The future of money: The digital currency revolution is here, and may sweep away 5,000 years of monetary history

There is a coming storm in the world of finance as governments around the world engage in a global contest to digitize their currencies

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For several hundred years, the people living on the Pacific island of Yap used giant rocks as a basic form of money. The most valuable of these massive limestone rings, called rai stones, weighed several thousand kilograms. As a result, they weren't easily exchanged when an item was bought or sold. Boulders that were too big to roll from one owner to the next were left in a permanent resting place.

Over time, the community devised a way to maintain the value and ownership of each rai stone by creating a shared oral history, a public account of the ledger. Each time a stone changed hands, metaphorically, members of the community spread word of the transaction and amended their memories.

Trust was implicit because everyone knew the story, rendering each transaction immutable. Over time, money transformed from an object to an idea, while the rocks sat in a forest somewhere, untouched.

A 2,000-kilogram rai stone, like a towering zero, hangs over a shallow pond at the Bank of Canada’s Ottawa headquarters, part of its renovated main floor. The Yap islanders used rai stones until the 1960s (eventually relenting to U.S. dollarization), and over that time the concept of money didn’t really change much.

But there is a coming storm in the world of finance.

At the onset of the COVID-19 pandemic, the Bank of Canada, the country’s central economic authority, realized that physical cash, which had already been in decline for several years, was in danger of reaching a tipping point. This threat to the centrality and basic functions of the loonie, along with looming outside forces of change brought on by cryptocurrencies, big tech and potentially proliferating central bank digital currencies (CBDC) such as China’s digital yuan, has forced the Bank of Canada to accelerate its plan to explore developing a digital loonie.

Governments around the world are now engaged in a global contest to digitize their currencies, and this is becoming the most disruptive force in finance and potentially geopolitics. The digitization of money could create an opportunity for a new benchmark currency. Will China outinnovate the United States in the race to become the dominant global digital reserve currency? Or will it be Big Tech player such as Facebook?

Whoever emerges the victor from the coming money revolution will wield one of the most powerful and truly global tools in human history. Money will be smart and designed to do
what its backers want, which promises efficiency and peril in equal measure.

All of this has served as a call to action for the Bank of Canada. For nearly 10 years, the central bank has been quietly developing a contingency plan for the day the future arrives.

In March of 2020, the bank put out a call to action to Canada’s universities to help develop a CBDC. It sought proposals for a digital loonie from the brightest minds in finance and computer science to help accelerate the plan for a central bank digital currency in what it called the Model X Challenge.

Those experts are saying that the future is now — and many worry that Canada and other countries are already running late.

**Model X – Designing the future of money**

In Canada, less than 5 per cent of what we think of as money is physical cash. The rest exists as commercial bank deposits, not in vaults in the back of a building, but merely data points on spreadsheets and other records, tracking millions of agreements and transactions with people, businesses and other banks and institutions.

Cash has been in declining use for years, outdone by the clinical power of swipe, chip and tap cards, and the convenience of e-transfers. The pandemic has hastened the functional demise of cash by two to three years, according to Andreas Veneris, a Connaught Scholar and professor of electrical and computer engineering at the University of Toronto who researches cryptofinance.

In February, 2021, the Bank of Canada announced three teams it asked to submit detailed proposals for its Model X Challenge to help shape the design, technology and vision for a digital loonie. Prof. Veneris and his colleagues are one of three winning teams of researchers. The other two are from the University of Calgary and McGill University.

Model X’s call for proposals was purposefully vague, according to those who participated, but one detail was made clear throughout the process: The bank does not want to leave it to outside actors to determine the fate of the loonie.

“They seem to want something down the hall, part of the bank, legally,” says Poonam Puri, a law professor at York University and a member of the U of T-York team along with Prof. Veneris, Prof. Fan Long of the computer science department and Andreas Park, a finance
researcher at U of T's Rotman School of Management. “The Bank of Canada wants to have a direct relationship with all of us, through an e-wallet.”

The bank has long held that while it explores a central bank digital currency, there remains “no compelling case” to issue one at this time. Even so, its leaders now acknowledge the rapid pace of global change signals the inevitability of a digital loonie.

**The Manhattan Project - How crypto made analog cash obsolete**

Representations of the virtual currency Bitcoin stand on a motherboard on May 20, 2021.

DADO RUVIC/REUTERS

Bitcoin was invented in 2008 by an unknown person or group using the pseudonym Satoshi Nakamoto, and came into use in 2009. For the first couple of years, it was basically a plaything of libertarian-leaning software nerds, but soon caught on.

The first known purchase with bitcoin took place in May, 2010, when a programmer in Florida jokingly paid a stranger in the U.K. to order him two pizzas from a local Papa John's for 10,000
BTC, then worth about $60. (At this week’s rates, those pizzas cost roughly $477-million).

Before it became a speculative boon seemingly out of thin air, bitcoin survived its beta stage because it could do things that fiat money and the global banking system could not. Instant and direct cross-border payments didn’t require a costly intermediary or that you trust the person on the other end of the exchange.

Just like those giant rai stones, there was no need for an intermediary. Bitcoin is built on a blockchain, which is conceptually the same as the Yap islander oral history. Each computer in a blockchain network, called a node, holds a copy of the entire history of every coin and each transaction conducted with it, called a block, and does the work of executing new transactions.

The Yap islanders didn’t require a trusted third party, such as a bank, to maintain one true copy of the oral history – and, of course, charge fees for storing it, accessing it and updating it. Until 2009, the ease of a dedicated bank made a lot of sense in a world dependent on an analog approach to payments and finance. Bitcoin upended that assumption with one pizza order.

“It was the Manhattan Project of money,” says Campbell Harvey, a Canadian economist at North Carolina’s Duke University who is an expert in how cryptocurrency technologies are decentralizing finance. “Bitcoin is really elegant. It was not done by finance people, who tend to be stuck in the past. This is not a renovation, it is a rebuild. And it’s very exciting.”

But bitcoin is limited in what it can do. And because it has become an enormously volatile and valuable speculative asset. While all currencies experience minor ups and downs in their worth, bitcoin can gain or lose thousands of dollars in value in a single day. Using bitcoin to, say, pay for a pizza feels more like a game of roulette than a simple transaction.

Like other members of finalist teams in the Bank of Canada’s Model X challenge, Prof. Veneris says that although bitcoin introduced him to the revolutionary potential of blockchain technology, he saw a more plausible future in the Ethereum network.

Unlike bitcoin, which was only designed for a single purpose, Ethereum is more than just a cryptocurrency. It’s a competitive and creative ecosystem that can host any number of other transactions on its network, and execute so-called smart contracts with its native currency, called ether.
The idea of the smart contract had been kicking around for years. In 1996, the American cryptographer Nick Szabo wrote a magazine article called “Smart Contracts” that foresaw what is now capable on a blockchain.

Mr. Szabo used a vending machine as a metaphor to explain its basic function: You put money in, a specific code is entered and a candy bar comes out (unless it gets stuck, of course).

In the digital world, these actions could be programmed to take place automatically. Basic forms of smart contracts have been in use for years, such as setting up automatic payments on credit cards. But because financial systems around the world are built on analog design, the concept has been capped at simple spreadsheet formulas.

Alfred Lehar, a member of the University of Calgary Model X team, believes that smart contracts are essential for any future CBDC, and will effectively change the world. “With a few lines of code, we will be able to make complex agreements without the need for an intermediary. No clerks, no lawyers, no waiting. You know you can trust the computer program,” he says.

“Think about how much the payment sector costs, as a percentage of GDP. It’s huge. We could use that money for other things,” he adds.

Prof. Lehar uses the analogy of buying a house to illustrate the shakeup programmable money will cause. When you buy a house, he says, you provide a deposit to a lawyer, and you pay fees to the lawyer and a bank for that.

When the transaction is complete, they release the money to the seller. “But that’s a fairly simple contract to automatically code,” Prof. Lehar says.

The deed for the house would be digitized and connected to the transaction. “If the transfer fails, it will send the money back. If it succeeds, it will release the money automatically. A smart contract makes it safer, more reliable, direct, immediate, and much cheaper than the current system.”

Katrin Tinn, a finance professor at McGill who co-authored the third finalist proposal, also argued that government-backed digital currencies be aligned with fiscal or public policies, unlike cash in its current form and the proxy system in banks.

Governments could, in effect, program public policy into money. “There could be a lot of innovation built on top of a CBDC,” she says. “Take student loans. They could be programmed
on a sliding scale to promote equity, reacting to how much you earn as you pay them off. If you earn more, you pay back more, but if you have a tougher time, the loan auto-corrects to allow you to pay back less.”

Prof. Tinn also says a programmable loonie would allow for wholesale social change in everything from paying your taxes allowing artists to leverage the power of a non-fungible token in order to be directly compensated in real time if their artwork is resold, their story is read or their song is streamed.

We would no longer need to trust the system or that the buyer and seller will comply with the rules, she points out. Just like the rai stone, the currency could do that for you.

The U of T-York team’s legal expert, Poonam Puri, says the government needs to think deeply about how its policies will be shaped with a central bank digital currency. She says a government might be tempted to tailor smart contracts to, say, impose restrictions on how benefits could be spent, which could turn the loonie into an ideological weapon.

The finalist proposals – Three blueprints from Canadian academics

Central Bank Digital Currency (CBDC) explorer

- **Retail**: Where central banks have done or are planning retail CBDC pilots
- **Exploring**: Where central banks have or are exploring issuing retail CBDC
- **Exploring but not announced**: Where central banks have done or are planning CBDC (unconfirmed)
All three finalist proposals share key similarities that posit an idea of the future. Each recommends the Bank of Canada maintain a closed blockchain, in place of leaning on retail banks or other private-sector players to create and maintain the core platform. This closed blockchain would issue and monitor the CBDC, with a certain level of day-to-day anonymity for Canadians doing basic transactions, such as small retail purchases.

All three models pitch the need for a digital wallet, which is a basic smartphone and desktop app. The wallet functions much like today’s banking apps, but with fewer features and products. It would only facilitate holding government tokens, and would be able to connect to an existing bank account and app. Retail banks may be allowed to develop their own version of a digital wallet as well.

For Canadians who do not have a smartphone or reliable access to the internet, all three teams proposed a card with an NFC chip that could accept and receive payments by tap, and could be connected to a digital wallet.

The U of T-York University proposal differs from the other two in this first phase of development, because it explicitly recommends that the Bank of Canada go on its own as a “narrow bank,” directly offering Canadians a basic digital wallet and access to its coins.

The authors suggest only engaging with retail banks after the CBDC is established and its value shown to Canadians. Retail banks might see the central bank offering a basic digital wallet as a challenge to some of their basic services, but the team believes that winning buy-in from Canadians first will force retail banks to embrace a CBDC.

“Involving the Big Six banks too early would allow them to slow walk the process,” says Prof. Park, who points out that these institutions will, naturally, resist giving up a lucrative part of their business model. According to a McKinsey report, the global payments market is worth US$1.9-trillion and accounts for, on average, 39 per cent of banking revenues.

“We’ve got to tear the Band-Aid off,” Prof. Veneris adds. ”When Canadians see the value and positive change brought on by a CBDC, they will want it, and commercial banks will have to fall in line.”

Prof. Lehar, who led the Calgary proposal, shares in the excitement about the promise of digital banknotes that can be programmed to settle and process transactions themselves. “To me, there has to be a value proposition to Canadians to go through with such a big change.”
The McGill proposal differs slightly from the other two in how it handles privacy, which is a key feature of its design. For the vast majority of small day-to-day transactions, the user of the CBDC would be completely anonymous, buying tokens with an e-wallet on an encrypted system that can only be unlocked with a court order, similar to how things work with conventional bank accounts. The person or business on the receiving end of the payment would be visible, however.

Prof. Tinn says the combination of direct access to this system and smart contracts could revolutionize how the government could deploy financial aid. “During the pandemic, many Canadians received CERB payments,” she says. “With this system, all payments could have been made automatically and immediately, with no confusion over who was eligible and who wasn’t, without the need for a bank account.”

Both the Calgary and Toronto concepts propose a second phase that invites major financial institutions to host a node on a secondary layer running a permissioned blockchain, so Canadians can have seamless access to loans and other financial products. The final step would be to deploy application programming interfaces (APIs), which are like limited keys for fintech firms to access the blockchain and offer new smart-contract-driven services on the platform.

Earlier this year, when all three teams met virtually with the Bank of Canada to discuss their respective projects, the bank was careful not to reveal its own plans. “They asked a lot of pointed questions about why blockchain, how each platform could be built and how smart contracts would work,” Prof. Veneris said.

“But my sense was that they already knew all of this, were asking questions about concepts they felt comfortable with or excited about and knew exactly what they were doing. They keep saying, ‘We don’t have a plan to release a CBDC, we are merely keeping all options open with a contingency plan.’

“But I get the sense that we’re going to wake up one morning soon, and we’ll be reading about an announcement from the Bank of Canada about a digital loonie. That it will use blockchain technology to some degree, will be a project at the Bank itself, and will hopefully include the ability to write smart contracts.”

In a statement to The Globe and Mail, the Bank of Canada referred to earlier comments by Governor Tiff Macklem and Deputy Governor Timothy Lane that acknowledged “the pandemic may bring us to a decision point sooner than we had anticipated.” The bank is also
monitoring Big Tech private digital currencies and other private stable coins. Even so, deploying a CBDC remains “a contingency plan.”

**Threat No. 1 – Facebook and private digital currencies**

For central bankers, Sept. 16, 2019, might be seen as their Battle of Waterloo.

It was a Monday, and representatives from 26 central banks from around the world, including Canada, hurriedly shuffled into the headquarters of the Bank of International Settlements in Basel, Switzerland.

The 20-storey modernist concave cylinder of smoked glass and sheet metal lords over the neighbourhood, and was the location for one of the most consequential showdowns in the history of finance.

Some bankers were angry, others no doubt afraid. Across the table sat representatives from Facebook, summoned there to explain the tech giant’s recently announced bombshell of a project – Libra, the world’s first truly borderless private digital currency.

The stakes for central banks were suddenly extremely high. If Libra caught on with the social network’s 2.8 billion users, it could topple the conventional payments sector, and pose a serious threat to the financial sovereignty of pretty much every country. Facebook’s announcement quickly scared some central banks into action, including China’s.

“They wanted to test central banks and see what their reaction would be,” says Hanna Halaburda, a professor at New York University and a former Bank of Canada economist. Prof. Halaburda was hired by the Bank in 2012, joining its e-money group, in part because she’d been researching unusual micro-economies, such as those in the video games *World of Warcraft* and *Second Life*.

One of her areas of interest was Big Tech, and she noticed that companies such as Facebook and Amazon were, in effect, prototyping currencies with their credits and tokens.

“This was back in 2012, and at first the impact of bitcoin was our primary concern, and should central banks start issuing digital currencies as well,” she says. “Back then, when we talked about the private sector, we had retail banks in mind, not Facebook.”
Prof. Halaburda, who left the bank in 2019, says that the tech giant simply identified the severe inefficiencies in the payments sector that it could uniquely exploit with its massive global reach and sophisticated platform.

“They were no doubt targeting remittance payments,” says Prof. Park of the U of T-York Model X team. He says workers send about US$800-billion a year to their home countries. ”Right now it’s extraordinarily expensive, slow and inefficient, and around 10 per cent of that gets extracted by the financial sector in fees.”

Getting ahead of countries in developing a powerful new digital currency would give Facebook an overwhelming advantage. The company also saw an opportunity to fill in one of its remaining holes in collecting our personal data.

“Our children could very well be using Facebook’s currency,” Prof. Veneris says, if Canada and other countries don’t fortify their financial sovereignty. The next generation “would have no idea what the loonie was.”

Since the meeting in Switzerland, the Bank of Canada has issued multiple statements that reinforce the view that a Big Tech-backed currency could be a threat to the loonie.

In December, 2020, Facebook retreated from Libra, refashioning the project as Diem, and focusing solely on the U.S. market.

**Threat No. 2 - China’s DCEP and money as Big Data**

**The global race to digitize money**

With the rapid decline in the use of physical cash, the race is on for countries to develop a digital alternative. China is the current world leader, and with the overwhelming majority of the country’s financial transactions already being done through mobile apps WeChat Pay and Alipay, it is well positioned for the digital yuan to take off. Canada has been investigating a central bank digital currency for many years, and may be on the verge of a pilot project.

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<th>Central banks</th>
<th>China in the CBDC lead</th>
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<td>Engaged in CBDC work</td>
<td>RMB314-trillion in mobile payment volume Jan.-Sept. 2020, up more than 135 times from Fiscal Year 2012.</td>
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Last October, while much of the Western world was in the throes of the second wave of COVID-19, the People’s Bank of China made history in the city of Shenzhen.

One of the 50,000 lottery winners of a virtual red envelope walked into a shop in the city’s trendy Luohu shopping district, picked up an item, held their phone up to a scanner at a self-checkout kiosk and became the first person to use China’s central bank digital currency, the most advanced form of fiat money in the world.

China unveiled its concept for a national digital currency with a splash, giving away 10 million yuan (or roughly $1.9-million) in 200-yuan packets for use in a controlled experiment – a one-week shopping splurge in more than 3,000 stores, just to see how the system would react to real-world transactions.

The new currency doesn’t have a name, but is being referred to as China’s Digital Currency Electronic Payment system, or DCEP, although some more informally call it the digital yuan or digital renminbi.

For the participants, the experience was indistinguishable from their usual method of transacting, which is overwhelmingly by smartphone through one of two dominant platforms, WeChat and Alipay.

The two private digital payment systems were borne out of the massive ecosystems built by their respective parent companies, Tencent and Alibaba. These twin forces represent more than 80 per cent of total payments in the world’s largest digital economy and their power and reach are perhaps one reason why Beijing has been hard at work developing a digital currency.
But some experts believe that DCEP is just a part of a much broader strategy. Together with China’s Belt and Road Initiative, the country’s long-term global financial influence campaign, the development of its Blockchain Service Network (BSN) and the export of smart city projects by government-associated firms export, China seems to be taking a unified approach to data, surveillance and state control of the economy, with an eye on becoming an even bigger economic player.

Carolyn Wilkins, the former deputy governor of the Bank of Canada, says one big question will be if a digital yuan can have the reach its analog forebear did not.

In addition to how DCEP could factor into a long-term Chinese challenge to the U.S. dollar as the premier reserve currency, the reach and influence of a digital yuan raises serious short-term questions for countries such as Canada when it comes to international payments.

Ms. Wilkins also warns that China’s attitude toward data privacy and potential use of personal data “don’t correspond with democratic and open-society values.”

“China is a data-based economy,” says Yaya Fanusie, a former CIA analyst and now a senior fellow at the Center for New American Security in Washington. “DCEP is as much about data as it is about money.”

Mr. Fanusie warns that while blockchain-based ideas are siloed in North America, China is laying down the infrastructure for a broad, fully integrated future internet.

Dr. Matthew Johnson, who studies China’s digital financial strategy at the Australian Strategic Policy Institute, says this matrix of tools is part of a grander data infrastructure that will link in with the Chinese Communist Party’s individual and business social credit system, and leverage the connectivity of the Internet of Things, which includes the world’s widest-reaching array of facial recognition cameras.

Mr. Fanusie points out that when China released its fintech plan for the country a few years back, it framed DCEP primarily as the missing piece of a surveillance data puzzle. And, unlike in the West, China’s security laws allow it access to user data.

**What about the Big Six? – Canada’s banks will have to adapt to adapt – and fast**
All three Model X finalists recognized that Canada’s powerful Big Six banks need to play a role or the financial sector could be severely disrupted.

“The danger in developing a CBDC is that retail banks will just drag their heels, resisting change, or could rebel and decide to develop their own private coins,” says Duke’s Prof. Harvey. He believes that Canada’s banking system has become oligopolistic – borrowing rates are too high and savings rates are too low, and that easy profits have created complacency.

Prof. Harvey says distributed ledger technologies are already taking other parts of the financial industry by storm. Just before the pandemic, he was flown to New York to speak with the board of a major stock exchange. “I didn’t know why they wanted to speak with me, but when I got there and got in front of them, they just had one question: ‘How long do we have?’ ”

He says that retail banks, insurance companies and other financial institutions need to embrace this uncertain future, just as that unnamed exchange has, and make their own contingency plans for a bold yet perhaps less profitable future. “With this change, we'll be asking commercial banks to spend more money so they can learn how to make less. My view on this is that the banks are too late to react to this change,” he says.
Prof. Harvey says smaller fintech firms designed to thrive in a decentralized environment could quickly challenge large bedrock institutions as technologies take hold, much like how Netflix devoured the once giant bricks-and-mortar home-video market.

Each time Prof. Harvey speaks with leaders at a major financial institution, he asks them how much blockchain research they are doing. “When they say, ‘We’ve got a dedicated team and we’re actively pursuing new ideas,’ I think to myself that they may survive what’s to come. But when they dismissively state, ‘We’re looking into it,’ I know I’m talking to a doomed institution.’

In 2019, Prof. Harvey was speaking at Toronto’s Rotman School and relayed that analogy to the crowd. The following speaker, a representative from the Bank of Canada, didn’t hear his speech, and when asked by a member of the audience where the bank was with blockchain research, the representative said, ‘We’re looking into it.’

“The crowd burst into nervous laughter,” Prof. Harvey says. “I hope their perspective has changed.”

After nearly a decade of doing its due diligence on the future of money, the Bank of Canada now seems on the precipice of having to make tough decisions, and act on its contingency plan.

“Given all that has happened, and this sudden momentum caused by outside forces all around us, I feel it’s now not a question of if but when the Bank of Canada launches a CBDC,” Prof. Veneris says. “My fear is that the answer to the question of when we should launch this was, well, yesterday.”

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