



Why would we use crypto euros?

Central bank-issued digital cash – a user perspective

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The rise of bitcoin and other cryptocurrencies and the decline in cash payments are the background for a new concept: digital cash issued by central banks. An old academic debate about who creates money and how is resurfacing, but what about the user's perspective? Why would we use crypto euros?

Central banks are looking into cryptocurrencies and the underlying distributed ledger technology, as they carry responsibility for issuing physical cash, overseeing and/or providing payment clearing and settlement systems, conducting monetary policy and safeguarding financial stability.

In the areas of payments and savings, digital cash would compete against bank deposits, physical cash and private cryptocurrencies to win over consumers.

Unless its use was strongly pushed by regulation, digital cash would need to convince users by offering better and more convenient payment solutions than other payment systems. In particular, it would need to match current low fee levels and high safety standards for regulated consumer payments.

In an environment of high trust in public institutions, consumers would probably not be concerned if digital cash offered little data privacy.

For savings purposes, consumers would simply base their choice between digital cash and bank deposits on the difference in interest rates.

However, in times of financial or political uncertainty, people may think beyond convenience and yield. In case of financial turmoil, consumers can use central bank money – physical or digital cash – as a safe haven. If fundamental trust in monetary and political stability were lost, people would probably turn away from any form of the sovereign currency in favour of other alternative assets or private cryptocurrencies.



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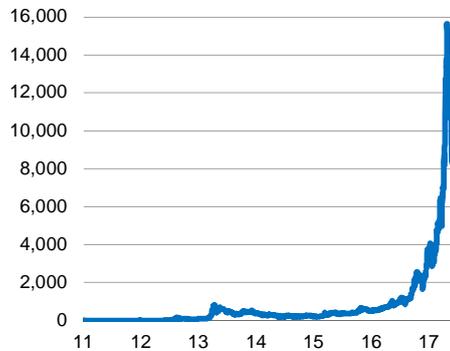
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Why digital cash issued by a central bank?

Bitcoin price skyrocketing in 2017

1

EUR price for 1 bitcoin (BTC)

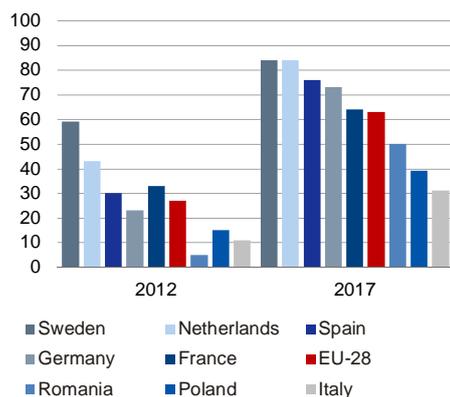


Source: bitcoincharts.com

EU: Widespread mobile internet access

2

Individuals with mobile internet access as % of total population (age group: 16-74 years)



Sources: Eurostat, Deutsche Bank Research

The rise of bitcoin and questions about the future of cash have been the breeding ground for a new concept: digital cash, issued by a central bank. Indeed, central bank-issued digital cash (or currency) – CBDC – is the focal point of various technical and economic developments. Private cryptocurrencies are proving to be more than a short-lived tech gimmick. The brand of bitcoin is widely known, especially since its value began to skyrocket in 2017. Actual participation in the bitcoin network (still) lags behind its celebrity, though.¹ Another tech trend is widespread. In many countries (mobile) internet access has become commonplace, opening up a plethora of new opportunities for payment service providers. For example, in some countries mobile or contactless card payments are making inroads into market areas so far dominated by cash transactions, which in turn are declining. In the longer term, these developments hold the potential to impact central banks' position and monetary power within the financial system. Indeed, conceivable competition by bitcoin and the decline in cash payments have re-sparked an old academic discussion about how money should be created and whether this should be the job of the private sector rather than a public institution. Against this background, central banks are exploring the concept of CBDC and its potential impact on the financial system. However, little heed is paid to the user's perspective: Why would we want to hold and pay with – let's say – crypto euros?

In this study, we will briefly explain why central banks are taking interest in the concept of CBDC and will also give a short introduction to private cryptocurrencies. The focus, though, will be on an evaluation of digital cash from a user's perspective: What is the value proposition of crypto euros if we can also use cash, bank deposits or bitcoin (and the like) to pay and to hold funds? We will draw on existing research on consumer payments to analyse the attractiveness of CBDC for individual users. Finally, we will discuss why a consumer may opt for or against holding his savings in CBDC.

Central banks' perspective

Many central banks are analysing the policy implications of digital cash against the background of their statutory functions. Technical design options are also being discussed.²

Issuance of physical currency – decline of cash usage

The central bank is the sole issuer of banknotes and coins of a sovereign currency. These are legal tender and central bank money available to everybody. A pronounced decline in cash usage would have implications for the central bank's cash operations as well as for its seignorage income. For consumers, access to cash could become difficult. In Sweden, cash usage has declined strongly and banks have reduced cash services to consumers. In this context, Sveriges Riksbank is assessing the case for issuing "e-krona".³ The Federal Reserve Board, by contrast, is cautioning against retail CBDC and is not

¹ For a discussion of bitcoin, see Möbert, Jochen (2018).

² E.g. Powell, Jerome (2017); Fung, Ben S.C. and Hanna Halaburda (2016); Bank of England's research agenda on central bank-issued digital currencies.

³ Skingsley, Cecilia (2016).

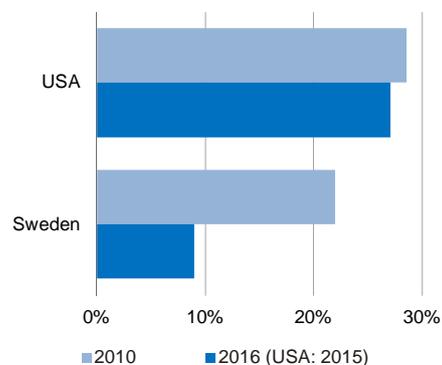


Why would we use crypto euros?

Cash payments in decline

3

Share of cash in the total number of consumer payments



Sources: Federal Reserve Bank of Boston, Sveriges Riksbank, Deutsche Bank Research

supporting the concept of “Fedcoin”, a retail CBDC first proposed in 2014.⁴ However, cash is still a popular way to pay in the US.

Payment and settlement systems – distributed ledger technology⁵

Central banks are the central body in the tiered bank payment system. They manage the central ledger which guarantees that changes correspond in all payment accounts within this system although the accounts are being kept at different banks.⁶ Furthermore, central banks provide reserves⁷ for safe settlement of payment obligations between commercial banks. They often own and/or run the system for such high-value payments. As payment system providers, they take interest in distributed ledger technology (see text box 8). Some central banks, e.g. the Bank of Canada, have tested DLT as a technical alternative to their current real-time gross settlement systems (RTGS). So far, such tests have not resulted in a replacement of RTGS by DLT systems.⁸

Central banks usually exercise oversight functions to ensure the sound operation of (private) payment systems, with an eye to the stability of the financial system. Therefore, they need to understand the implications of payment innovations like DLT for financial stability. Moreover, in order to promote efficient payment systems, central banks can act as a catalyst in payments markets. These are network industries and display high entry barriers which can hamper innovation, even if it promises efficiency gains.

Monetary policy – private cryptocurrencies

Competition between currencies is becoming more realistic. A central bank issuing sovereign fiat money (cash, reserves) and influencing money creation by commercial banks (bank deposits) is now competing against privately and independently issued cryptocurrencies (see figure 6). In the future, it may also compete against sovereign, DLT-based digital currencies issued by other central banks. If people were to switch to a significant extent from using the sovereign fiat currency to using an alternative currency, the central bank would lose monetary power within the national economy. This would be similar to the situation of countries where people prefer to use US dollars or euros instead of the local currency (known as dollarisation or euroisation).

However, depending on the actual design and the level of adoption within the economy, digital cash could also enlarge the central bank’s influence on the money supply or the interest rate level.

Financial system

The introduction of digital cash has the potential to alter the structure of the financial system. If people were to shift large parts of their savings from bank accounts into digital cash, the banking sector’s ability to provide credit would be reduced. In an extreme scenario, money creation by commercial banks would cease, turning depository institutions into brokers or mutual funds. Such a

⁴ Koning, J.P. (2014).

⁵ See Committee on Payments and Settlement (2017) for DLT in payments and settlement systems.

⁶ Committee on Payments and Settlement (2015).

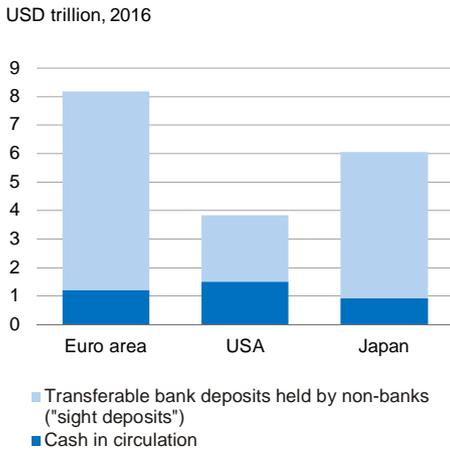
⁷ Central bank money in the form of balances held by commercial banks in accounts at the central bank.

⁸ Bech, Morton and Rodney Garratt (2017). The Bank of Canada and the Monetary Authority of Singapore have tested real-time gross payment settlement on DLT platforms (“Jasper” and “Ubin” projects).



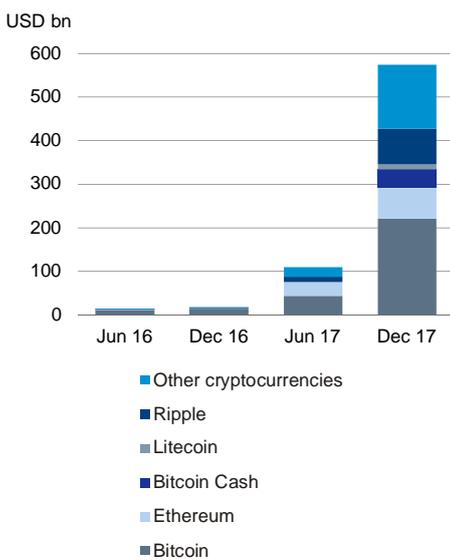
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Sovereign currencies are largely digital 4



Sources: BIS, ECB, Deutsche Bank Research

Private cryptocurrency market cap driven by price surge 5



Sources: coinmarketcap.com, Deutsche Bank Research

demise of today's fractional reserve banking recalls the Chicago Plan, i.e. banking reforms suggested by University of Chicago economists during the Great Depression. They proposed to separate the granting of credit and the creation of money, both performed by commercial banks today. 85 years later, research and a still vivid debate around these fundamental questions are reflected in publications and speeches.⁹ However, these questions will not be the focus of this study, since such theoretical considerations will hardly be relevant for an individual choosing whether or not to use crypto euros.

Digital currencies: sovereign or private

Existing "monies" – cash, bank deposits and private cryptocurrencies – can be characterised by their issuer, form, accessibility and transfer mechanism. This also helps to understand the essence of CBDC.¹⁰

Taxonomy of money 6

| | Issuer | Form | Accessibility | Transfer mechanism |
|------------------------|--------------|----------|---------------|--------------------|
| Cash | Central bank | Physical | Universal | Peer-to-peer |
| Bank deposit | Other | Digital | Universal | Centralized |
| Private cryptocurrency | Other | Digital | Universal* | Peer-to-peer |
| CBDC | Central bank | Digital | Universal* | Peer-to-peer |

*Accessibility can be limited to a permissioned user group. For a retail CBDC, as discussed in this study, access is universal. A wholesale CBDC for settlement purposes between financial institutions would be a system with limited access.

Sources: Bech, Morton, Garratt, Rodney (2017), Deutsche Bank Research

Sovereign currencies like the US dollar, euro or pound sterling are fiat currencies steered by a (supra-) national central bank. And they are largely digital, because most of the money supply is not held in physical cash, but in the form of bank deposits. In the euro area, for instance, bank deposits constitute about 80% of total money.¹¹ Payments with bank deposits are largely digital, too: card payments, (online) credit transfers and direct debits are processed electronically via bank or card payment systems with a central settlement point.

This contrasts with the decentralised payment and record-keeping system of private cryptocurrencies, which was first successfully introduced with the bitcoin protocol. Private cryptocurrencies allow for digital, peer-to-peer transfers of value on the basis of distributed ledger technology.

⁹ For an overview of monetary questions raised by CBDC, see Tolle, Marilyne (2016).

¹⁰ Bech, Morton and Rodney Garratt (2017).

¹¹ Narrow money supply (M1) is defined as physical cash in circulation and sight deposits held at banks. Wider concepts of money supply also comprise bank deposits with longer maturities (M2) and certain money market instruments (M3). For simplicity, we will refer to "money" instead of "M1", and "bank deposits" instead of "sight deposits held at banks".

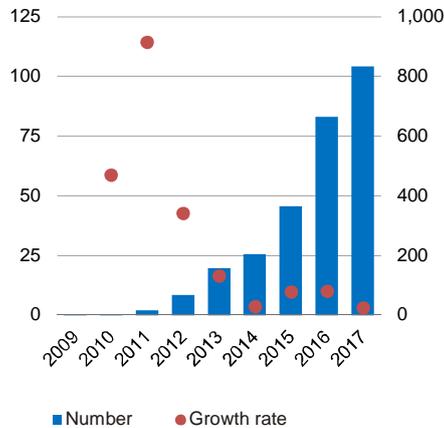


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Bitcoin payments: More and more ...

7

Number of transactions in millions (left);
growth rate (yoy) in % (right)



Sources: blockchain.info, Deutsche Bank Research

Distributed ledger technology (DLT)¹²

8

DLT is based on protocols and infrastructure which permit nodes in the network to hold a copy of the distributed ledger, to propose changes to this shared database, to validate proposed changes, to issue new assets or to provide services to participants who are not a node. Nodes may fulfil all or some of these functions, depending on the rules of a certain DLT network. In contrast to traditional payment systems, no central trusted authority is needed to maintain the consistency of ledgers kept by different participants. Instead, a new transaction submitted by a participant is broadcast peer-to-peer within the network. The proposed transaction is validated by the network on the basis of a consensus protocol. It ensures that the transaction is permissible, e.g. that the payer owns the funds he wants to use and that he is not using the same assets twice (double-spending problem). Then the network makes the entries to the distributed ledger, i.e. executes the transaction. Basically, the consensus protocol is the mechanism used to reach and ensure agreement between all nodes on the new valid state of the distributed ledger.

The bitcoin protocol relies on the competitive proof-of-work method for consensus. Specialized nodes called "miners" employ strong computational power to be the fastest to verify a new block of transactions to be added to the distributed ledger. According to the bitcoin protocol, this miner earns the transaction fees and new bitcoins created by this process. Alternative consensus protocols have been developed for other DLT networks, based on voting (proof-of-stake, Ripple protocol) or luck-based concepts (proof-of-elapsed-time). The objectives are to improve the efficiency of the consensus mechanism, e.g. in terms of processing speed or energy consumption.

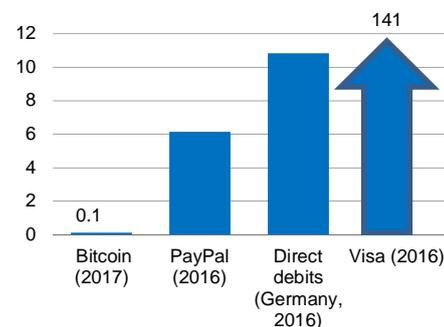
Cryptography is crucial for DLT. In order to authenticate himself, a participant (who does not always have to be a full node) uses private/public key cryptography to sign transactions and encrypt the data. Cryptography is also used in the proof-of-work consensus mechanism. A participant keeps his private key in a digital wallet. The key enables him to transfer the assets (e.g. bitcoins) allocated to him in the distributed ledger.

So far, private cryptocurrencies – even the frontrunner, bitcoin – have not become money which is defined as fulfilling three basic functions: means of payment, unit of account and store of value. These functions can only be fulfilled if a currency is widely used and accepted, and perceived as relatively stable and predictable in value. Nevertheless, despite starting from a low level as compared to sovereign currencies like euro or dollar, private cryptocurrencies are growing strongly, be it by number of transactions, number of tokens ("coins") in circulation or value measured in US dollar or euro. Given the early stage of this financial innovation, it is hard to foretell its future success. So far, the main reasons for the growth of private cryptocurrencies have been passion for technology, avoidance of bank payment systems (fees, speed, surveillance) and financial speculation. Widespread use and acceptance, though, will crucially depend on easy and safe technical handling, legality and legal certainty, and a predictable value – and, of course, on the relative attractiveness in comparison to the sovereign currency.

... but minimal compared to established competitors

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Number of transactions in billions



Sources: blockchain.info, PayPal, Visa, BIS, Deutsche Bank Research

Digital cash for retail payments

In this paper, we will not focus on the technical infrastructure necessary to hold and move digital cash. We will simply assume that storage and transfer mechanisms exist and function at sufficient scale, and that most people have a connected end-user device. This is, of course, a simplifying assumption. However, it is not entirely unrealistic: in some countries (e.g. Sweden), physical cash payments have been largely replaced by card and mobile payments, proving that a large share of the population is equipped with electronic end-user devices connected to the internet and is willing to pay digitally.

In this study, CBDC will mean digital cash running on a distributed ledger infrastructure. It may be used by everybody, and it is similar to existing private

¹² For more details, please refer to Committee on Payments and Settlement (2017), Deutsche Bundesbank (2017), ENISA (2016), and Bech, Morton and Rodney Garratt (2017).

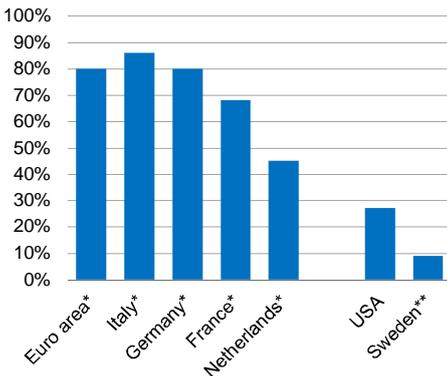


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Cash payments - national differences

10

Share of cash in the total number of consumer payments in 2016 (USA: 2015)



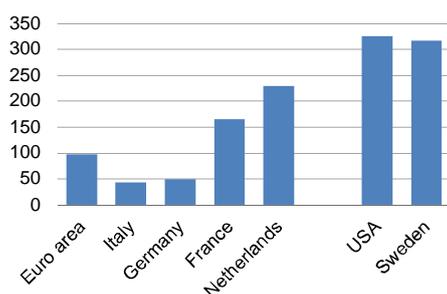
* Figures for the euro area and euro area countries refer to share of cash payments in consumer payments made at the point-of-sale.

** For payments between SEK 100 - 500 (approx. EUR 10 - 50). Share of cash payments below SEK 100 is 26%; for payments above SEK 500: 4%.

Sources: ECB, Federal Reserve Bank of Boston, Sveriges Riksbank, Deutsche Bank Research

Card payments per person in 2016

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Sources: BIS, ECB, Deutsche Bank Research

cryptocurrencies in this regard.¹³ CBDC, however, is by definition issued by the central bank, and we will assume that it is issued at par with the other forms of the sovereign currency, i.e. cash, bank deposits and reserves. Users would “see” their digital cash in an internet-based application similar to existing online accounts or mobile banking interfaces. They would also make and receive payments in digital cash via such applications.

We will focus on consumer payments in advanced economies to analyse the attractiveness of digital cash while being aware that CBDC must not be restricted to a certain user group or payment situation.

Reach – sine qua non

A necessary condition that any payment instrument has to meet is significant reach within the market. “Reach” means how many people make payments and how many people accept payments with a certain payment instrument, e.g. cash or a credit card. Payments display positive network externalities, i.e. the more people use a payment instrument, the more useful it becomes. Therefore, established payment instruments with large numbers of users are at an advantage over new methods. CBDC would compete against well-established payment solutions. Cash, card and bank payments (credit transfers, direct debits) enjoy almost universal adoption. They are very frequently used¹⁴ and are widely accepted, albeit for different payment situations (e.g. point-of-sale, recurrent bill payments).¹⁵ Cryptocurrency transactions, a payment innovation, are so far niche payment instruments. They have not reached a critical mass to offer mainstream users network benefits.¹⁶

Nonetheless, new payment solutions can and have overcome market entry barriers posed by strong incumbent networks. There is no recipe for guaranteed growth, but there are characteristics which are (all or somewhat) typical for successful new services: they offer a solution to a real problem or service gap, have access to a large captive customer base, benefit from favourable infrastructure or regulation, or combine payments with loyalty rewards.¹⁷ Recent examples include PayPal, which benefitted from eBay’s client base and introduced a solution for online payments between parties who do not know or trust each other. SWISH, the popular mobile payment solution Swedish banks offer their clients, is based on the banks’ common trusted infrastructure for payments and customer identification.

What would be the competitive edge of digital cash over other payment means in order to achieve high adoption and use levels? CBDC could easily be supported or pushed by regulation, e.g. by requiring merchants to accept it, or by demanding tax payments in crypto euros, thus creating a captive customer base. But if individuals – private or business – may decide freely between payment methods, CBDC will need to solve a real problem or score highly on features which have proven to be important in the retail space, like price, safety or convenience.

¹³ A centralised solution with all users holding their digital cash in accounts at the central bank would be an alternative technical set-up. This has long been possible – at least theoretically – and will not be considered in this study.

¹⁴ The focus is on countries with developed payment markets, mainly in Europe and the US. Even though the relative payment mix can vary considerably between countries, cash, card and bank payments are the prevalent payment instruments.

¹⁵ See Mai, Heike (2015) for an overview of payment instruments and use cases.

¹⁶ See Aaron, Meyer, Francisco Rivadeneyra and Samantha Sohal (2017) for a discussion of the stages in an innovative technology’s adoption life cycle.

¹⁷ The Boston Consulting Group, Google (2016).



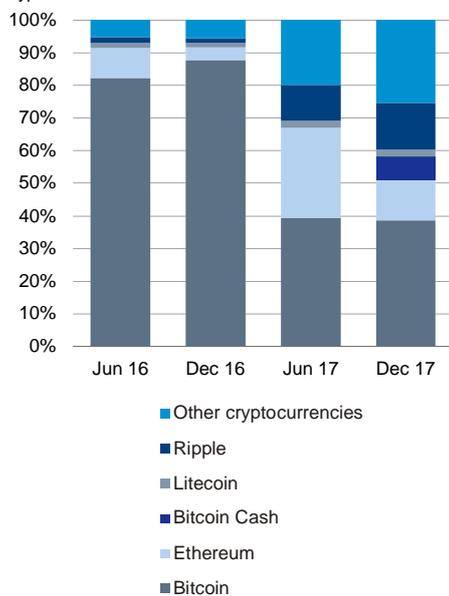
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Pricing in a two-sided market and costs

Bitcoin dominance in the cryptocurrency universe is diminishing

12

Share in market capitalisation of all private cryptocurrencies



Sources: coinmarketcap.com, Deutsche Bank Research

Digital cash payments would compete with payment types that consumers can use free of charge, or without visible per-transaction fees. Especially at the point-of-sale, consumers are not used to paying for making payments. Cash is legal tender and a free-of-charge option for proximity payments. As such, cash payments constitute a price reference. Research shows that consumers are indeed price-sensitive when choosing payment instruments. For instance, Dutch consumers opted more often for cash instead of debit card payments in case the latter were subject to a merchant surcharge.¹⁸ Similarly, IKEA found that the introduction of a surcharge on credit card payments induced clients to substitute over one-third of these with debit card transactions.¹⁹

Serving a two-sided market, CBDC would also have to appeal to merchants. Introducing a new payment tool resembles the chicken-and-egg problem. Consumers can only choose payment instruments accepted by merchants, and merchants will only accept instruments frequently used by consumers. Research suggests, though, that merchant acceptance is a crucial determinant for a new instrument to spread, and that adoption depends to a great extent on the pecuniary costs merchants incur for the new instrument.²⁰ Of course, non-pecuniary costs as well as commercial benefits built on a payment instrument also come into play. Accepting cards may increase a merchant's sales. Analysing payment data may be useful for stock management, targeted advertisement or ancillary financial services.²¹ A merchant's evaluation of digital cash would be strongly influenced by, but not limited to, its pecuniary cost.

Which benchmark do private cryptocurrencies set regarding transaction fees? This is hard to answer today. First, bitcoins are indeed used for purchasing a pair of jeans or ordering a pizza, but very rarely. Only a very limited number of merchants accept bitcoin payments.²² Second, the fee for a bitcoin transaction, which is charged in bitcoin, varies constantly due to a complex calculation (see text box 13). Indeed, the pricing of bitcoin transactions is seen as a hurdle to stronger retail use – besides the volatility vis-à-vis US dollars or euros. All in all, fee levels and pricing mechanisms for private cryptocurrency transactions are a field of development and of competition between the almost 1,500 cryptocurrencies.²³

Bitcoin transaction pricing

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The fee for a bitcoin payment depends on the size of the transaction message in bytes, the available mining capacity (i.e. computational power) and the desired transaction speed, among other factors. Given the complex calculation and uncertainty arising from an auction-like price-finding mechanism, a retail payer cannot be sure about the cost of a transaction before it is executed. While a free-of-charge transaction is still possible in the bitcoin network, the average price for a transaction surged from 26 US cents in January 2017 to USD 6.80 a year later.²⁴ The transaction fee is paid in BTC (bitcoin), so the extreme appreciation of the BTC against the USD has pushed up the cost in USD. But even measured in BTC, i.e. without exchange rate effects, transaction fees have still doubled in the same period of time.²⁵ Although such fees are competitive for high-value and international payments, they are high for retail transactions. New pricing concepts are being introduced and tested in the cryptocurrency universe, and alternative private cryptocurrencies may provide price concepts better geared to the retail sector.

¹⁸ Bolt, Wilko, Nicole Jonker and Corry van Renselaar (2008).

¹⁹ Schuh, Shy, Stavins, Triest (2011).

²⁰ Wilkinson, Michael (2011) compares payment statistics and merchant fees for several countries. Arifovic, Jasmina, John Duffy and Janet Hua Jiang (2017) base their results on a laboratory experiment on payment instrument choice.

²¹ World Bank, World Economic Forum (2016).

²² See <http://spendbitcoins.com> for a list of merchants accepting bitcoins.

²³ See <https://coinmarketcap.com>, retrieved 25 January 2018.

²⁴ <https://bitcoinfees.info>, retrieved 25 January 2018. On 22 December 2017, a price hike to USD 37 per transaction was recorded. Average fee refers to a transaction of 250 bytes in size which is submitted to be executed on the next block, i.e. within 10 minutes.

²⁵ <https://bitcoinfees.info>, retrieved 25 January 2018.



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Given the price sensitivity of consumers and merchants, the ability to offer (seemingly) free-of-charge payment services could prove to be crucial. At first sight, digital cash looks well positioned: the central bank will earn seignorage which can be used to cover the central bank's expenses related to CBDC. So no charges need to be levied, neither on consumers nor on merchants. In a distributed ledger network, however, users will need to deploy computing power and electricity to participate, which everyone has to pay for out of pocket.²⁶ Such ancillary costs of crypto euros can easily prove to be a stumbling block. Much will depend on designing a distributed ledger network which functions at low cost for everybody, and especially for consumers.

By contrast, payment options offered by private providers, like bank or e-payment services, need to generate fee income to cover the providers' expenses and produce a profit margin. This typically results in merchant charges. Alternatively, private providers can cross-subsidise their payment business or run a data-based business model, i.e. use the payment information for other commercial interests. Last but not least, cost and reach are closely intertwined: the more popular a payment instrument, the lower its unit cost due to economies of scale. This is clearly an advantage for established payment options.

High level of safety in established payment systems

It is self-evident that a payment has to be safe in order to be useful for value transfer. Would CBDC meet the level of safety which consumers are used to? While the general level of trust in conventional means of payment is high, survey-based research shows that the perceived safety of a payment instrument varies somewhat and that this influences the probability of its use.²⁷ The perception of security depends to a significant degree on personal experiences and on demographic characteristics.²⁸ These studies usually refer to established payment options, which indeed display a relatively high level of security. Security breaches do occur and are likely to influence an affected user's behaviour, at least in the short run. Nevertheless, established instruments like cash or cards show a very low risk of fraud compared to the high number of transactions and the value transferred.²⁹ Moreover, they are subject to regulation enforcing technical security standards and consumer protection. Against this background, a high level of safety is taken for granted by consumers.

This stands in contrast to private cryptocurrencies, which lack legal frameworks and suffer from a reputation as being abused for criminal purposes. Reported security breaches at wallet providers or exchanges are probably one of the factors which so far have kept mainstream payment users from adopting cryptocurrency.

CBDC will certainly have to meet – if not improve upon – the safety level attributed to existing regulated payment methods. With the central bank as issuer, there will be no legal uncertainties impairing the attractiveness of CBDC. However, people also need to be convinced of the safeness against fraud and operational failure. So far, the technical security of distributed ledger technology has not been tested on a large scale. Improvements in safety seem possible, as do new challenges. On the one hand, it will be harder to corrupt the ledger,

²⁶ If users are not a node, they will have to use services provided by third parties who run a node and might levy fees. Besides, the network would become more centralised.

²⁷ Schuh, Scott and Joanna Stavins (2011) assess the impact of transaction characteristics on consumer choice of payment, using data from a US consumer survey.

²⁸ Kosse, Anneke (2014), research based on a Dutch consumer survey.

²⁹ Mai, Heike (2016).



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because so many copies of it would have to be manipulated at the same time. On the other hand, the consensus protocol could be manipulated by a malicious (group of) participant(s) controlling the majority of voting or computational power (“consensus hijack”). Besides, cryptographic methods which are safe today may be hacked in the future if computing power continues to increase.³⁰ The positive reputation of a trusted central bank might lend digital cash upfront credit as being safe in the view of the public. However, the system will need to deliver safe transactions, i.e. positive user experience, in order to prove and maintain its status as a safe payment method.

Privacy usually no concern

Data protection does not seem to matter much for many retail payment users. Although people tend to rate privacy highly in surveys, actual payment choices call this stated preference into question. A recent experiment on personal privacy preferences and actual behaviour showed that many people quickly abandon their stated privacy requirements if this means a small extra effort (less convenience), or if less privacy is rewarded by a small incentive.³¹ This effective lower-than-stated appreciation of privacy is reflected in the successful business model of many online platforms which offer free-of-charge services in exchange for user data.

The degree of anonymity will only matter in specific and exceptional situations. If a payer has doubts about the trustworthiness of his counterparty, he may not want to reveal much personal information, e.g. to prevent spam advertisement or potential identity theft. In case of a general lack of trust in the government, the legal system of a country or the currency, payers will seek third-party anonymity. They would not want authorities to be able to monitor their payments. In such an extreme case, digital cash issued by the central bank will surely not be the payment type of choice to avoid state surveillance or tight capital controls. Private cryptocurrencies, though, are well positioned to enable citizens to circumvent state-controlled payment systems, as is happening in China, Zimbabwe or Venezuela.

Cash and private cryptocurrencies certainly offer a higher degree of anonymity than bank deposits or CBDC. But for the purpose of everyday retail payments, many consumers value convenience over data privacy. Many households may find it acceptable to use crypto euros even if they are required to register with their true identity, especially if registration is not too cumbersome and payments are convenient. This would help a central bank to design digital cash in a way that meets anti-money laundering requirements.

Convenience

Convenience means how easy it is to use a payment method and, if necessary, to register for it. Other characteristics of a payment instrument – like speed, record-keeping or easy access to savings or credit lines – also determine its attractiveness, although the judgment also depends on personal preferences. Plenty of research has found a relation between demographic attributes like age, gender or income and preferences for certain payment instruments.

Overall, certainly not all people would regard digital cash as convenient. Especially heavy cash users could find it difficult to handle CBDC (e.g. many older people, or the very young), or too expensive given the technical

³⁰ ENISA (2016).

³¹ Athey, Susan, Christian Catalini and Catherine Tucker (2017).



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preconditions (low-income households). The need to register (supposing that CBDC would not be fully anonymous) would exclude people without identity papers or legal residence status. The higher the legal, economic and technical hurdles to adoption and use, the higher the safety against criminal abuse. But this comes at the expense of convenience and financial inclusion.

As regards digital-savvy users – the majority of people in advanced economies – CBDC would need to offer a superior user experience or fill a service gap in order to win over users. In fact, CBDC could offer a digital alternative to cash payments where other solutions do not exist or have not succeeded so far, e.g. for person-to-person payments. However, real-time mobile payments have already gained significant market share in some countries, substituting cash payments in various use cases. And further innovation is under way, e.g. instant payments within the European banking network.

In the end, digital cash would probably just be another retail payment option. Its convenience, and thus ultimately success, will depend on the one hand on the operational capabilities of the underlying distributed ledger technology compared to centralised systems. So far, DLT does not match the efficiency of centralised retail payment networks. On the other hand, central banks – accustomed to wholesale clients – will compete against retail market specialists for market share in digital payments, i.e. against banks, online platforms and fintechs. Given the strong competition and innovation in retail payments, it is questionable whether digital cash will offer a superior enough user experience to convince a critical number of people to adopt CBDC and to actually use it for a large share of their payments. And strong usage is a must, as consumers tend to use only one or two payment methods most of the time, even if they are registered for several services.³²

Holding digital cash

Usefulness for transaction purposes is not everything. Bank deposits and cash also serve as means of savings. Crypto euros could combine important aspects of both. Digital cash would not be threatened by a bank default, similar to cash, but funds would be digitally accessible, like bank deposits. However, the risk of losing bank deposits in a bankruptcy is to a large extent mitigated by prudential supervision of banks, deposit insurance and the central bank's function as lender of last resort.

Central bank money and loss through bank default

Nevertheless, “retail” central bank money – cash – is to some extent used as a protection against bank default: cash demand rises in times of financial or political uncertainty, and such preferences for higher cash holdings have proven to persist for a long time.³³ Would digital cash also be perceived as a safe haven? This is not fully clear. It would be default-proof central bank money, but it would still depend on technical infrastructure and electricity – in contrast to physical cash.

Interest and protection against infringement

Interest income would be an important argument to turn to digital cash. People tend to hold less cash when interest rates rise, i.e. when the interest which they

³² Cohen, Michael and Marc Rysman (2013).

³³ Jobst, Clemens and Helmut Stix (2017).



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can earn on bank deposits increases. So interest-earning crypto euros would certainly be an attractive alternative to physical euros, and also to private cryptocurrencies. Under substantially positive rates, the decision is rather between putting funds in a bank account and holding digital cash. From a retail investor's point of view, this will largely depend on which interest rate is higher and on convenience regarding the ease and speed of accessing these funds for payments. In case of significantly negative interest rates, however, this would work the other way round: savers would probably flee to non-interest bearing alternatives, i.e. cash or private cryptocurrencies, besides foreign currencies or other assets. As long as consumers can turn to cash or alternative currencies, the central bank's power to steer interest rates far below zero remains limited.

Indeed, "old-fashioned" cash and newly invented private cryptocurrencies make an odd couple. Both offer a way out whenever people fear that public authorities could infringe on their savings. This refers not only to negative interest rates, but also to capital controls or expropriation (for inflation see below). CBDC storage and transfer mechanisms would surely not be viewed as distant enough from public control to be attractive if trust in political institutions were to erode.

Price stability

When it comes to price stability, CBDC, cash and bank deposits are only various forms of one currency and compete against private cryptocurrencies. Holding a currency for future use only makes sense if its value in terms of purchasing power will not substantially decrease. Digital cash would therefore benefit or suffer from the success or failure of the central bank to keep inflation low. The choice of instrument comes down to a competition between sovereign and private currency. If there is fear of strong inflation or of a derogatory currency reform, households will weigh expected losses against the risks of alternative assets. A shift into private cryptocurrencies is no safe bet to protect one's savings, though. As long as the private cryptocurrency is not used as unit of account and accepted by many shops, a consumer will have to exchange it into dollars or euros before being able to purchase goods and services in the vast majority of cases. As a result, exchange rate volatility will be a risk on top of the uncertainty as to whether prices in bitcoin (or similar) will remain stable for goods which are available in exchange for bitcoins.

Conclusion

Why would we use crypto euros? There are two possible use cases: for payments and for saving purposes. We would use crypto euros for payments if they offered a higher service level than other payment options at comparable levels of cost and safety. With DLT still in its infancy and competitive private retail payment solutions available, this will hardly be the case. CBDC's chance of gaining substantial market share by catering to unserved payment needs is low given the popularity of established digital payment means and ongoing innovation by incumbent and new service providers. Moreover, it remains an open question whether DLT can deliver the same level of cost efficiency and safety as existing technical set-ups. For day-to-day use, privacy concerns have proven to be of minor relevance to consumers. So even if CBDC was designed with a high degree of anonymity, this would not be a competitive edge – at least not for legal transactions. Unless the acceptance of CBDC is pushed by regulation, CBDC is not likely to gain sufficient reach to become a competitive payment network.

But what about crypto euros for saving purposes? In an environment of popular trust in public institutions and financial stability, digital cash or bank deposits will



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be the most convenient options for consumers. The biggest difference between these two would be a potential difference in remuneration. The highest yielding digital money will simply be the most attractive.

However, in times of financial or political uncertainty, people may think beyond convenience and yield. As long as there is “only” doubt about the liquidity of the banking system, physical and digital central bank money will be perceived as a safe haven until the crisis is resolved. If fundamental trust in monetary and political stability is lost, though, digital cash will simply be sovereign currency. In order to escape it, consumers would have to turn to private cryptocurrencies or other alternative assets.

In conclusion, a compelling reason for consumers to switch voluntarily to crypto euros is hard to see – at least for the time being.

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