other core features.

Preliminary research on CBDC adoption can be found in Huynh, Nicholls and Shcherbakov (2019) and Jiang (forthcoming). Initial public response through focus groups imply there could be a basic level of demand for a CBDC but that it may not be substantial at this time. More research is required on the degree of adoption needed to meet the policy goals and the likely level of user demand given the design factors being considered.

6. Business models

An important consideration in developing a CBDC is the appropriate business model. This would need to achieve the policy objectives of a CBDC while aligning with the Bank's best management practices:

- managing costs effectively,
- applying technology in innovative ways,
- developing and managing strategic partnerships, and
- maintaining agility.

One business model to consider is the current approach to producing and distributing bank notes: a public-private mix involving partnerships with security feature providers, bank note printers, regulated financial institutions and others. However, other business models may be viable and offer advantages in a digital era with consumer expectations of innovation.[19]

One example would be a direct model in which the Bank would provide a CBDC to consumers without intermediation. The Bank would provide all end-user products (e.g., smartphone apps, UADs) and services. An alternative would be a platform model, where the Bank develops a core system that third parties, not necessarily just regulated financial institutions, could use to build end-user products. The incentive for third parties may be as simple as making their product more attractive to their users by integrating methods of payment. A mixed model is also possible where the Bank develops high-quality baseline services and products for end-users while allowing third parties to supplement these with value-added services and products.

One focus of our future work and research will be on the selection of an appropriate business model to balance the costs, public policy objectives and interests of the participants. For further information, see Shah (forthcoming).

7. High-level strategy

This section outlines a high-level strategy and approach by which the Bank could achieve a state of readiness to move ahead promptly to issue a CBDC if that decision is made.

Government policy support for a CBDC would be required to provide the Bank clear legal authority to issue the CBDC and to spell out how the CBDC fits within various regulatory schemes that apply to other types of assets and methods of payment. This implies that the case for a CBDC would need to be not only valid but also straightforward, compelling and compatible with other government priorities.

The Bank will actively engage with external stakeholders in the government and business as well as with end-users. This activity is required to gather further input into the implications of a CBDC on the policy goals of various government bodies. The demands of merchants and end-users, as well as the effects on participant financial institutions in the CBDC ecosystem, will also need to be considered. Another important aspect of our stakeholder engagement will be consultations with other central banks around all aspects of the drivers, motivations and design choices for a CBDC.

The Bank will also need to understand the priorities of Canadians with respect to their currency. The next rounds of consultations will aim to educate the public about a CBDC and its differences from other forms of digital money, to understand their preferred currency traits and model attributes and to gather their views on the possible adoption of a CBDC.

The Bank will set up a framework to continuously monitor contingency conditions with respect to use of cash and private digital currencies. As part of this analysis, research will need to identify triggers to help determine whether and when to move forward with increased readiness or even issuance of a CBDC. At the same time, work on technological options will continue. The Bank would require several years of work to get to the point where it would be possible to issue a CBDC. Because of this long lead time and the uncertainty about the issuance conditions, foundational work will begin immediately. Work can be sped up or ramped down should the assessment of prospects for introducing a CBDC change.

Our estimation of a long development period to make a CBDC available to Canadians rests on several assumptions and uncertainties. We are assuming a target of a generally available CBDC with both UAD and smartphone app platforms exhibiting a high degree of privacy and compliance with regulations. These platforms need to fully consider the needs of external stakeholders and aim to achieve the policy recommendations outlined in this note.

The Bank will continue to collaborate with other central banks to share experiences, assess use cases and discuss functional and technical design choices, including cross-border interoperability.[20]

Technical attributes

Deciding on a technical approach requires further work to clarify requirements and the business model and might depend on the circumstances that lead to the decision to issue. The Bank will continue to investigate both centralized and decentralized options for implementing a CBDC. For the core system, the Bank will draw on cutting-edge techniques, such as new cryptographic schemes, tamper-resistant hardware and hardware security modules to ensure privacy, security and resilience.[21]

Technology will evolve as the project proceeds. A design that may not be deployed for some years risks becoming obsolete. Core technologies, such as internet protocols and server hardware, evolve very slowly once they become pervasive. But end-user interfaces tend to evolve much more quickly. Good system design minimizes interdependencies between core services that evolve slowly and front-end technology that evolves more quickly (e.g., smartwatches).

We will pursue a progression of experimental pilot projects to understand the value proposition to consumers and other stakeholders in the ecosystem and to shape the design of the CBDC. Pilot projects will help mitigate the risks of user-experience design flaws, help gauge adoption, inform and test a communications strategy, inform legal and regulatory issues, hone the operational model, provide a venue to involve stakeholders, etc. Pilot projects may also help gauge the viability of a platform business model and refine and test incentives.

Wholesale payments

This paper describes the Bank of Canada’s decision to create the capabilities needed to issue a cash-like retail CBDC. The changes in money and payments described here also have an effect on wholesale payments, which are larger payments between financial institutions and business. Wholesale payments are also facing potential competition from private cryptocurrencies.

The Bank of Canada is collaborating with Payments Canada on the Payments Modernization program, which includes modernizing Canada's core wholesale payments system. In addition, the Bank has been doing research, outreach and experimentation in the area of distributed ledger technology and wholesale payments since 2016. The flagship of this work, Project Jasper, has allowed the Bank to explore the benefits and risks of new technologies for wholesale payments.[22] The Bank plans to continue this work to be prepared for future developments in wholesale payments.

8. Conclusion

The Bank currently has no plans to launch a CBDC. Rather, as a contingency plan only, the Bank will build the capacity to issue a retail, cash-like CBDC should the need to implement one ever arise. Two scenarios have been identified in which launching a CBDC could enable the Bank of Canada to fulfill its mandate. Either scenario could materialize very quickly, warranting vigilant attention to evolving developments in payments. Because of this and given the time required to create a viable CBDC, the Bank has decided to pursue a contingency strategy designed to create a state of sufficient policy and operational readiness to launch a CBDC relatively quickly should that decision be made.

Significant work is required to achieve such a state of readiness. What the Bank brings to a digital currency is public trust, and such trust needs to be maintained through execution that minimizes the risk of an operational failure, data breach or cyber attack, ensures adequate public uptake and prevents negative consequences for the financial system.

A CBDC can also work together with Payments Canada's Payments Modernization program and the Bank's efforts to improve the efficiency of the bank note distribution model to ensure that Canadians continue to have access to a variety of safe, resilient and efficient payment choices.

For many years now, cash has been at the core of the Bank's efforts to deliver on the public policy objectives described above. The need for the Bank to pursue these objectives does not disappear as payments become more electronic. A cash-like CBDC could be an important component of an effective strategy for the Bank to achieve its public policy goals of safety, universal accessibility, privacy, resilience, competition and monetary sovereignty. In the years ahead, the Bank will conduct its work on a CBDC in a transparent manner, with regular consultations with stakeholders at home and abroad and public presentation of conclusions and issues, as they emerge.

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Endnotes

Footnotes

1. See Henry, Huynh and Welte (2018), Payments Canada (2019) and Bech and Boar (2019) for discussions of payment trends.[←]

2. See Payments Canada (2017) for an overview of the various components of the Payments Canada Modernization Project. See **Payments Canada’s website** for more information. The Real-Time Rail will be an always-available system that facilitates the real-time delivery of low-value payments with immediate funds availability for the recipient.[←]

3. See Henry, Huynh and Welte (2018). Information on merchant cash acceptance can be found in Huynh, Nicholls, and Nicholson (2019).[←]

4. Note that there is a dichotomy in the Canadian cash data. While cash use at point of sale is declining, cash outstanding scaled by GDP has been flat to increasing for an extended period. Part of our research goal is to better understand these divergent trends.[←]

5. Some of these points are also discussed in Engert, Fung and Hendry (2019).[←]

6. Canada Deposit Insurance Corporation (CDIC) provides deposit insurance that covers up to $100,000 per account held at CDIC’s member financial institutions, which include banks,

federally regulated credit unions, as well as loan and trust companies and associations governed by the *Cooperative Credit Associations Act* that take deposits.[←]

7. See Henry, Huynh and Welte (2018).[←]

8. See the results of the Cash Alternative Survey by Huynh, Nicholls and Nicholson (forthcoming).[←]

9. Private digital currencies, cryptocurrencies and stablecoins are different types of new, private, blockchain-based, alternative units of account that can be used to make payments. Examples include Bitcoin and Libra (which is a new stablecoin proposed by Facebook).[←]

10. Until now, examples where an alternative currency has challenged the dominant position of the official currency of a jurisdiction have been restricted to cases where the state was facing severe social and political stress from other sources. But this does not mean it would be impossible for modern technology to enable the establishment of a challenger currency in a stable, advanced economy.[←]

11. Further detail on the risks of stablecoins can be found in G7 (2019). CPMI (2015) contains a review of the risks of private digital currencies.[←]

12. See Chiu and Wong (2015).[←]

13. See Fernández-Villaverde and Sanches (2019), who show that a monetary system with competing private issuers of fiat currencies does not lead to a socially efficient quantity of money. In a model where agents have access to two competing currencies (Bitcoin and a domestic currency), Shilling and Uhlig (2019) show that the price volatility of Bitcoin is consistent with it being used as a means of payment, although achieving the central bank's inflation target requires frequent injections of domestic currency.[←]

14. See "**Regulatory issues of stablecoins**," for more information.[←]

15. Kumhof and Noone (2019) propose some design principles for a CBDC through which central banks can ensure the stability of banks. Monnet and Keister (2019) argue that an appropriately designed CBDC can improve the stability of the banking system because monitoring the flow of CBDC funds can provide valuable information for the central bank on the banks' balance sheets.[←]

16. Keister and Sanches (2019) argue that issuing an interest-bearing CBDC can increase the cost of funding for banks, thus leading to less intermediation. Chiu et al. (2019) discuss effects of a CBDC on the banking sector where banks have market power. See also Andolfatto (2018). Brunnermeier and Niepelt (2019) show that if the central bank can lend back to private banks, then the substitution of a CBDC for deposits would not change macroeconomic outcomes.[←]

17. For more information about adoption and design, see Kahn, Rivadeneyra and Wong (2018), Kahn and Rivadeneyra (forthcoming), Jiang (forthcoming), Huynh et al. (forthcoming) and Huynh, Nicholls and Shcherbakov (2019).[←]

18. Barrdear and Kumhof (2016) estimate that introducing a CBDC can permanently increase GDP by 3 percent. Yet, improving monetary policy through a CBDC is not currently a motivation for the Bank of Canada.[←]

19. See Kahn, Rivadeneyra and Wong (2018) for a description of various distribution models. [←]

20. On January 21, 2020, the Bank of Canada announced it will work with several other central banks to assess potential cases for CBDC. See the **press release** for more information.[←]

21. Shah et al. (2020) provide more information on the overall technology research conducted in 2019.[←]

22. See "**Fintech Experiments and Projects**."[←]

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