

CREATING A CANADIAN CRYPTOCURRENCY:
Why Canadians Need a Central Bank Digital Currency

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Table of Contents

Introduction	3
Background on the Canadian Economy	4
Monetary Policy.....	4
An Increasingly Digital Economy	6
With Digitization Comes Concerns	6
The Need for Digital IDs	7
Privacy is a Public Good.....	7
Central Bank Digital Currency (CBDC) Design	9
Risks and Feasibility	11
Adoption	11
Current Digital Privacy Policy Framework	13
Options	15
Constant Nominal Value.....	15
Stable Real Value.....	16
Interest Bearing.....	16
Account-based Options.....	17
Recommendation	18
Monetary Policy Implications	19
A New Framework – Price level targeting.....	20
A New Monetary Policy Tool – Velocity of money	21
Policy Implementation Strategy	22
Incentivizing Adoption	22
Project Management	22
<i>User centric approach</i>	23
<i>Iterative approach</i>	23
Conclusion	24
Limitations due to Uncertainty	25
Future Considerations	25
Future Challenges	25
References	26

Introduction

Evolution is borne from the existence of a problem. The development and advancement of the Canadian dollar is not exempt from this phenomenon. Bank of Canada author James Powell published an extensive paper on the History of the Canadian dollar. As early as 1698, soldiers experienced difficulty receiving funds due to delays in supply of ‘specie’ – silver and gold (Powell, 2005). To solve the problem, Jacques de Meulles, Intendant of Justice, Police, and Finance, provided a temporary solution – paper money, printed on playing cards (Powell, 2005). The change in medium of exchange was prompted by inefficiencies experienced under the financial system of the time. Nonetheless, this solution was not without drawbacks, as the problem of counterfeiting arose, which illuminated the second concern of the financial system (Powell, 2005). Not only must a medium of exchange be efficient, but it must also be trustworthy. The issuance of bank notes, following the establishment of the Montreal Bank in 1817, aimed to satisfy the need for financial security, and these banknotes were issued in dollars (Powell, 2005). Throughout history, Canadian money has experience currency reform, gone on and off the gold standard, and the exchange rate of the dollar has transitioned from fixed to floating (Powell, 2005). What remains constant is the need for currency evolution, to satisfy the ever-changing monetary demands in the Canadian economy. Discomfort remains the driving force of innovation, as today, the financial system experiences pain points in multiple areas, signaling a need for the next evolutionary stage of the Canadian dollar.

A central bank digital currency (CBDC) was proposed prior to the pandemic, but the current state of the economy demands such monetary reform now more than ever. The National Bureau of Economic Research (NBER) published a paper by Michael D Bordo and Andrew T Levin, in 2017, and notably concludes “in the absence of a CBDC, the central bank may find itself with no real policy alternative”. The authors colloquially characterize the potential predicament of the central banks as being “out of ammunition”. Canada had historically low interest rates at the beginning of the pandemic, constraining the Bank of Canada’s ability to use conventional monetary policy tools to protect against economic instability. As such, an alternative method was used, known as Quantitative Easing (QE). Although the central bank has been able to protect against a significant economic downturn thus far, with new methods come uncertainty with regard to future implications.

As previously stated, problems are the source of innovation. The financial system has demonstrated this through the emergence of ‘fintech’. Currently, the unregulated fintech sector satisfies the growing demand for increased security and reliability in financial transactions. Essentially, cryptocurrencies, stablecoins and non-fungible tokens (NFTs) fill the gap in financial services that traditional institutions fail to provide. As alluded to before, with solutions come new problems. Technological advancement has increased digital privacy concerns with regard to financial payment services and collection of user data by big data companies. Results from a Statistics Canada 2020 survey on level of concern according to applications or digital technologies, indicate 24.9% of Canadians were extremely or very concerned about online shopping sites or applications, and 43.4% were somewhat or a little bit concerned (Statistics Canada, 2021). Additionally, 27.3% of Canadians were extremely or very concerned about social networking sites (Statistics Canada, 2021). Digital privacy concerns reiterate the need for constant evolution, by demonstrating the demand for a digital ID system and robust digital privacy policy. The BoC

provides an extensive analysis on why this problem exists, by providing a macroeconomic model framework to characterize privacy as a public good. One of the solutions proposed by authors Garratt and van Oordt is the adoption of a digital currency.

This paper will provide a recommendation based on a comprehensive analysis of various central bank digital currency (CBDC) options given two base model designs, with a focus on monetary policy implications. Nevertheless, the risks and feasibility of introducing a CBDC will be analyzed as well, bearing in mind the necessity of privacy policy and features required for successful adoption. Additionally, this paper analyzes the monetary policy implications of the chosen CBDC design, which facilitates a new monetary policy framework. Based on the recommended CBDC design, a policy implementation strategy will be outlined, including project management that focuses on a user centric and iterative approach, coupled with scenario crisis planning and an education campaign. Concluding remarks will elucidate limitations due to uncertainty, future considerations and future challenges given the introduction of a Canadian CBDC.

Background on the Canadian Economy

Monetary Policy

The introduction of monetary policy marks a transition away from previous views of economists, as it created a framework for state invention. Adam Smith's *Invisible Hand* theory is based on free markets, that is, prices and production quantities adjust to equilibrium levels due to market functions. Although this economic view explicitly discourages state intervention, as it would inhibit market mechanisms, an alternative view of John Maynard Keynes lends support. As famously said by Keynes, "in the long run, we are all dead". In essence, he is arguing that waiting for markets to adjust is not feasible in some cases, particularly prolonged periods of economic instability or discouraged demand.

The *1929 Stock Market Crash* marked the beginning of *The Great Depression*, and markets did not self adjust over the span of a decade, illuminating the need for state intervention. The Bank of Canada (BoC) was established in March of 1935, serving as the lender of last resort to satisfy the need for a financially stabilizing organization – a central bank. The role of the Bank of Canada is to facilitate economic stability through intervention when necessary, and monetary policy tools have evolved over time. Christopher Regan provides a thorough explanation on why monetary policy matters, and a general overview of how it works. He outlines three characteristics of Canadian monetary policy.

1. It is conducted by the Bank of Canada, which is a government-owned Crown corporation (Regan, 2010). The BoC still operates independent from the federal government, but remains accountable to Parliament (Regan, 2010).
2. Since capital flow across Canada is relatively smooth, interest rates are consistent in all regions (Regan, 2010). It follows, there is a single monetary policy for the entire nation, and the Bank of Canada is the sole issuer of legal tender (Regan, 2010).
3. The Bank of Canada has only one policy tool at their disposal, although multiple economic variables influence decisions related to policy (Regan, 2010).

The monetary policy tool the Bank of Canada uses to maintain stable prices and achieve economic stability is the *overnight interest rate* target. The *overnight interest rate* is the market-determined rate at which commercial banks lend funds to one another (Regan, 2010). By lowering the target, all interest rates fall. This leads to an increase in demand for credit because the price of loanable funds is relatively cheaper, and commercial banks increase the quantity supplied accordingly (Regan, 2010). Conversely, when the BoC raises the target, interest rates increase, reducing the demand for credit, resulting in a reduction in the quantity of credit supplied by commercial banks (Regan, 2010). It is important to recognize that an increase in the quantity of credit in an economy means an increase in the volume of transactions for goods and services, hence an increase in the demand for money (Regan, 2010). The demand is satisfied by withdrawing bank notes from commercial bank accounts, but when there is a shortage of bank notes, a commercial bank must buy them from the BoC by selling other assets, such as government securities (Regan, 2010). Regan effectively outlines the relationship between the *overnight interest rate* target set by the BoC, and the amount of money circulating in an economy.

As alluded to in the third defining characteristic of monetary policy in Canada, inflation targeting is the focus. Regan argues this is the case for two reasons. Firstly, high inflation damages the economy because costs rise for firms and individuals, resulting in a reduction in purchasing power and real wages (Regan, 2010). Secondly, inflation leads to economic uncertainty, which interferes with market mechanisms as price adjustments no longer explicitly reflect changes in quantity based on scarcity (Regan, 2010). For these reasons, the central bank targets inflation in an economy to protect against the eroding effects of rising prices.

The views of economist Milton Friedman were initially controversial, as he argued monetary policy could only have a sustained influence on the inflation rate in any economy, although other economic variables including real output, unemployment, and investment can be influenced in the short run (Regan, 2010). After the 1970s, empirical evidence emerged, and theoretical reasoning lent support for his claims (Regan, 2010). Experimenting with nominal interest rate adjustment to achieve price stability was used during the 1980's due to volatility in oil prices. Despite the price stabilizing efforts of the central bank, there were still a few recessions in the 80's. Nonetheless, many valuable lessons were learned regarding how monetary policy should be conducted. As a result, the targeting of the *overnight interest rate* was formalized as the objective of the Bank of Canada in 1991, which set the annual inflation target to 2% with a range from 1% to 3% (Regan, 2010).

This positioned Canada to execute monetary policy effectively during the second historic economic downturn – *The Great 08-09 Recession*. During this period, the Bank of Canada lowered nominal interest rates to stimulate aggregate demand and the results proved the monetary policy tool was effective. Through the combination of monetary and fiscal policy, the trajectory of the Canadian economy recovery outperformed the United States in speed and magnitude. It is important to note stimulus was also provided by the government, which was made possible due to the government budget surplus that had been run during times of economic prosperity. Furthermore, the current state of the government budget would prevent such fiscal stimulus, due to the pandemic induced deficit. Consequently, there will be a heavy reliance on the central bank to stimulate aggregate demand through nominal interest rate adjustment in the event of an economic downturn in the future.

Which leads to the context of monetary policy today. Canada currently has record low interest rates, and this is an issue for monetary policy due to the zero lower bound on nominal interest rates. Essentially, the central bank is unable to reduce nominal interest rates below zero because agents would be better off converting funds into cash, where a return of 0% is earned. This negates the fundamental purpose of monetary policy, as it increases the risk of bank runs. The current solution to the zero lower bound on nominal interest rates is quantitative easing (QE). However, this alternative monetary policy tool comes with its own set of downfalls.

An Increasingly Digital Economy

Similar to the mass adoption of the internet in the early 2000's, the financial markets are experiencing the next phase of technological advancement. Blockchain technology enables increased security and verifiability. These features are particularly attractive in the financial sector, coupled with the emergence of the financial technology (fintech) sector, Canada's digital economy is evolving. The defining characteristic of blockchain technology is the removal of an intermediary role for verification purposes. Decentralized finance (DeFi) is a movement that advocates the removal of the "middle man", due to increased concern regarding big tech companies and the collection/usage of user data. Although the removal of an intermediary is attractive in private sector instances, disadvantages occur when applied on a larger scale. If enough people in an economy decide to use a private form of digital currency, this could weaken the central bank's ability to provide economic stability through monetary policy. On the extreme end, DeFi could displace the role of the central bank entirely, as they are an intermediary, like all banks. Ultimately, the emergence of fintech indicates there is a demand for improved financial services that can be provided through the usage of blockchain technology. Ultimately, Canadians desire secure financial services, and are seeking out technology that aligns with these preferences.

With Digitization Comes Concerns

The increased usage of crypto currency and other fintech services also alludes to Canadian preferences for anonymity, due to a growing concern over the collection of user data. The Office of the Privacy Commissioner of Canada provides a 2020-21 survey on privacy related issues in Canada. They reported 89% of Canadians are concerned about their personal information being used, and 88% are somewhat concerned about companies using online information to make crucial decisions about employment, insurance claims and health coverage (Office of the Privacy Commissioner of Canada, 2021). The report also indicates how Canadian views have changed since COVID-19, as nearly half of the survey participants report being more concerned about personal privacy (Office of the Privacy Commissioner of Canada, 2021).

Data privacy concerns are not exclusive to the public, as governments around the world have growing concern about the usage of consumer data by big tech companies. *Meta*, previously known as *Facebook*, planned to issue their own stablecoin – *Diem* (formerly *Libra*). The project was discontinued in January of 2022, due to concerns of multiple governments regarding the abuse of user data. The Government of Canada published a report on the potential economic impacts of digital technologies and makes the following comment (Policy Horizons Canada, 2019):

“Digital technologies could improve or weaken the robustness of data, reduce or increase uncertainty and volatility of the business cycle and household incomes, and reinforce or challenge basic assumptions of economics. This would reduce the reliability of macroeconomic forecasts, and challenge traditional business and government planning and growth. This, in turn, would weaken macroeconomic policy.”

Furthermore, digital technology not only increases privacy concerns, but could potentially reduce the central bank’s ability to facilitate economic stability through the usage of monetary policy tools.

The Need for Digital IDs

Data privacy issues demonstrate the need for a security digital ID system to protect user data. In 2019, the Minister of Finance Advisory Committee on Open Banking recognized millions of Canadians were subjected to screen scraping technology leveraged by applications (Accenture, 2021). Screen scraping refers to the usage of a computer program to copy data from a website. The data collection technique can be used in various ways including banking applications and financial transactions. However, screen scraping can also be used for unethical or controversial purposes, such as tracking the online activities of users and potentially stealing data. After identifying the issue, a report was published by the Standing Committee on Banking, Trade and Commerce in June of 2019 (Accenture, 2021). The report, *What it Means for You*, outlines four recommendations that call for timely changes to modernize the *Personal Information Protection and Electronic Documents Act*, to align with global privacy standards and include “consumer data portability rights” (Accenture, 2021). Lessons can be learned from other open banking jurisdictions, including the EU, the UK and Australia. Consumer data portability rights aim to protect user data, by allowing users to obtain and reuse personal data on their own accord. Additionally, consumer data portability rights prevent user data from being stored by closed platforms that restrict user control and access of content. Evidently, the establishment of clear regulatory guidelines to address digital privacy concerns is needed.

Digital identification products have been increasingly considered because user autonomy over data helps to mitigate digital privacy concerns. Ontario announced their commitment in October 2020, to the development of a secure digital ID, and plan to become the leading digital jurisdiction globally (Accenture, 2021). Industry consultations were set to begin January 2021, but the project was stalled due to a focus on developing COVID-related technologies (Accenture, 2021). Similarly, in 2019, Quebec announced a digital platform roll out over the next five years (Accenture, 2021). The plan outlines various commitments, but most notably, the introduction of digital wallets in Quebec by 2025 (Accenture, 2021). Overall, the adoption of fintech in Canada has created a need for a digital ID system.

Privacy is a Public Good

The largest consumer concern regarding increased digitization is loss of privacy. The Bank of Canada argues privacy is a public good because it results in price discrimination – a negative externalities. A public good is one that is non-excludable – as consumption by an individual does

not prevent others from benefiting, and nonrival – as consumption by an individual does not reduce the amount available to others.

To illustrate how the data revealed by a customer can be used to price discriminate among future customers, the BoC uses the Over-Lapping Generations Model (OLG) – a one period, three cohort model that includes an equal number of young merchants, middle-aged consumers, and old consumers (Garratt & van Oordt, 2019). Businesses are able to use payment data collected on users, to group consumers and charge a price that maximizes profits, by exploiting consumer surplus (Garratt & van Oordt, 2019). In the model, middle-aged consumers fail to preserve privacy because private costs are less than social costs, since some of the cost is borne by future consumers (Garratt & van Oordt, 2019). Additionally, middle-aged consumers fail to adequately estimate social costs and benefits associated with privacy protection due to the *Privacy Paradox* – privacy preferences are inconsistent with privacy preservation behaviour. This phenomenon explains why digital privacy issues arise, as individuals want more privacy, but fail to take sufficient action to protect their privacy. The overall result is less than socially optimal decisions, and price discrimination leads to a reduction in social welfare in two ways:

1. *Unavoidable Errors in Consumer Profiling*

When an error in consumer profiling occurs, a retailer quotes prices higher than the consumer's reservation price – the highest price they are willing to pay for a good or service (Garratt & van Oordt, 2019). Consequently, transactions that would have increased social welfare do not occur, as the individual cannot afford the product (Garratt & van Oordt, 2019). Alternatively, the consumer is hurt if they decide to pay the higher price, as they now have less money to allocate to other goods (Garratt & van Oordt, 2019). Microeconomic theory would characterize this as a lower utility obtained at the optimal bundle, which means the individual is worse off under price discrimination.

2. *Reduction in Purchasing Power*

Higher prices result in a lower level of consumption, because an individual can purchase less goods given their budget constraint (Garratt & van Oordt, 2019). Essentially, there is less “bang for their buck”. Additionally, the BoC study argues the reduction in purchasing power could act as a disincentive for young agents to earn money (Garratt & van Oordt, 2019). Working, but not being able to purchase many goods is not an ideal situation, and high prices induce such an instance.

Two solutions are proposed to mitigate price discrimination that occurs when agents fail to preserve privacy. The first is the addition of privacy features to private sector payment platforms, and the second is digital cash substitutes that offer privacy similar to cryptocurrencies (Garratt & van Oordt, 2019). The second solution will be examined throughout this study, through the proposal of a central bank digital currency (CBDC).

Central Bank Digital Currency (CBDC) Design

Introducing a CBDC could transform monetary policy by providing a costless medium of exchange, a secure store of value, a stable unit of account, and potentially enable true price stability. Although there are many potential benefits associated with adopting a CBDC, there are different types of designs, each providing specific advantages and associated risks. Furthermore, it is not sufficient to simply decide on the adoption of a CBDC. Careful selection of CBDC design is necessary to ensure the desired benefits are attained and nonnegotiable risks are circumvented.

The National Bureau of Economic Research (NBER) extensively outlines the two base models for a CBDC design – token-based and account-based. The token-based approach is comparable to current crypto currencies as it requires the usage of distributed ledger technology (DLT) to verify the chain of ownership and validate transactions (Bordo & Levin, 2017). For this reason, the main benefit associated with the token-based design is the protection of privacy while maintaining financial security and reliability. Conceptually, a token-based system, or more colloquially known as a ‘coin-based’ system, is analogous to cash. The differentiating factor is only the technology, as instead of a physical loonie, a digital coin circulates electronically. Similar to cash, the central bank determines the supply of CBDC tokens, which is fixed nominally (Bordo & Levin, 2017).

Conversely, the account-based approach is analogous to debit cards, as agents’ funds are held electronically in an CBDC account by the central bank (Bordo & Levin, 2017). Moreover, one of the largest differentiating factors between the two designs is agent privacy. The account-based model does not offer the same anonymity associated with DLT. Instead, the central bank maintains an intermediary role by processing each payment by debiting the payer’s CBDC account and crediting the payee’s CBDC account (Bordo & Levin, 2017).

The difference in technology used in each design also presents contrasting energy requirements which are particularly important with regard to emission reduction and climate change efforts. The mining process needed for a token-based system is extremely energy intensive. The chain of ownership of each token must also be stored, increasing the energy demand even further (Bordo & Levin, 2017). Furthermore, before selecting a CBDC design, it is important to recognize the environmental implications to ensure the new financial system does not contradict and interfere with net-zero emission goals. Additionally, choosing a CBDC design that neglects to incorporate an environmentally conscious component is incompatible with the preferences of Canadians. Furthermore, since a token-based system is energy intensive, this CBDC design is incongruent with sustainable finance and demand for Environment, Social, and Governance (ESG) products in Canada.

An imperative design feature is undoubtedly efficiency, and the token-based system is again less than ideal in this respect. Although DLT offers many benefits in terms of security and reliability, it is much less efficient compared to an account-based system. The primary advantage of an account-based system is that payments are instantaneous and costless (Bordo & Levin, 2017). Nonetheless, it is vital to recognize the initial costs to implement an account-based system are large due to operational, management and transitional costs. Overall, the token-based system offers privacy, but is not environmentally sound, and the account-based system provides an efficient payment process but there is a loss of anonymity.

A comprehensive comparative analysis of the two CBDC design base models is conducted by the C.D Howe Institute. The authors characterize the differences between a token-based and account-based system across various dimensions. A token-based system provides robust anonymity, but the cost is an increase in the ease at which money laundering and terrorism financing can occur as well as tax evasion (Kronick & Zelmer, 2021). A study conducted by the Bank of Canada echoes these concerns, as they believe if a CBDC is anonymous, then it could be well-suited for criminal activity, as it would be comparable to cash in nature (Engert & Fung, 2017). Hence, although the benefit of a token-based design is anonymity, the trade off is an additional method to solicit illegal financial activity. The account-based system differs in this respect, as the loss of anonymity may decrease the prevalence of financial crime, as a reduction in privacy acts as a deterrent.

Similarly, although cyber risks exist under both systems, an account-based design can potentially mitigate these risks. The authors note that a token-based system would experience the same risk of theft or loss of cash today, but this risk would not be present under an account-based system (Kronick & Zelmer, 2021). Regarding international payments, the account-based system offers relatively greater ease at which cross border payments are facilitated compared to a token-based system. This is due to central banks being on either side of the payment process, increasing efficiency and trustworthiness (Kronick & Zelmer, 2021). Conversely, a token-based cross-border transaction would require multiple platforms, using different crypto currencies, resulting in a more difficult payment process (Kronick & Zelmer, 2021).

Lastly, the authors note the importance of the broader public policy context when choosing a CDDBC design. Due to the lack of anonymity associated with an account-based design, the central bank is privy to better information regarding personal finances of Canadians and businesses in Canada (Kronick & Zelmer, 2021). This is advantageous from a policy perspective as it allows better targeting of monetary policy, however it is controversial as it could potentially weaken the distinct separation of monetary and fiscal policy. Kronick and Zelmer are concerned about whether the central bank could be regulated to execute liquidity operations mandated by the government. They caution that a hybrid type of monetary-fiscal policy would create inferior inflationary control, and eliminate the current independent monetary policy framework (Kronick & Zelmer, 2021). Maintaining distinct monetary and fiscal policy promotes Canadian and foreign investor confidence (Kronick & Zelmer, 2021). These concerns are not present in the token-based system, because the central bank would not have access to such information. Consequently, if separation of monetary and fiscal policy is a preferred element of design, then the token-based system is suitable. Nevertheless, the separation of monetary and fiscal policy as a determined preference does not necessitate a token-based design. Concerns under an account-based design could be mitigated with legislation governing the framework and operations of the central bank, through central bank law (Kiff et al., 2020). Evidentially, there are differing benefits and risks associated with each design, and careful consideration of preferences should be taken into account when deciding which model best fits the specific objectives of a Canadian CBDC.

Risks and Feasibility

Adoption

Universal adoption of a CBDC as legal tender is essential to a successful implementation. It is not sufficient for the central bank to simply declare a new legal tender. Instead, the new digital currency should be phased in, so that Canadians can become familiar with the new medium of exchange and choose to adopt a CBDC as their preferred method of payment. The strategy of policy implementation will be examined in later sections. For now, successful Canadian adoption is the priority to assess the feasibility of a CBDC. Worldwide adoption of our selected CBDC design is preferable, however, an international economy analysis is not within the scope of our study. Furthermore, the following analysis looks at the feasibility of introducing a CBDC strictly in the domestic economy context of Canada.

Multiple central banks, which include - Bank of Canada, European Central Bank, Bank of Japan, Sveriges Riksbank, Swiss National Bank, Bank of England, Board of Governors Federal Reserve System, Bank for International Settlements - have compiled information on the necessary components for a successful CBDC adoption. The private sector offers valuable insight on how to implement new payment technologies and maximize user adoption. The takeaways from the analysis of private sector case studies are that a competitive edge against traditional service providers is based on price, efficiency, and accessibility regarding the onboard process (Group of central banks, 2021). There are three primary factors identified that influence the success of adoption.

1. *Focus on user needs*

There is an opportunity to fill the gap of current consumer demand, which is not fulfilled by present payment services (Group of central banks, 2021). This is evident as constantly emerging fintech is able to capture these consumers with cryptocurrencies, stablecoins, non-fungible tokens (NFTs), and more. Essentially, traditional financial institutions are failing to meet user needs. The consequence is ‘shadow banking’, as unregulated institutions make use of emerging technologies to provide financial services outside the traditional framework. Furthermore, to ensure the successful adoption of a CBDC in Canada, the design and delivery must correspond with these unmet financial service needs and remain consistent with financial preferences and trends. Adoption is facilitated in a CBDC environment that encourages innovation to meet an evolving consumer demand.

2. *Harness network effects*

Adoption of a CBDC presents the classic “chicken and the egg” problem, which exists for all new technologies. Consumers will only use a CBDC if merchants accept it as payment, but merchants will only accept a CBDC as payment if enough consumers want to use it (Group of central banks, 2021). Consequently, network effects must be considered carefully during implementation. Research indicates adoption is more successful in one-sided markets, such as person-to-person (P2P) payments (Group of central banks, 2021).

To encourage adoption of a CBDC, an emphasis on ‘peer to peer’ (P2P) functions should be encouraged during the initial stages of implementation. After this stage achieves successful adoption, merchants will then have sufficient incentive to accept CBDC as payment (Group of central banks, 2021). After merchant acceptance, then the compounding effects of a network can be harnessed to achieve successful CBDC adoption.

3. *Use of existing devices or hardware*

An important lesson derived from the study of private sector introductions of payment service technology, is that success was generally in cases where the service was provided via mobile phone applications (Group of central banks, 2021). This corroborates the idea that consumers are more likely to use a CBDC if it is accessible through technology already widely used (Group of central banks, 2021). To increase adoption, the central bank should ensure account set up can be done easily through an app that would hold the CBDC. The usage of existing technology also fosters merchant acceptability because they do not have to purchase any additional hardware.

There are however special cases to consider with regard to the usage of existing devices, as individuals without smartphones or bank accounts would experience greater transitional frictions. Similarly, merchants with dated technology would be unable to incorporate additional functions for CBDC payment (Group of central banks, 2021). In this case, CBDC payment would have to be enabled through existing infrastructure and networks, by using point of sale (PoS) systems. (Group of central banks, 2021). Although this reduces transitional frictions, achieving practically instantaneous merchant adoption, this approach is not recommended for the long-term strategy. It would result in dependence on existing networks and infrastructure, blunting adoption of new technologies and negatively impacting competition (Group of central banks, 2021).

To summarize the findings of various central banks, the lessons learned for previous adoption of payment services lend vital insight on how a CBDC can be adopted successfully. It is important to recognize there are significant barriers and frictions in the short-run, which include time consuming account opening processes, and difficulty finding places where CBDC can be spent (Group of central banks, 2021). Nonetheless, there are strategies the government can utilize to increase universal adoption. Regarding the minimization of transitional frictions from consumer to merchant adoption, interoperability will play a fundamental role (Group of central banks, 2021). This means synergy of technology and devices used to perform CBDC payments is necessary to successfully achieve adoption.

Current Digital Privacy Policy Framework

There are currently two pieces of legislation that aim to alleviate digital privacy concerns. The first is the *Personal Information Protection and Electronic Documents Act (PIPEDA)*. The Office of the Privacy Commissioner of Canada (OPC) provides an overview of *PIPEDA*. The purpose of the act is to ensure consent is obtained from an individual before the collection, use or disclosure of personal information (OPC, 2019). Additionally, *PIPEDA* enables the right to access personal information held by an organization, and the right to challenge the accuracy of the information held (OPC, 2019).

The usage of information is not without bounds, as personal data may only be used for the purpose for which it was collected (OPC, 2019). If an organization intends to use personal information outside of these bounds, then additional consent for the specific purpose must be obtained (OPC, 2019).

The *PIPEDA* applies to private-sector organizations in Canada, specifically those that collect, use, or disclose personal information during *commercial activity* (OPC, 2019). As defined by law, *commercial activity* refers to any particular transaction, act, or conduct, in addition to regular course of conduct, including selling, bartering, leasing of donors, membership or fundraising lists (OPC, 2019). Regarding provincial jurisdictional differences across Canada, *PIPEDA* applies to all information that crosses borders (OPC, 2019). Consistency in digital privacy policy across provinces and territories is essential to successful CBDC introduction. This legislation is relevant to the creation of a CBDC because banks fall under federally regulated organizations. It follows, the central bank is subject to the *PIPEDA*, and is also listed under the *Privacy Act*, the second piece of legislation relevant to digital privacy policy.

The *Privacy Act* is distinct from *PIPEDA*, as the laws set out privacy rights for federal government organizations, with regard to the collection, usage and disclosure of personal information. This act also applies to Crown corporations, hence the Bank of Canada is subject to these laws. The Office of the Privacy Commissioner of Canada outlines five areas of data privacy concern, and the corresponding requirements.

1. **Collection** - Only personal information directly related to the operations of a government institution's program or activity can be collected.
2. **Use** – Consent is necessary for data usage, and only applicable unless additional consent is provided, for the following uses:
 - The purpose for which the data was collected, or consistent with the purpose.
 - Other specifically identified purposes listed in the *Privacy Act* – sections 7(b) and 8(2)
3. **Accuracy** – Government institutions are required to take reasonable steps to ensure personal information used is accurate, complete and up-to-date.

4. **Retention** - Personal information used for administrative purposes must be retained for a minimum of two years (unless you consent to its disposal).
5. **Disclosure** - Personal information under the control of a government institution cannot be disclosed without consent. The following exceptions apply:
 - Disclosure is authorized in federal legislation.
 - To comply with subpoenas, warrants or orders of a court or other bodies with authority to compel information.
 - When disclosure clearly benefits the individual.
 - When public interest in outweighs invasion of privacy.

Given the current privacy legislative framework, the issuance of a CBDC would require considerable revisions to account for the loss of anonymity associated with an account-based design. Daniel Therrien, the Privacy Commissioner of Canada, provides valuable insight to address these risks and the feasibility. During the International Association of Privacy Professionals (IAPP) Canada Privacy Symposium in 2021, Therrien gave a speech on the future of privacy law reform in Canada. He emphasizes three elements needed under a Consent Model, which are relevant to the introduction of a CBDC.

Rights-Based Framework

Therrien argues future privacy law should be based on the principle that privacy is a human right (OPC, 2021). As such, he posits reform to the *Privacy Act*, specifically to include a clause stating the following to maintain privacy as a human right.

“Protecting an individual's human dignity, personal autonomy, and self-determination.”

Alignment of Public and Private Principles

The first element leads to the second, as clear rules must be laid out for public-private relationships (OPC, 2021). Therrien draws on examples to illustrate the need for alignment of public and private principles. The RCMP used Clearview AI technology to match photographs of people using more than 3 billion images from data scraped without authorization (OPC, 2021). The incident resulted in billions of people ending up in a police line up. Therrien states this is a clear example of mass surveillance, therefore, it is a violation of *PIPEDA*. The case sheds light on risks associated with an account based CBDC, as the central bank will be privy to sensitive information regarding financial data and transactions. It is imperative a similar situation does not occur, and the necessary reforms must be put in place to minimize the risk.

The second example Therrien discusses is also relevant to CBDC data concerns. He recounts an issue with Statistics Canada, as they had collected credit information on millions of Canadians and wanted to collect more financial transaction and account balance data from private sector companies (OPC, 2021). He believes these initiatives were privacy-invasive, however, due to the inadequacy of federal law at the time, the situation was not managed effectively as the

investigation found no legal violations (OPC, 2021). This case reiterates the need for updated privacy policy to prevent misuse of data by public and private institutions. .

Interoperability – Internationally and Domestically

On an international level, Therrien claims data that supports trade must be able to cross borders without infringing on the rights and values shared by international partners (OPC, 2021). International consistency of data rights and privacy policy is necessary if Canada transitions to a CBDC. This alludes to the need for clear international and domestic digital privacy policy standards for both token-based and account-based CBDC designs. It is necessary to reassure Canadians that personal information is subject to the same protection outside of Canada (OPC, 2021). Which leads to the final remark made by Therrien that is relevant to the introduction of a CBDC. The fragmentation of digital privacy laws across Canada poses an issue (OPC, 2021). He acknowledges this is not uncommon for a federal state, but the aim should be for substantial similarity across provincial borders(OPC, 2021). Furthermore, this claim reasserts the need for consistency in legislation across the nation to ensure CBDC user data is protected equally.

The IAPP Canada Privacy Symposium for 2022 will be held May 26-27 in Toronto. Considering the speech given by Therrien proves to be substantially relevant to CBDC risks and feasibility, close attention should be paid to remarks made at this year’s conference. It must also be noted that central bank law and monetary law may require amendments, but are currently beyond the scope of this paper. Additionally, research indicates privacy reform may currently be a barrier to CBDC implementation. Nonetheless, our team believes the introduction of a digital ID system would curb the need for such legislative reform, as it would provide personal data autonomy and data protection. With awareness of the risks associated with adoption and digital privacy policy, a continuation of CBDC design analysis will follow, discussing CBDC options and focusing on the monetary policy implications for each.

Options

A primary benefit a CBDC provides is a secure store of value. This feature refers to the change in the nominal value of funds in a CBDC account overtime. There are, however, multiple options that can influence the store of value. The selected option will be incorporated in the overall design. The National Bureau of Economic Research (NBER) presents three potential options to determine the store of value of a CBDC – constant nominal value, stable real value, and interest bearing (Bordo & Levin, 2017). Understanding how each store of value option for a CBDC interacts with monetary policy is imperative.

Constant Nominal Value

This option would make a CBDC similar to paper currency, as the value would not be subjected to change over time. For this reason, CBDC accounts would remain distinct from reserves of commercial banks that are held by the central bank because these funds usually are interest-bearing (Bordo & Levin, 2017). The monetary policy implications are notable, as households would have

an incentive to reduce the quantity of funds in a CBDC account when nominal interest rates are positive, resulting in the total value of CBDC to remain limited (Bordo & Levin, 2017). Additionally, monetary policy would function in virtually the same manner as today, with the central bank maintaining the ability to adjust short-run nominal interest rates. Consequently, the zero-bound on nominal interest rates would remain an issue as agents would convert funds to CBDC where zero interest is earned, which limits the central bank's ability to reduce nominal interest rates below zero. This presents a challenge during cases of deflation or economic downturns because the central bank would require additional stimulus tools such as quantitative easing (QE). The alternative is fiscal stimulus by increasing government spending to stimulate aggregate demand and increase the price level to target (Bordo & Levin, 2017). However, this is not ideal, and the central bank should hold sole responsibility over price stability and inflationary control.

Stable Real Value

The option requires funds to be indexed to previous changes in price level to effectively preserve the value. This approach captures the “tabular standard” proposed by Jevons (1875) and Marshall (1877) and the “compensated dollar” of Fisher (1913) (Bordo & Levin, 2017). Although the rationale for indexing currency was advantageous under the gold standard when price levels were volatile, the support for this option is weak if the primary goal of monetary policy is to maintain price stability. Indexing is notably problematic in instances of economic downturns and when real interest rates fall below zero (Bordo & Levin, 2017). During these times, agents would again have incentive to convert funds to CBDC's, as it bears a real interest rate of zero. Consequently, this option induces a zero lower bound on *real interest rates*, presenting a much more severe constraint on monetary policy compared to a lower bound on nominal rates (Bordo & Levin, 2017). The central bank would be excessively dependent on QE or fiscal policy to increase aggregate demand under these circumstances. It may be the case that fiscal policy actually ends up bearing responsibility for stimulating economic recovery and restoring price stability (Bordo & Levin, 2017). For this reason, this option is unappealing, as it diminishes the role of the central bank in maintaining price stability through monetary policy.

Interest Bearing

All CBDC funds would bear a nominal interest rate, independent of whether the funds belong to an individual, firm, or financial institution. The option captures the theory proposed by Friedman (1960), who argued an efficient monetary system of government issued money should bear the same interest as other risk-free assets (Bordo & Levin, 2017). One benefit of an interest bearing CBDC is it fosters competitiveness in the banking system. The interest paid on CBDC would generally be positive in the case of economic growth and relatively stable prices. However, in the event of an economic downturn, when there is downward pressure on price levels, a CBDC would be able to reduce interest rates to stimulate economic recovery and facilitate price stability (Bordo & Levin, 2017). Understanding how monetary policy functions presently, positions the benefits of this option to be fully appreciated.

The current constraint on the central bank's ability to lower nominal interest rates below zero in response to severe negative economic shocks is attributed to paper currency. Since this form of

currency earns zero interest, it becomes an attractive store of value if nominal interest rates are negative. For this reason, if the central bank currently reduces nominal interest rates excessively, then the likelihood of a bank run is worrisome. Agents would increasingly prefer to hold funds in cash to protect against the store of value erosion.

The aforementioned constraint on monetary policy is eliminated under an interest bearing CBDC, when fees apply to transfers between cash and CBDC, as it deters conversion (Bordo & Levin, 2017). By imposing a fee on large or frequent transfers, this effectively creates a “wedge”, making it unprofitable for agents or investors to convert funds into cash during periods of negative nominal interest rates (Bordo & Levin, 2017). Consequently, the previous lower bound on nominal interest rates is removed. This is the largest downfall of current monetary policy, as it significantly limits the fundamental tool of the central bank. Under this option, interest rates on a CBDC would serve as the primary monetary policy tool, successfully omitting the need for alternative methods or reliance on fiscal stimulus to provide price stability (Bordo & Levin, 2017). Additionally, the current lower bound on nominal interest rates is the reason for the targeted inflation level of 2%, as it serves as a buffer that allows the central bank to reduce nominal interest rates when aggregate demand is depressed. The most compelling argument for the interest bearing option is under this design there would be no need for an inflationary buffer. As a consequence, not only would a CBDC provide a store of value, but it would also preserve purchasing power over time. Such a revolutionary transformation of currency is not exclusively beneficial to monetary policy, but to society as a whole.

An interest bearing CBDC ultimately enables *symmetric monetary policy*, as the central bank is able to adjust nominal interest rates upwards and downwards without limit (Murray, 2019). As previously stated, this type of monetary policy would support financial stability through the preservation of purchasing power.

Account-based Options

The account-based design requires additional consideration, as there are multiple options to build on this base model. The BoC provides research on three different account-based designs – *cash-only scheme*, *CBDC-only scheme*, and *co-existence scheme*. Hence, it is not enough to simply choose an account-based design. The specific scheme of the design must also be determined. Each scheme is analyzed by the BoC in the context of monetary policy, to see how each CBDC account-based design would interact with inflationary control measures.

Results provided by the Bank of Canada indicate the *co-existence scheme* may result in lower welfare compared to the absolute schemes, either only cash or only CBDC (Mohammad & Davoodalhosseini, 2018). The reduction in welfare is attributed to possibly constrained monetary policy capability under a *co-existence scheme*. If the objective of a CBDC design is to improve current monetary policy tools, then this should be taken into consideration.

Although initially the account-based, *co-existence scheme* appears suboptimal relative to the absolute scheme, a more rigorous analysis of the co-existence option is required before making such a definitive claim. The BoC models each scenario and arrives at the following conclusion.

The results of a *co-existence scheme* vary depending on the substitutability between the two mediums of exchange (Mohammad & Davoodalhosseini, 2018). Additionally, the carrying cost of a CBDC relative to cash influences the result (Mohammad & Davoodalhosseini, 2018). The carrying cost of a CBDC is characterized as the loss of anonymity associated with usage. Given the two factors that impact results, the following scenarios occur under an account-based system with the co-existence option.

Perfect Substitutes in a Co-Existence Scheme

When cash and CBDC are perfect substitutes and the carrying costs of CBDC are sufficiently small relative to cash, then CBDC is exclusively used (Mohammad & Davoodalhosseini, 2018). However, if the carrying cost of CBDC is sufficiently large relative to cash, then only cash is used (Mohammad & Davoodalhosseini, 2018). Under these two scenarios, the co-existence system fails due to perfect substitutability between the two mediums of exchange. Similarly, even if the carrying cost of the CBDC is intermediate, cash still may be used because agents seek to evade taxation by avoiding CBDC usage (Mohammad & Davoodalhosseini, 2018). The primary issue with all of these scenarios is that the interest bearing gains of a CBDC are not realized when cash and CBDC are perfect substitutes. In this case, the account-based option would have to be the *CBDC-only scheme* to ensure the usage of CBDC and obtain the monetary benefits of an interest bearing CBDC. However, this option is associated with large transitional frictions and operational costs. Even more concerning, such an extreme option is likely to hinder adoption.

Imperfect Substitutes in a Co-Existence Scheme

If cash and CBDC are not perfect substitutes, then the *co-existence scheme* may be optimal (Mohammad & Davoodalhosseini, 2018). Furthermore, research on the substitutability between the two mediums of exchange is imperative to deciding which option to incorporate in the chosen CBDC design.

These conclusions illuminate the importance of understanding substitutability when designing a CBDC. Additionally, results provide motivation for the reduction of carrying costs. This could be achieved through digital privacy policy measures and by introducing a secure digital ID system to be coupled with a CBDC account.

Recommendation

Based on the careful analysis of different designs and options, with consideration of carrying costs and substitutability, by understanding the explicit monetary policy implication associated with each variation, we recommend the following design – An account-based system, with an interest bearing CBDC, under a co-existence scheme where a fee is imposed on *large* and *frequent* transfers. As mentioned in the options section, this design element is necessary to deter *large* and *frequent* transfers from CBDC to cash during times of low nominal interest rates, to ensure protection against bank runs. Additionally, it is important to recognize transfer fees are only applied to *frequent* and *large* transfers, to effectively gain the benefits associated with the fee component, without hindering adoption. Users should still have a choice to convert mediums of exchange with ease, but within the necessary boundaries to maintain financial stability. Further analysis and research will need to be conducted on what *frequent* and *large* are specifically defined as in the CBDC context, to establish clear metrics and set standards to be implemented. These metrics and standards will need to be presented in an accessible way, with full transparency, to make certain Canadians understand the implications and rules of transfer fees.

We will refer to this design as “*AICEF*” to stand for a CBDC that is:

Account-based
Interest bearing
Co-Existence scheme
Fee driven

Our chosen design maximizes the potential monetary policy benefits a CBDC offers, by removing the zero-bound limit on nominal interest rates, allowing for symmetric monetary policy. This CBDC design enhances the tools of the central bank, and positions the Bank of Canada to effectively facilitate price stability and stimulate the economy in times of distress. Additionally, our recommended design provides a digital currency with a secure store of value and preserves purchasing power over time. We make this recommendation with full recognition of the concerns regarding the loss of anonymity. For this reason, we recommend this CBDC design to be combined with both comprehensive digital privacy policy and the establishment of a secure digital ID system to protect the privacy of Canadians. Our CBDC design aims to capture the monetary policy benefits that enable overall economic stability while maintaining user privacy.

AICEF is also recommended because it aligns with Canadian sustainable finance preferences. It is important that all new public policies are environmentally sound to complement national and global climate change mitigation efforts.

The central bank will continue to play an instrumental and critical role in international transactions. It is essential Canada provides a trustworthy and secure currency in the global market, while evolving to incorporate technological innovations.

Lastly, our design is sensitive to how Canadians will feel during a time of major monetary reform. For this reason, we have ensured cash is still a viable option for agents, to cushion the transition and allow Canadians to exercise their choice regarding medium of exchange usage. We hope over time, Canadians will see for themselves the benefits a digital currency provides for all, and choose *AICEF* as their primary currency.

Monetary Policy Implications

A New Framework – Price level targeting

As previously stated, *AICEF* will transform monetary policy, with this comes a new monetary policy framework. Instead of inflationary targeting, the central bank will engage in price level targeting. Hence, the establishment of a specific *price level targeting rule*, which would not involve the CBDC interest rate explicitly (Bordo & Levin, 2017). The targeting rule allows for an optimal-control strategy for short-run management of tradeoffs between price stability and other macroeconomic variable stability (Bordo & Levin, 2017). The authors from the NBER report caution against this method, on the basis that a clear understanding of monetary transmission mechanisms is imperative. Essentially the dynamic relationship between setting the policy rate and the effect on the behaviour of prices and real economic activity is needed. Additionally, the impact of rapid developments in automation and fintech should be considered and they are likely to increase uncertainty about monetary transmission mechanisms.

An alternative approach recommended requires the central bank to frame policy strategy in terms of a *simple benchmark rule* (Bordo & Levin, 2017). This method is analogous to the Taylor Rule, but is a price stabilizing tool instead of an inflationary control tool. It is essentially a benchmark for adjusting real interest rates according to fluctuations in prices and overall economic activity (Bordo & Levin, 2017). The following expresses the Taylor rule, as modelled by NBER:

$$i_t = \tilde{\pi}_t + r_t^* + \alpha(\tilde{p}_t - p^*) + \beta(p_t - p^*) + \delta(y_t - y_t^*)$$

- i_t is the interest rate on *AICEF*
- p_t denotes the price level
- p^* is the target price level
- \tilde{p}_t represents the “core” measure of the price level, it is smoothed to removed transitional fluctuations in volatile components
- $\tilde{\pi}_t$ is the core inflation rate
- r_t^* denote the equilibrium real interest rate
- $(y_t - y_t^*)$ is the output gap – the deviation of real GDP for its potential level

Note the interest rate should respond more to the core measure of price level than fluctuations in the price index – ($\alpha \gg \beta > 0$). Additionally, authors believe the interest rate should respond to the movements in the output gap ($\delta > 0$).

A New Monetary Policy Tool – Velocity of money

The technology associated with the introduction of a CBDC will allow the central bank to potentially influence the velocity of money. The velocity of money refers to the number of times the average dollar is used to purchase finished goods and services in the given time period. Currently, the central bank is unable to control the velocity of money, however, due to the traceability of an account-based CBDC, this may provide the necessary mechanisms to effect the velocity of money through monetary policy. The Quantity Theory of Money (QTM) identity is based on nominal GDP equality that enhances our understanding of changes in price level, or inflation.

$$M * V = P * Y$$

- *M* refers the supply of money in the domestic economy
- *V* denotes the velocity of money
- *P* is the price level of finished goods and services in the domestic economy
- *Y* represents all finished goods and services produced and sold in the domestic economy, hence it is real GDP

The right side represents the actions of buyers in the domestic economy, while the left side of the identity models the seller's actions in the domestic economy. When real GDP (*Y*) is multiplied by the price level *P*, the result is nominal GDP. Similarly, when the money supply (*M*) is multiplied by the velocity of money, nominal GDP is also calculated, thus the identity holds. Because on either side of the identity the variables are multiplied, this means that a change in one variable must be accompanied by a proportional change in a variable on the other side, all else equal.

In the long run, output and the velocity of money are assumed to be relatively stable. Monetary policy functions based on this assumption, as it must be true that a change in the money supply must be combined with an equal change in price level. It is for this reason the central bank can influence price levels through adjustments of the money supply. However, if the issuance of a CBDC allows the central bank to formulate tools to influence the velocity of money, then they would be able to affect the price level through an alternative approach. Essentially, if our CBDC design enables the central bank to control the velocity of money, then alternative inflationary tool will be at their disposal.

Policy Implementation Strategy

Incentivizing Adoption

The design of *AICEF* allows for CBDC usage to be phased into the Canadian economy. The internationally collaborative report on “*Central bank digital currencies: user needs and adoption*”, published in September 2021, emphasizes a new payment service that requires both consumer adoption and merchant acceptance. The report notes the role public sector authorities play in the usage of CBDC (groups of central banks, 2021). To avoid friction, the initial phase of the *AICEF* launch would focus on increasing the likelihood of consumer usage. To achieve this goal, the government can incentivize adoption in the following three ways (groups of central banks, 2021):

- 1. Issuing social benefits and transfers in *AICEF***
- 2. Allowing public employees to receive salaries in *AICEF***
- 3. Allow consumers to pay taxes in *AICEF***

By incorporating these methods in the implementation strategy, the government can foster consumer adoption. The next phase would focus on achieving merchant acceptance by ensuring current systems are up to date with the latest technology needed to integrate *AICEF* payments into their business model.

A more rigorous policy implementation strategy would include legislation that sets a minimum level of *AICEF* acceptance in certain jurisdictions, including taxation, healthcare providers and pharmacies (groups of central banks, 2021). This would ensure customers in these jurisdictions could use *AICEF* to purchase essential goods and services. Nonetheless, we recognize this is an austere approach, which some jurisdictions may interpret as overreaching and would be against forcing private businesses to accept *AICEF* (groups of central banks, 2021). With this in mind, we still present the option, as elements may be incorporated in some jurisdictions that are welcoming of the strategy.

Project Management

Before implementation, a clear framework regarding data collection is crucial to success. Performance indicators, expected outcomes and corresponding target variables must be identified to clearly determine success criteria. The desired frequency of data collection should also be considered. In addition, the key players in the delivery network include the following – the Bank of Canada, other relevant public agencies, financial sector representatives, and the general public who will function as the ‘users’ (Kiff et al., 2020).

We recognize the maximization of user adoption and ability to test design features in a relatively controlled environment is critical for the successful implementation of a CBDC. For this reason, our project management strategy will include the roll out of multiple and distinct pilots, which require two fundamental components.

User centric approach

Promotes adoption and builds trust, by including end-users in CBDC development and fosters usability (Kiff et al., 2020). The project management strategy should be focused on understanding how users' behaviour changes with the introduction of *AICEF* and what influences these changes specifically. By understanding what specific factors are specifically attributed to public acceptance, the full implementation strategy can harness this information and incorporate these approaches in an iterative process. This leads to the second component necessary for successful implementation.

Iterative approach

Allows each function and design feature to be tested separately by multiple programs (Kiff et al., 2020). Consequently, the evaluation of success can be analyzed in a meticulous manner and will effectively inform on the true implementation and maintenance costs of *AICEF* (Kiff et al., 2020). Additionally, this approach facilitates participation and feedback from key project stakeholders and end-users (Kiff et al., 2020). The report conducted by the IMP indicates programs should be designed to collect information by testing the following areas:

- 1. Cyber security**
- 2. Financial integrity**
- 3. Financial stability implications**

The combined project management approach will enable the implementation team to use empirical evidence to incrementally improve their strategy as the full program rolls out. The user-centric and iterative approach will enhance the team's ability to address gaps in deficiencies as they arise (Kiff et al., 2020). Similarly, cultivate the ability of the team to rapidly test assumptions of the design and react accordingly by making the necessary alterations and/or additions (Kiff et al., 2020). Independent analysis and evaluation of success by third parties would also be beneficial, as produced findings would be unbiased (Kiff et al., 2020). Evaluation and achievement of the outlined project management strategy should be complemented by the following additional undertakings according to the comprehensive analysis conducted by the International Monetary Fund (IMF).

Scenario Crisis Planning

The rationale to support this additional operation is two-fold, logical and practical. Development of a crisis playbook involving *AICEF* introduction would enhance the central bank's flexibility regarding response to both unexpected and expected scenarios (Kiff et al., 2020). Possible scenarios to consider include technical glitches, cyber breaches, missuses, and infringement of financial integrity standards. The practical reasoning focuses on sensitizing the central bank staff to emerging risks, as this may reduce response time and increase the efficiency in terms of address time (Kiff et al., 2020).

Education Campaign

Communication is essential during a substantial change to the Canadian financial system, to make certain *AICEF* users know where to seek guidance and obtain answers to emerging questions. To facilitate an environment that prioritizes the education of the public on a Canadian CBDC, the establishment of a change management plan and communication strategy are instrumental (Kiff et al., 2020). Both elements complement the overall implementation strategy by supporting user adoption to achieve the successful introduction of *AICEF*.

Conclusion

Given the analysis of different designs and the specific monetary policy implications, *AICEF* effectively harnesses technological advancements in an evolving digital economy to eliminate the ELB on nominal interest rates, the largest constraint on current monetary policy. Consequently, the central bank will be less inclined to use alternative price control tools, such as Quantitative Easing (QE). A major downfall of this price stabilizing approach is the devaluation of the domestic currency. The BoC engaged in QE during the COVID-19 pandemic to support the labour force and the resumption of GDP growth with the Government of Canada Bond Purchase Program (GBPP). However, this resulted in the devaluation of the Canadian dollar. Additionally, QE puts an economy at risk of stagflation, which is characterized as slow economic growth and high unemployment, combined with rising prices. This is a huge concern in Canada, as the post-pandemic economy entails a large government budget deficit and high inflation. Furthermore, the usage of nominal interest rate adjustment by the BoC to target inflation is the preferred method over QE, and *AICEF* enhances the ability through *symmetric monetary policy*.

As previously mentioned, we recommend *AICEF* will full acknowledgement of the costs. The first being the loss of privacy, which is especially important due to the effect of carrying costs on user adoption. Nonetheless, digital privacy policy and legislation offer a robust solution to privacy loss. Secondly, operational and practical constraints impose large creation costs (Murray, 2019). However, our team posits these as initial costs, as once the infrastructure is in place, costs will level out in the long run. *AICEF* is an investment in the financial stability of the Canadian economy. Regarding operational difficulties, the management of a CBDC will require consistent learning and pivoting.

Our team would like to emphasize the importance of the interest-bearing design component of *AICEF*. As outlined in the options section, in the absence of this feature, the ELB would pose an even tighter and more persistent constraint on monetary policy (Murray, 2019). The result would be a lower bound on *real* interest rates, increasing the risk of bank runs.

The final conclusions will include remarks covering limitations due to uncertainty, future challenges, and future considerations. As we aim to provide a comprehensive analysis of what the introduction of a CBDC entails.

Limitations due to Uncertainty

Although we argue all the benefits a CBDC can offer, limitations occur due to uncertainty. The work of Nassim Taleb on *Antifragility* and *Black Swan events* are important concepts relevant to the implementation of *AICEF*. *Antifragility* refers to things that gain from disorder or volatility (Taleb, 2012). The introduction of a CBDC enhances monetary policy, however, there is uncertainty regarding the overall effects on the fragility of the financial system. Close monitoring on how the introduction of *AICEF* impacts the economy and interacts with volatility will help answer the questions regarding *Antifragility*. Secondly, a *Black Swan event* is characterized as a phenomenon that is only explainable after the fact (Taleb, 2007). The concept is based on the probability distribution function (PDF), and rather than occurring in the tails, implying low probability of an event, the phenomena is outside the tails of the distribution, illustrating the unobservability. It is only until the event has occurred that it can be incorporated into the distribution through *post hoc* explanation. Moreover, even though we have included an analysis of relevant factors today, other variables and considerations may appear to impact a CBDC after introduction. Only then, observable, and explainable.

Future Considerations

The need for macroeconomic steady state research and analysis could alleviate some uncertainties. Additionally, estimates on the cross elasticities of demand for cash and a CBDC would help support our analysis. Currently we assume cash and a CBDC are imperfect substitutes under an interest-bearing, *co-existence* design. Another future consideration is the development of a digital ID system to create a safe and trusted digital identity to remedy fictions and privacy concerns. The ownership of data is analogous to control over data, thus better privacy is achieved if the control is held by the individual (Member Consultant Hyperion, 2018). Digital Identity is currently used in financial services, digital commerce, health, and government (Member Consultant Hyperion, 2018). Furthermore, the private and public sectors could benefit from collaboration to establish standards for digital identity.

Future Challenges

An international economy analysis is necessary to develop an implementation strategy for international markets. Specifically, understanding how the Purchasing Power Parity (PPP) of exchange rates will be applied in the context of the introduction of *AICEF*. One day there will be an exchange rate between a domestic digital currency and foreign digital currency, but for now, how will international markets value *AICEF* relative to foreign currency?

To conclude, Canada can position itself as a global leader in an increasingly digitized global economy. Not only in CBDC design, but policy implementation and project management strategy. In a time of polarized political views, Canadians still share preferences for sustainable finance, technological innovation, and price stability, all which *AICEF* captures. In essence, the introduction of *AICEF* could potentially unify the nation through a central bank digital currency.

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