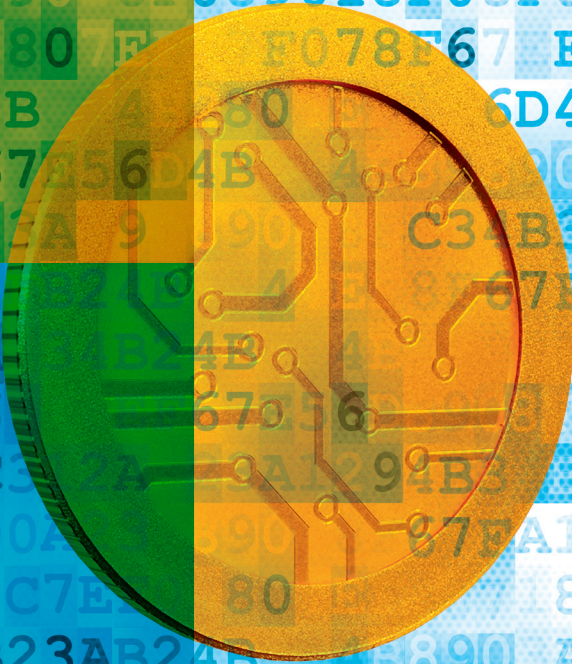


THINK ACT

PART 2

BEYOND MAINSTREAM



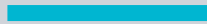
January 2017

New realities in central banking

The rise of cryptofinance in central banking

THE BIG

3



5-7%

of GDP is the cost of cash in developing economies.

Page 6

90+

central banks are currently discussing the implications of digital currencies.

Page 7

3%

Central bank digital currency could lead to an increase in the steady-state level of GDP of almost 3%.

Page 8

The digital dawn beckons: Introducing the concept of a central bank digital currency.

2017 is heralded as the dawn of digital currencies in the financial services industry. Emerging digital and virtual technologies are lauded as the most disruptive innovations since the advent of the internet. Both hoodies and suits – start-ups and incumbents – are embracing the arrival of digital currencies. Amid all the hype, it is important to sift through and identify the key messages relevant in the world of finance. In our previous THINK ACT edition, *New realities in central banking: The organizational challenge*, we examined the structural changes and transformation necessary for central banks to become high performance organizations. In this edition, we reveal the impact of digital currencies on central banks, explain the underlying technologies, and make recommendations for central banks in the digital age. In order for central banks to maintain relevancy into the future, they are tasked with evaluating the development of a central bank digital currency. Having currency represented in a digital manner is nothing new. In fact, this has been the case since the digitization of communications. At present, in developed markets nearly all money is held and exchanged by digital means in the form of information and only a small percentage of all money in circulation exists in physical form. While a central bank digital currency will not completely replace physical notes and coins any time soon, adoption rates are difficult to predict. There can be no doubt that these digital technologies are here to stay. → [A](#)

DEFINITIONS

BLOCKCHAIN: A blockchain is a distributed ledger, consisting of immutable, digitally recorded data in packages called blocks.

DIGITAL CURRENCY: Digital payment mechanism that is denominated in fiat currency (for example a central bank digital currency).

VIRTUAL CURRENCY: Digital representations of value, issued by private developers, and denominated in its own unit of account.

CRYPTOCURRENCY: Digital or virtual currencies that use cryptography for their operations (these include Bitcoin, Litecoin, Ethereum).

PROBABILISTIC CONSENSUS SYSTEM: Database that is updated by the consensus of the participants in the system. The system requires no trusted intermediaries (e.g. blockchain).

DETERMINISTIC CONTRACTING SYSTEM: The transfer of assets occurs through the exchange of cryptographically secured digital contracts between trading parties. Transactions in these systems are validated by a neutral third party witness – a digital notary.

Decoding digital currency: Differentiating the emerging digital technologies.

Bitcoin started as a digital alternative to current central bank backed fiat currency in 2009. It is decentralized in its nature, has a fixed supply, and is not legal tender. Furthermore, it is not issued by a central authority or backed by a central bank and is still young and mostly unknown to the general public. It has not seen widespread adoption in its first six years for a number of reasons. The most notable of these being a lack of infrastructure and price fluctuation – which makes the process of buying, trading, and securing Bitcoin complex. The majority of people are yet to realize its potential benefits as an exchange mechanism and store of value. The technology, however, enables end users to hold on to digital assets directly, whether they are a fiat currency, asset, or commodity.

Our current financial system is built on a model of custodian guardianship – trusting financial institutions to hold and track who owns each asset. This includes stock brokers, financial managers, commercial banks, and others. Bitcoin alone will not shape the future of financial services. However, in the future, the underlying blockchain technology will shake up the structures of a broad variety of industries, allowing individuals to conduct transactions without relying on a third party. With this technology, people are able to hold assets directly, just as banknotes and coins are held in a wallet today. →B

Although Bitcoin is considered a digital currency, it is more accurately described as a cryptocurrency. Cryptography is what makes Bitcoin unique. It is where the differentiation between every other virtual or digital currency becomes apparent. Cryptography controls nearly every aspect of Bitcoin – from production to distribution and storage. As there is no central entity or bank controlling the production of Bitcoin, one of its greatest values comes from trusting the math and not a centralized institution's policy decisions.

As a medium of exchange, national fiat currency is ubiquitous within its respective geography by way of associated trust in the issuer, a reserve bank. To be widely accepted, money requires trust. Banknotes are issued by the reserve bank as bearer instruments, which can be thought of as contracts issued and guaranteed by a government or central bank.

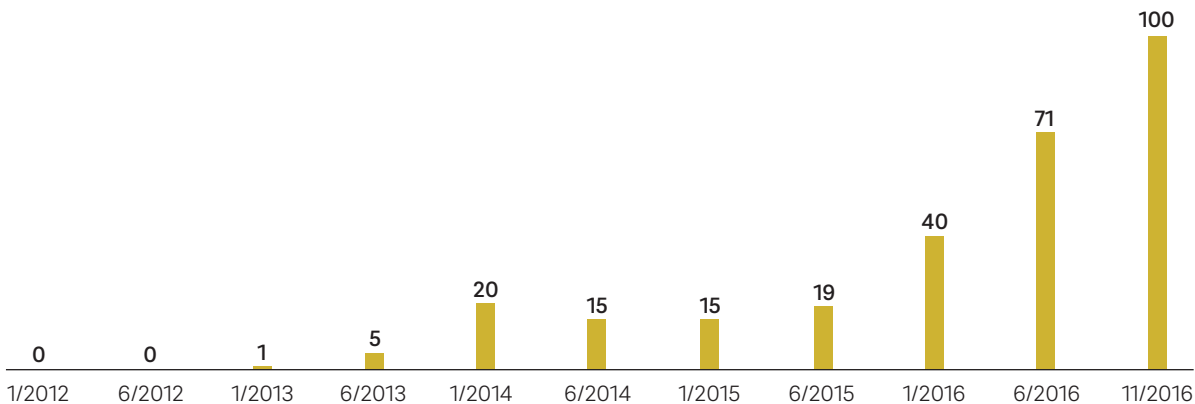
Central bank digital currency utilizes many of the benefits that an asset like Bitcoin possesses, but with the predictability and trust provided by the issuer. Central banks could leverage the public trust in their institution to offer the national currency to citizens in digital form, resulting in a reduction in costs relating to securing, distributing, and processing physical notes and coins. A central bank digital currency is simply a digital innovation of a central bank's primary product, cash. This comes nearly 30 years after the advent of dig-

A

EVERYONE IS TALKING ABOUT BLOCKCHAIN

Google Trends reveals blockchain technology is growing in popularity

Google Trend Score



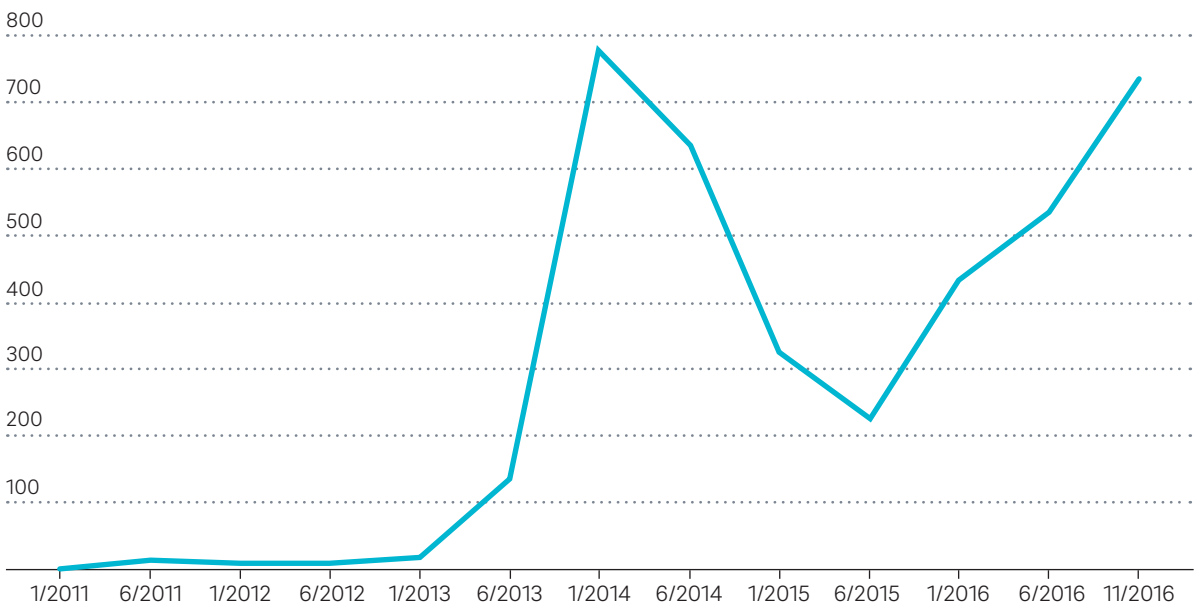
Source: Google

B

BITCOIN'S VALUE AGAINST THE US DOLLAR HAS FLUCTUATED SINCE ITS INCEPTION IN 2009

Despite being just one of hundreds of digital currencies, Bitcoin is the most widely accepted

FX Rate BTC/USD



Source: CoinDesk

6 THINK ACT

Digital currencies

ital communications. Other industry innovations have not yet addressed the digitization of legal tender. Instead, they look at solving issues present in the back end of today's account based systems. Settlement coins are being proposed by many institutions in order to increase the efficiency of settlement and reconciliation. Other FinTech companies like Ripple are providing a digital bridge cryptocurrency, "XRP", to enable faster cross-currency settlement and reconciliation.

A central bank digital currency as full digitization of the bearer instrument avoids issues present in different "settlement coins". Just as cash is transacted between two parties, when value is transacted with a central bank digital currency, the bearer instrument changes possession directly in real time. As with a cash transaction, this implies there is no need for any reconciliation or clearing between the parties transacting.

Ideally, a central bank digital currency should mimic banknotes and coins in all respects, meaning once a consumer has converted money held in an account or as physical cash into a central bank digital currency, it could be used anywhere as payment without the intermediation of a bank or any other facilitating organization. The digital money will be kept in a digital wallet or electronic cash box system similar to how banknotes and coins are held in the physical world.

REDUCING THE COST OF CASH

The idea of a central bank digital currency is already gaining popularity around the globe. The Vice-Governor of the People's Bank of China states that a major goal of a central bank digital currency is to replace physical cash. This serves to cut the cost of issuing and circulating traditional paper money as the burden of managing an economy based on physical cash is large.

A study by the Finance Ministry of India estimates the cost of cash to the economy at between five and seven percent of the gross domestic product in developing countries and at one to two percent in developed countries.

The production, security, distribution, and eventual destruction of notes and metal coinage is expensive. By providing a digital means to store, transact, and use legal tender, these costs are reduced, resulting in huge savings not only for central banks but also for banks, merchants, governments, and the economy as a whole. The Bank of America alone spends \$1 billion a year on cash handling processes. Repositioning the central

bank at the center of the digital economy enables all the advantages of digitization, while maintaining control over monetary policy, regulation, and reducing costs. Creating a more transparent system, a central bank digital currency will widen the range of monetary policy instruments available. This will allow for execution of monetary policy in an efficient and targeted manner across all digital financial service providers.

Over two billion people currently have no access to bank accounts and rely solely on physical cash. Millions more have bank accounts, but are still excluded from financial services to a large extent. Without access to formal financial services these individuals are unable to save, invest, or access loans, and it is estimated savings suffer an annual reduction of one fifth due to theft, losses, and costs on an annual basis. The introduction of digital legal tender and the leveraging of increasing smart phone usage, especially in emerging markets, can help to increase financial inclusion and thereby expand the size of the formal economy.

Furthermore, the cost to enforce "know-your-customer" (KYC) and "anti-money-laundering" (AML) requirements will decrease for banks and other businesses since the monitoring of central bank digital currency transactions could be executed in real time with greater efficiency. Counterfeiting and the associated preventive costs will also be reduced as digital currency can be secured by cryptographic algorithms, as opposed to physical security measures such as holograms.

CHALLENGES STILL NEED TO BE OVERCOME

The many advantages brought forth by central bank digital currency are not without their challenges. Central banks need to adopt a new mindset and build capabilities and structures that allow them to collaborate with innovative software providers and understand current and future technologies, which are evolving and changing at a high speed. When we look back at the early stages of growth and adoption of the internet in the early 1990s, the challenges in corporate evolution become apparent. Many large companies lack the ability to pivot business models in a short time frame, and often have internal political challenges when the need to channel internal business units becomes a necessity. With the internet, some companies denied or even actively fought against the potential of digital communication, while others began acquiring or partnering with innovative, young start-ups. Those who

missed the significance quickly fell by the wayside, as Silicon Valley drove creative destruction at an unprecedented rate. With a central bank digital currency, central banks and commercial banks will need to push for drastic and rapid internal transformation, to avoid becoming obsolete as faster, cheaper, and better services become available. These will be created by small groups of software engineers who have the potential to enact great change.

A SMOOTH TRANSITION IS VITAL

If not properly transitioned from the current economic model, a central bank digital currency has the potential to disrupt the entire financial ecosystem, which is built on fractional reserve banking. Our current model of commercial banking is built upon the assumption that depositors are not in need of immediate liquidity. This enables custodians of deposits, commercial banks, to hold a fraction, usually between 10 and 40 percent, and issue new loans with the remaining amount. The money multiplier, as it is commonly known, enables these commercial banks to create new money in the form of debt.

Once a central bank digital currency is issued by a central bank, users will no longer have the need for secure storage within the vaults or books of commercial banks, as value can now be securely stored using digital cryptographic means. This will likely result in greater "M0" or central bank cash in circulation, as users have no need to risk storing it in a consumer checking account. The annual interest rate on a checking account will not be enough to stop a bank rush, as users exchange value in checking accounts for a central bank digital currency to be stored directly in their digital wallets. Continuing to use a traditional consumer checking account will mean greater cost and inconvenience, as well as the necessity to trust a bank. As we have seen in the last five years alone, bank liquidity in many places, including Greece and Cyprus, has compromised consumer deposits with irresponsible lending and debt portfolios. Consumers lost trust in financial service providers in 2008, when many of the world's top global banks were caught up in fraud and business practices detrimental to customers – including collusion to fix foreign exchange rates, gold price fixing, and more.

If this mistrust continues at the same time as consumers receive additional options to store and transact

wealth without the need for trusted third parties, nations will come under the risk of economic uncertainty as commercial banks lose depositors to new technologies. At the same time they will still have inflated debt portfolios, only made possible by fractional reserve lending. The transition to a central bank digital currency must be done in such a way as to increase convenience and reduce cost for consumers, thereby increasing efficiencies within an economy, without endangering the banking system and creating widespread havoc due to a bank run.

In October 2016, the European Central Bank proposed a directive to the European Parliament stating that "virtual currencies do not qualify as currencies from a union perspective". It demanded Bitcoin and similar currencies not be defined as legal currencies or money. Furthermore, according to the European Central Bank, they pose a threat, as criminal groups are able to transfer money within digital currency networks while maintaining a certain level of anonymity. On the other hand, the Bank of England has rated the risk of money laundering via Bitcoin as low, ranking even further down the threat list than physical cash, traditional banks, and the art trade.

THE BEST OF BOTH WORLDS

Bitcoin and other cryptocurrencies compete with the monopoly of central banks to issue currency. However, according to the European Central Bank, cryptocurrencies do not pose an immediate risk to the system – in fact, they bring technological advantages that can be applied to the current financial system. More and more central banks have shifted from simply observing developments in cryptocurrency spheres to proactively engaging in dialogue and starting to explore a combination of the "best of both worlds". The result is the issuing of a legal tender as digital currency, which harnesses the advantages of digitization and avoids the challenges of non-legal digital currencies, be it on a blockchain or an alternative technology.

Central bank digital currency is a hot topic among central bankers. A World Economic Forum research paper revealed that more than 90 central banks are engaged in discussions worldwide about the potential issuance of a central bank digital currency. → [C](#)

C

CENTRAL BANK DIGITAL CURRENCY:

A hot topic among central bankers.

CANADA AS A PIONEER

This year, the Bank of Canada, the Canadian Payments Association and the Royal Bank of Canada demonstrated their strong interest in cryptofinance technologies, beginning to experiment with a digital fiat currency called CAD-COIN. Confined to interbank payments, this experiment is an early step towards central banks enhancing their understanding of the capabilities these technologies hold.

BANK OF ENGLAND

"Central bank digital currency will lead to an increase in the steady-state level of GDP of almost 3%."

SWISS NATIONAL BANK

"Cryptofinance systems could render the reconciliation of transactions and balance data between banks and the third-party system obsolete. The paradigm seems to have been turned on its head. Decentralization, not centralization, now appears to promise the greatest efficiency gains."

SWEDEN'S RIKSBANK

"If the market can make use of the new technology to launch new and popular payment services, why shouldn't the Riksbank be able to do the same?"

CENTRAL BANK OF DENMARK

Is planning to issue its own digital currency called e-krone as its reserve currency.

GERMAN BUNDESBANK

Is investigating the "technological achievements of blockchain and possible business cases especially in the financial sector."

CENTRAL BANK OF RUSSIA

A central bank digital currency is "still on the agenda" and if adopted, the technology could deliver a range of benefits. "Interest has shifted from private digital currencies to national ones."

PEOPLE'S BANK OF CHINA

"Central banks should lead on digital currency ... since 2014 the PBOC has attached high importance to the development of legal digital currency. We look forward to cooperating with all sectors of society to make China's legal digital currency a reality."

Minting a central bank digital currency: Roland Berger envisions the emerging digital future.

The issuance of a central bank digital currency is nearly identical to the way paper currency is currently issued, as seen in the diagram to the right. → **D**

The only difference is the digitization of the process. Production, secure storage, and distribution would occur in the same manner as today, just in a digital format. With central bank digital currency, the process occurs without physical printing presses. Instead, there is a secure issuance machine held in the vault of a central bank. Distribution occurs without armored vehicles driving freshly printed banknotes to brick and mortar commercial bank locations. Instead, this can be done through digital transfers, directly to the digital currency vaults of financial institutions. Still held in a vault, central bank digital currency is secured on a cryptographically secured offline machine at the central bank and enters the economy through commercial banks in an identical manner to physical cash. Currently, a bank customer has the ability to withdraw cash from an ATM. In the future it will be possible to withdraw central bank digital currency into a wallet on a mobile phone or other device (in its simplest form an application program interface connected to a consumer checking account).

WHICH TECHNOLOGY WILL BACK A CENTRAL BANK DIGITAL CURRENCY?

The question of which technology will be used to create a central bank digital currency is yet to be answered.

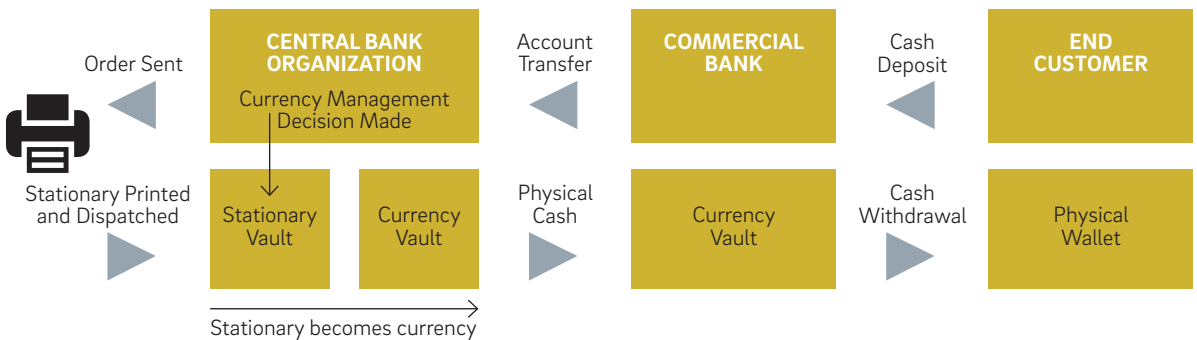
A number of digital currencies are already in existence, but it remains to be seen how they will be adopted by central banks. The age of cryptofinance was ushered in by the invention of Bitcoin, sparking thousands of new cryptofinance start-ups. The key innovation lies not only in digitization, but in the platform on which this value is exchanged. The development of these game changing new technologies is accelerating and there are different mechanisms emerging to facilitate the efficient flow and exchange of a central bank digital currency throughout national economies. Each technology has certain advantages and potential drawbacks, depending on the application. Two basic technology paradigms can be distinguished, namely blockchain, and off-blockchain. Blockchain based solutions include offerings such as Bitcoin, Ethereum, and Tezos. Non-blockchain consensus systems, such as Ripple, also exist. Blockchains can be described as a cryptographic consensus system. These systems have many desirable properties that have powerful applications in finance and commerce, which is why they are being actively researched by financial institutions, central banks, and many other enterprises worldwide. Consensus systems operate by means of algorithms that run on a distributed network of computers. A transaction on such a network is completed when the computers in the network achieve consensus that the transaction is valid. A well designed algorithm, implemented on a large, open, globally distributed network can achieve

D

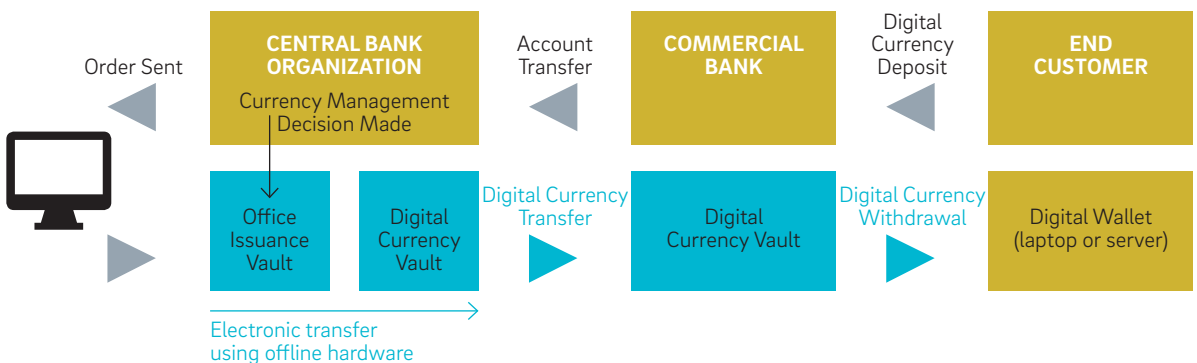
HOW CURRENCY IS CREATED

The issuance of a central bank digital currency is nearly identical to the way paper currency is currently issued.

LEGACY PAPER CASH ISSUANCE



DIGITAL CURRENCY ISSUANCE



"The less those of us living in Sweden use banknotes and coins, the clearer it becomes that the Riksbank needs to investigate whether we should issue electronic money as a complement to the money we have today."

Cecilia Skingsley
Riksbank Deputy Governor

exceptionally strong resilience and security characteristics. These security characteristics, most notably decentralization achieved by publicly broadcasting all transaction data to the network, are the most important feature of consensus systems. However, this type of security comes at a price. Achieving consensus across such a large, open, globally distributed network is inherently a slow and expensive process.

Financial institutions believe they understand the downfalls of public consensus systems and are looking for alternative options. A number of start-ups and consortiums are working on the creation of private or permissioned blockchains. These technologies use the process native to public blockchains, while restricting network access to a small number of select participants, enabling control over the network. While this increases transaction speed, reduces costs, and provides transaction privacy, the core characteristic of blockchain technologies – distribution – is essentially sacrificed, resulting in far less resilience. In addition, a number of these new consensus systems generally require the use of an internal cryptocurrency (eg. XRP used by Ripple as a bridge currency), which

highlights the necessity of trusting the company offering the service.

For the reasons alluded to above, consensus systems are not an ideal solution for retail transactions (which make up over 99 percent of global transaction volume). For example, does the purchase of a cup of coffee necessitate the verification of the transaction through consensus across a globally distributed ledger?

To achieve uptake, a central bank digital currency must easily, quickly, affordably, and securely exchange value between transacting parties. It is becoming increasingly recognized that, despite the hype, a consensus based system may not be the ideal technology – and a new cluster of cryptographic technologies are being developed to provide a separate non-consensus layer to handle transaction processing not using blockchain. This new category of cryptofinance technologies includes, for example, cryptographic contracting platforms. Settlement happens in real time, transfer costs are predictable, and the paradigm is simple and robust. Because of compliance and legal requirements in the formal business world, a professional organization is able to operate such software in parallel with existing infrastructure.

Alternative approaches leverage the Bitcoin or Ethereum blockchains to link physical cash, which is stored at custodian banks, to cryptocurrencies and exchange the property right of the asset via a cryptocurrency transaction.

As the current technologies are still emerging and not yet ready for widespread adoption, there is no one-size-fits-all technology, which solves all challenges perfectly. Central banks need to evaluate current technologies and choose partners to move forward with in developing national and regional solutions.

BUILDING NEW CAPABILITIES

In order to proactively shape the future of digital currencies, central banks need to build up the necessary capabilities and organizational structures to make sense of ongoing developments in the field of digital currencies. As highlighted in our publication *New realities in central banking: The organizational challenge*, central banks need to transform their organizations in order to achieve a cultural change to embrace working with new technologies, attract talent with the necessary skill sets, and build up the capabilities for engaging in strategic alliances with third parties.

CASE STUDY A:

MONETAS – A CRYPTOGRAPHIC CONTRACTING PLATFORM FOR CENTRAL BANK DIGITAL CURRENCY

Monetas, a Swiss software company, is promoting a digital platform for global commerce. Their contracting system utilizes cryptography to enable the digitization of existing assets – from legal tender to equities and more. The fast, secure, and efficient transfer of the digital value takes place peer-to-peer. Moving beyond the design limitations hindering public blockchain technologies in the low value transaction business, the Monetas platform maintains transaction privacy – data is only shared between those parties with legitimate involvement in the transaction. Validation is achieved by using cryptography and digital notary services to certify transactions. The notary plays a passive role in that it is unable to initiate any transaction or alter any aspect of a transaction. It also does not have the ability to effect changes to the value contained in any wallet, and at no time holds customer funds.

Full automation and the absence of financial intermediaries in the processing of transactions vastly reduces costs and enables users to send as little as \$0.001, in any currency, to any device globally at negligible cost.

The platform is available to central banks and financial institutions as a service with minimal technology investment required to introduce a central bank digital currency in their domestic market. This will open up an efficient digital payment environment available to everyone – including financially excluded or under-served individuals, as well as small and micro enterprises.

CASE STUDY B:

ETHEREUM – AN ALTERNATIVE APPROACH TO DIGITIZE FIAT CURRENCY

Similar to Bitcoin, Ethereum is a public blockchain that is open to all internet users and offers a platform on which decentralized, smart contract based applications, and so-called apps can be programmed and hosted. The value token of Ethereum is called ether and can be compared to other cryptocurrencies. Initiated and backed by the Swiss based Ethereum Foundation, which was co-founded by programmer and writer Vitalik Buterin, Ethereum's purpose is to create an alternative protocol for building decentralized applications with a broad variety of uses, from decentralized investment funding (e.g. DAO) to digital identity management (e.g. KYC-Chain).

Decentralized Capital (DC), a Chicago based start-up, provides users with a secure, convenient way to bring government backed currencies on and off the Ethereum network. DC converts cash deposits into DC Assets, a form of digital currency that is secured by the Ethereum network and collateralized by these customer deposits, which are secured by third party bank custodians. Users can transact with DC Assets for products and services on the Ethereum blockchain, gaining the benefits of familiarity and price stability of the national currency they represent. A similar approach to convert cash into digital currency is used by start-up Tether, which is built on the Bitcoin blockchain.

While Ethereum is seen as the most promising rival of the original Bitcoin blockchain and has been adopted for proof of concept projects by various commercial and central banks, and the industry leading R3 CEV consortium, a wide array of technical, legal, and security questions remain.

Taking on the challenge: Central banks need to follow a clear roadmap.

CENTRAL BANKS NEED A CLEAR ROADMAP TO EVALUATE THE OPPORTUNITIES AND MAKE THEM TANGIBLE IN A NEW DIGITAL PARADIGM

STEP 1: Develop a vision.

Based on deep understanding, identify the nation-specific pain points that need to be addressed and create a vision of how digital legal tender will support fulfillment of the central bank's mandate.

STEP 2: Build technology partnerships.

Identify and form relationships with suitable technology provider(s). Identify and establish a project plan – selecting key financial services providers to participate.

STEP 3: Conduct tests.

Conduct a proof of concept to test and gain familiarity with technology within a small internal central bank group. Conduct a pilot program in a wider group to test technology, market acceptance, and usability.

STEP 4: Roll out phase one.

First commercial rollout of digital legal tender in a limited environment of early adopters such as university campuses.

STEP 5: National rollout.

Widescale rollout of central bank digital currency and continuous improvement of processes. International know-how exchange to share experiences.

REVOLUTION OR EVOLUTION? THE FUTURE OF CENTRAL BANK DIGITAL CURRENCY

Blockchain technology and cryptocurrencies have made their mark in the financial system and are here to stay in one form or another. If ignored by central banks, private institutions and entrepreneurs will continue to innovate and drive the development of alternative technologies, new methods of payment and new forms of cryptocurrencies.

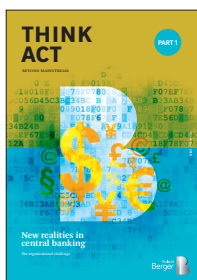
It is clear that a central bank digital currency will not completely replace physical cash in the near future, but will seamlessly fit into the economy of notes and coins, as well as create a new impetus for electronic commerce. Adoption rates are hard to predict as first movers will set standards and take a large share of the market. We have seen mobile based financial services flourish in places like Kenya, where 80 percent of citizens use their mobile phones for making payments less than a decade after the first services were released. Adoption of digital currencies will depend on the willingness of central banks to issue a central bank digital currency. With the interest shown by central banks in recent months, it is not unlikely that we will have a large portion of the world utilizing central bank digital currency for their domestic and cross-border transactions within the next decade.

As the underlying technologies are still emerging and no dominant design has been established yet, central banks need to become active shapers in the current debate in order to fulfill their mandates as overseers of their national payment systems and currency management responsibilities.

ABOUT US

Roland Berger, founded in 1967, is the only leading global consultancy of German heritage and European origin. With 2,400 employees working from 34 countries, we have successful operations in all major international markets. Our 50 offices are located in the key global business hubs. The consultancy is an independent partnership owned exclusively by 220 Partners.

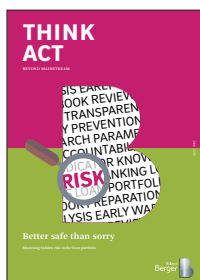
FURTHER READING



NEW REALITIES IN CENTRAL BANKING

The organizational challenge

In the past 10 years, public scrutiny of central banks has increased dramatically as a result of the financial crisis and subsequent sovereign debt crisis. Monetary authorities are confronted with demands for higher transparency and accountability around policy decisions. Now, aggressive low interest regimes in developed economies combined with general pressure on public spending are magnifying public attention on central banks. In order to evolve, central banks require organizational transformation.



BETTER SAFE THAN SORRY

Mastering hidden risk in the loan portfolio

Risk and cyclicity are inherent attributes of banking – but volatility in banking is intensifying. To successfully steer a bank through such turbulence, its executives must obtain a solid understanding of the potential impact of economic downturns on the bank's loan book and income statement. Secondly, undertake preventive measures and closely monitor the development of the loan book. And, thirdly, take swift action upon early warning to prevent and minimize losses.

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