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**CBDC: CAN CENTRAL BANKS SUCCEED
IN THE MARKETPLACE FOR DIGITAL
MONIES?**

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JEL Classification: E42, E44, E52, E58, G21, G28

Keywords: Central bank digital currency, central banks, Payment systems, international payments

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The discussion about central bank digital currencies (CBDC) has gained an impressive momentum. So far, however, the main focus has been on the macroeconomic implications of CBDCs and the narrow perspective of developing a digital substitute for cash. This paper adds a microeconomic dimension of CBDC to the discussion. We provide an overview of the existing payment ecosystem and derive a systemic taxonomy of CBDCs that distinguishes between new payment objects and new payment systems. Using our systemic taxonomy, we are able to categorize different CBDC proposals. In order to discuss and evaluate the different CBDC design options, we develop two criteria: allocative efficiency, i.e. whether a market failure can be diagnosed that justifies a government intervention, and attractiveness for users, i.e. whether CBDC proposals constitute attractive alternatives for users compared to existing payment objects and payment systems. Our analysis shows that there is no justification for digital cash substitutes from the point of view of allocative efficiency and the user perspective. Instead, our analysis opens the perspective for a retail payment system organized or orchestrated by the central bank without a new, independent payment object.

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1 Introduction

The discussion about Central Bank Digital Currency (CBDC) has gained an **impressive momentum**. [Auer, Cornelli and Frost \(2020\)](#) report that as of mid-July 2020, at least 36 central banks have published retail or wholesale CBDC work. At least three countries have completed a retail CBDC pilot and six retail CBDC pilots are ongoing. In speeches of central bank governors and board members about CBDC there have now been more speeches with a positive than a negative stance. In October 2020, the European Central Bank (ECB) ([ECB 2020](#)) has published a comprehensive report on “a digital euro”.

With the introduction of CBDCs central banks enter a completely new sphere. For decades they lived the “**quiet life**” of a **monopolist** ([Hicks 1935](#)) supplying private households and firms with cash. This product offers properties that no other financial asset can offer: It is legal tender and it allows for completely anonymous peer-to-peer transactions. But with more and more sophisticated digital payment instruments and payment systems, central banks have realized that their unique position as monopolistic supplier of cash is in danger of being undermined.

As a consequence, many central banks now consider offering a **digital substitute for cash**. E.g. in its report on the digital euro, the [ECB \(2020, p.4\)](#) notes:

*“A digital euro could be designed to replicate some key features of cash that are useful in the digital economy, such as the ability to make offline payments.”*¹

While there is an intensive debate on the macroeconomic implications of CBDC, especially on the financial intermediation by banks and the risk of digital bank-runs ([Bindseil 2020](#)), the **microeconomic dimension of CBDC** has so far received very little attention. But this dimension matters as the issuance of CBDC in whatever form means a **fundamental change in the role of central banks**. As supplier of cash they did not directly interfere with the business of banks and other payment service providers. In addition, there was hardly any doubt that the issuance of cash should be made under a government monopoly. Hayek’s proposal for a denationalization of money ([Hayek 1976](#)) was never considered as a realistic alternative to the current monetary system.

As supplier of CBDC, central banks would start something new. They would actively compete with the products and services offered by commercial banks and other payment service providers. When central banks become additional players in the competition between private financial institutions, fundamental questions arise that have hardly been discussed so far.

- How can such an expansion of government activities be justified from the point of view of **allocative efficiency**? Is there an identifiable **market failure** that can justify CBDC?
- In contrast to cash with its unique features, it is by no means certain that digital products and services offered by central banks that are similar to those offered by commercial banks

¹See also [Auer and Böhme \(2020, p.86\)](#): “The consumer’s prime need is that CBDC embodies a cash-like claim on the central bank, ideally transferable in peer-to-peer settings.”

and payment providers would meet **enough demand from the private sector**. It would be anything but beneficial for the **reputation of the central banks** if they were to develop a digital product that would not be able to assert itself on the market against private competitors.

In principle, the discussion of these two crucial questions should take place before any macroeconomic analysis. For if it should turn out that there is no justification for the creation of CBDCs from the point of view of allocative efficiency, or that CBDCs cannot compete in the marketplace, the macroeconomic dimension would become superfluous, at least from the point of view of policy relevance.

Our paper tries to deal with the microeconomic deficit in the CBDC debate. In order to answer the two key questions, we first develop a **comprehensive taxonomy** of possible forms of CBDC. It is characterized by the fundamental distinction between

- CBDC as an innovative **payment object** used in existing payment systems and
- CBDC as an innovative **payment system** based on CBDC payment objects.

The categorical separation between payment objects and payment systems, which is usually overlooked in the CBDC literature, opens the perspective for the option that central banks may develop **retail payment systems** that do not necessarily have an independent payment object.

In this paper, we discuss and evaluate the different CBDC design options under **two criteria**:

- **Allocative efficiency:** Any government interference with the market process requires the **diagnosis of market failure** (Carletti et al. 2020). The burden of proof lies with the central banks. They have to show that the objectives which they pursue with CBDC are currently not satisfactorily met by the market. And even if public goods like financial stability or stability of the payment system are not optimally met, it is not obvious that CBDC is the adequate solution.
- **Attractiveness for users:** If CBDC are designed as new payment objects that are used within existing payment systems, the user perspective implies that CBDCs must compete with existing payment objects (above all cash and traditional bank deposits). If CBDC constitute **new payment systems**, their acceptance by private users must be analyzed within the context of the existing payments ecosystem.

The microeconomic approach in our paper makes it possible to **critically review** the activities of central banks to date. Is it really a question of creating a **digital substitute for cash** as a means of payment, or does the challenge of digitalization not consist in finding **alternatives to global payment systems** such as PayPal or, in the future, Libra?

The central message of our paper is that there is no justification for **digital cash substitutes** from the point of view of allocative efficiency and that such products, as they are currently being

discussed by central banks, would most likely not be widely accepted by private households and businesses.

In contrast, a clear market failure can be identified for **global payment networks**, which are based on monopolistic or oligopolistic structures. However, the central banks' response would then have to be supranational rather than national. Moreover, successful networks such as PayPal show that such systems are not tied to a system-specific currency. The broad range of additional services such service providers offer to their customers shows that it will not be easy for central banks to develop an attractive alternative.

In **Chapter 2**, we begin with a short presentation of the **key features of the present payment ecosystem**. This leads to a **comprehensive taxonomy of CBDC design options**, which is characterized by the analytical separation between payment objects and payment systems.

In **Chapter 3**, we discuss the **two criteria for the evaluation of the CBDC design options**: allocative efficiency and attractiveness for users. We ask, whether a market failure can be identified that would justify the supply of CBDC objects or the introduction of a retail payment system operated by central banks. From the user's point of view, the fundamental problem with all CBDC options is that their unique feature, absolute security, is irrelevant for most private households. Since balances at commercial banks are covered by the deposit insurance up to EUR 100,000, there is no incentive for the most important target group of CBDC initiatives to open an account at the central bank for reasons of security.

Chapter 4 analyses retail payment **CBDC objects without stand-alone payment systems**, i.e. CBDC objects that can be used within the existing payment systems. The potential for **token CBDCs**, which can be regarded as a digital substitute for cash, suffers from the tight legal restrictions for e-money that aim at preventing money laundering and terrorist activities. Thus, it is unlikely that token CBDC could become an alternative for cash, which today is especially attractive in the shadow economy and as a store of value in crisis times. **Account CBDCs** without a stand-alone payment system would not be different from accounts held with commercial banks. If such CBDCs are designed with prohibitive interest rates, e.g. already for deposits exceeding 3,000 euro (Bindseil 2020), and if they do not provide the broad spectrum of services that bank accounts typically offer, it is very unlikely that they would be met with great interest. In addition, there is no obvious market failure that could justify the provision of such assets and services by central banks.

Chapter 5 deals with **CBDC objects** that can only be used as **store of value** so that only bilateral transactions between a commercial bank account and a central bank account are possible. In the literature this variant of CBDC has not been discussed in detail. It is explicitly dismissed as central banks should not become financial intermediaries (Bindseil 2020). However, from an allocative point of view, store-of-value CBDCs could be justified with a **lack of "safe assets"** that only central banks can produce. Depending on the interest rate they could be a very attractive asset for investors and firms with deposits exceeding 100,000 euro. With an auctioning mechanism

central banks could perfectly control the amount of such CBDC. Store-of value CBDC are especially relevant as **wholesale CBDC**, i.e. as collateral for deposits held with payment service providers. While Alipay is already obliged to back its deposits fully with reserves held by the People’s Bank of China, this approach could also be useful to keep Libra’s activities under the control of central banks.

Chapter 6 discusses **stand-alone CBDC payment systems** that are based on CBDC objects. A relatively advanced model is the Swedish **e-krona** (Sveriges Riksbank 2018). The main problem with this system is its stand-alone architecture that implies a **lack of interoperability**. Thus, CBDC held with a central bank account cannot be used for payments outside the CBDC payment system. A related problem is the domestic range of this system and the focus on the national currency. In the case of a small country like Sweden this must be considered as a particular disadvantage. Thus, while the demand for CBDC payment objects is already likely to be small in general, the inability to make direct payments to commercial bank accounts makes it a non-starter. The **total neglect of the users’ point of view** characterizes the CBDC proposal by [Kumhof and Noone \(2018\)](#). In the attempt to design a scheme that cannot trigger digital bank runs, they propose a CBDC that is inconvertible in central bank reserves and commercial bank deposits. The projected **Libra system** ([Libra Association 2020](#)) would also suffer from a lack of interoperability as payments are only possible from one Libra account to another. But in the case of Libra, the large number of Facebook users could at least partially compensate for this fundamental disadvantage.

The **“digital euro”** that the [ECB \(2020\)](#) has presented in a first report is difficult to evaluate. It is so far not clear whether the ECB envisages the digital euro as a payment object that can only be used in the existing payment systems or whether it should also be used in a stand-alone payment system. In the first case, the evaluation of [Chapter 4](#) would apply, in the second the evaluation of [Chapter 6](#). But without further details, a comprehensive assessment is not possible.

Chapter 7 discusses the option of a **retail payment system organized or orchestrated by central banks**. Such a scheme would not necessarily require central bank accounts for all. Successful payment systems like credit card systems and PayPal can operate payments without system specific payment objects. Payers do not need positive balances on their account held with the system. In addition, such systems can operate international transactions where the currency of the payer differs from the currency of the payee. Thus, if central banks have the intention to develop an answer to activities of international payment system providers, a completely different approach is required. Instead of a domestic solution that requires system specific payment objects and that is limited to the domestic currency only, a **supranational multicurrency scheme** is required that can also deal with **accounts held with commercial banks**. As the example of PayPal shows, a competitive global payment system must be capable of more than just the transfer of funds. It must offer a sophisticated bundle of services especially for online-trade. As it is questionable whether central banks are qualified for such products and services, one might envisage solutions where central banks orchestrate a payment system that is provided by private financial institutions.

2 A Systemic Perspective on CBDCs

2.1 The existing payment ecosystem

From a systemic perspective, CBDC, however designed, constitute a new element or subsystem of the existing payment ecosystem. This suggests starting the discussion on CBDC with a short presentation of the essential features of the existing payment ecosystem. This allows to develop a comprehensive taxonomy of CBDC options. On this basis, one can discuss the innovations that central banks could introduce with CBDC in this system.

Ugolini (2017, p.22) describes the payment ecosystem as follows:

“(...) different payment systems actually coexist (often concerned with transfers of different nature, like credit card networks, derivatives clearinghouses, or foreign exchange markets), but it is the interaction among all of them that constitutes the economy’s payment system proper. As hierarchies play a crucial role in networks, not all of the “regional” components will play an equally important role in the “global” architecture of the system. In the case of the payment infrastructure, the “core” of the system consists of the wholesale interbank network, to which “peripheral” components necessarily need to be connected in order to work efficiently.”

The **constituent elements** of payment systems, can be classified as follows (Füssel and Kokkola 2010):

- A **network infrastructure** connecting payment institutions (banks and other payment service providers) for the transfer of funds from a payer to a payee. This can be a one-way or two-way transfer.
- **Payment instruments** that connect payers and payees, as they trigger the flow of funds: cards, credit transfers, direct debits, and e-money.²
- **Payment objects**, i.e. funds for settlement that are in the possession of the payer and that guarantee the finality of payments when they are received by the payee.
- A **single currency or multiple currencies** in which the funds are denominated that can be used within the system.

²This follows the ECB’s definition of payment instruments: *“Payment instruments and schemes are an essential part of payment systems. Cards, credit transfers, direct debits and e-money are non-cash payment instruments with which end users of payment systems transfer funds between accounts at banks or other financial institutions.”* (ECB n.d.). A different definition is used by BIS (2020, p.3): *“A CBDC is digital payment instrument, denominated in the national unit of account that is a direct liability of the central bank.”*

Table 1: The payment ecosystem

Payment system	Market infrastructure	Payment instrument	Payment object for settlement	Unit of account
Cash payment system	Peer-to-peer Legal tender	Banknotes Coins	Banknotes Coins	National currency
Commercial bank payment systems	Euro area: SEPA/ TARGET/ SWIFT US: CHIPS/ Fedwire	Bank transfer Debit cards Cheques Mobile Payment	Bank deposits (between payer and payee) and Central bank reserves (between bank of payer and bank of payee)	Sepa: Euro CHIPS and Fedwire: US-Dollar Swift: Multi-Currency system
Credit card payment systems (VISA/ Mastercard/ American Express)	Systems have their own procedures for data transmission/ authorization/ clearing/ settlement	Credit cards Debit cards Mobile Payment Anonymous: e-money	Bank deposits (between payer and payee)	Multi-Currency schemes
PayPal	PayPal	PayPal-Transfer Mobile payments	Deposits on PayPal account or bank accounts (direct or indirect via credit cards)	Multi-Currency scheme

The most basic payment system is the **cash payment system**. It has a decentralized network as funds are exchanged on a peer-to-peer basis. This informal network is supported by the legal tender status of banknotes. In this system, the payment instrument (i.e. banknotes or coins) is identical with the payment object that is exchanged. The cash payment system is typically a one-currency system as banknotes can only be used within their own currency area. The role of the US-dollar as a parallel currency in countries with weak domestic currencies is an exception.

Today, the most widely used payment system is the **bank-based payment system**. In the euro area, the infrastructure for this system is provided by SEPA and the TARGET network, which is operated by the European Central Bank. In the United States, two networks coexist: Fedwire is operated by the Federal Reserve Banks and CHIPS is operated by the banking system. It characterizes this payment system that it can be used with a variety of payment instruments. In addition to traditional instruments like bank transfers and checks, payments can be triggered by bank debit cards and mobile payments. The funds that are exchanged are bank deposits **and** central bank reserves: The bank deposits of the payer decline and the deposits of the payee increase. If the payer and the payee have their accounts with different banks, the exchange of deposits is paralleled by an exchange of central bank reserves between the bank of the payer and the bank of the payee. In the euro area, this exchange is provided by the TARGET system. TARGET and Fedwire are one-currency systems.

Credit card payment systems play an important role in national and international payments. These systems (VISA, Mastercard, American Express) are typically one-way systems from the purchaser of a product to the seller and have their own infrastructures for data transmission, authorization, clearing, and settlement. They offer debit and credit cards as well as mobile payments as payment instruments. The funds that are used for settlement are bank deposits. In the case of credit cards, an immediate settlement is not required. When prepaid cards (electronic money) are used, credit card payment systems can also be used without a bank account. In contrast to bank-based payment systems and the cash-payment system, credit card systems are multi-currency systems.

A more recent development is the **PayPal payment system**. It began as a payment system for eBay but it is now a completely independent international payment system. Compared to bank accounts, PayPal accounts can be opened without information on the identity of the owner. Only an email address and phone number are required. Compared to credit card payments, PayPal is a two-way system and the payee does not require specific interfaces and a contractual relationship with PayPal. PayPal payment instruments are internet transfers and mobile payment solutions. In addition, PayPal uses credit card systems and bank-based systems for the transfer of funds. PayPal settlements can be made with deposits held with PayPal, but also with bank deposits. PayPal also allows for multi-currency payments and to hold deposits in different currencies. A more detailed discussion of PayPal will be provided in Chapter 7.3.

In sum, the current payment ecosystem is characterized by a coexistence of a purely public payment system (cash payment system) with a purely private payment system (PayPal). The bank-based system is a hybrid, as it uses private bank deposits and central bank reserves as funds and the interbank payment network is provided by the central bank. In credit card systems the role of the state is reduced as the infrastructure is private and bank deposits are required only for the monthly settlement of balances.

Thus, if cash is no longer used for payments, this **does not imply that central banks have no more influence** on the payment systems. This would only happen with a declining role of the bank-based system that relies on central bank reserves and the RTGS provided by the central bank. In other words, the real threat to the role of central banks in payment systems is not the decline in cash usage. It is the emergence of private payment systems like PayPal and possibly Libra. They could lead to closed payment systems that no longer rely on traditional bank deposits and subsequently on a central bank operated payment network.

Box: “Digital currency areas”: A useful concept?

The presentation of the existing payment ecosystem shows that a payment system does not need its own currency and that the same payment instruments, i.e. mobilpay solutions can be used in different payment systems. This contradicts the views of Brunnermeier, James and Landau (2019, p.14) who argue that “a digital currency is inseparable from the characteristics of the platform on which it is exchanged”. Furthermore, they “define a digital currency area as a network where payments and transactions are made digitally by using a currency that is specific to that network” (Brunnermeier, James and Landau 2019, p.19). “Specific” in this context is either defined as an “own unit of account” used by the network or the network operating a medium of exchange “that can only be used inside, between its participants” (Brunnermeier, James and Landau 2019, p.19).

As credit card systems and PayPal show, payment platforms are typically **multicurrency platforms**. Thus, they are able to perform payments between different currency areas. As our taxonomy above shows, some networks/ payment systems (e.g. the PayPal system) can operate with multiple payment objects (PayPal deposits and bank deposits) whereas some payment objects (e.g. bank deposits) can be exchanged on multiple payment systems (e.g. commercial bank payment systems and credit card payment systems).

The development of the **Libra** project also reflects the insight that payment platforms do not need their own currency. The first whitepaper was based on the notion of a platform specific currency, where Libra was designed as a basket of existing national currencies. This approach was in line with the definition of “digital currency area”. However, the second white paper announced that in addition to issuing one global payment object they would issue Libra denominated in individual existing currencies, e.g. a euro-Libra, dollar-Libra or Yen-Libra (Libra Association 2020). The single-currency Libras and multi-currency basket Libra are both compatible with the same (Libra-)payment system. The payment instruments (e.g. Libra wallets) are again independent of the unit of account of the payment objects.

Bitcoin is an exception as this platform can only operate with deposits denominated in Bitcoin. However, the role of Bitcoin as a global payments system is very limited compared to Visa, Mastercard or PayPal.

In addition, we use the term “payment instrument” differently than Brunnermeier, James and Landau (2019) as we differentiate between “payment instruments” (e.g. a credit card) and payment objects (e.g. a deposit on a bank account). Brunnermeier, James and Landau (2019, p.5) use the term “**payment instrument**” for what we would refer to as payment object:

“We say a collection of payment instruments form an independent currency if the following two conditions hold:

- (i) The payment instruments are denominated in the same unit of account.*
- (ii) Each payment instrument within the currency is convertible into any other.”*

Using the term “payment instrument” for payment objects has the problem that there is no specific term for what we (and the ECB) call payment instrument.

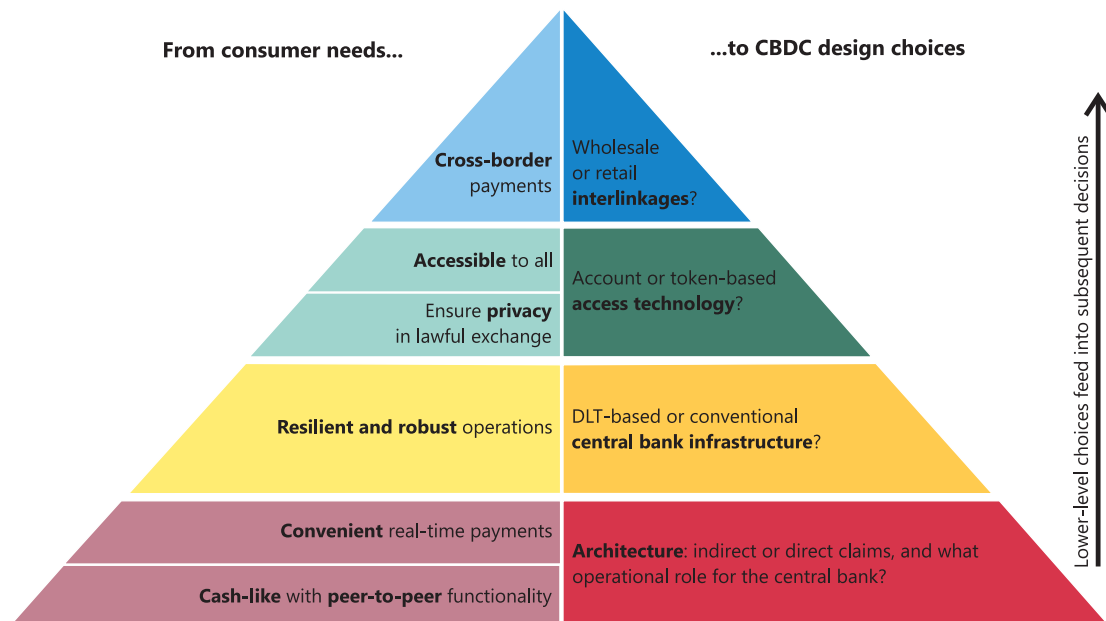
2.2 A systemic taxonomy of CBDC

The central banks' discussion about CBDC is strongly influenced by the idea that the primary goal must be to develop a substitute for cash. The pyramid developed by [Auer and Böhme \(2020, p.87\)](#) (Figure 1), which is based on the property “cash-like with peer-to-peer functionality”, reflects this focus on cash. In our view, this has narrowed the discussion on CBDC. It has led to the implicit assumption that payment systems and payment objects coincide. An example is the following statement by the ECB:

“If industry efforts fall short of developing an innovative and efficient pan-European payment solution, the social need for it could potentially be met by issuing a CBDC. For instance, a CBDC with the status of legal tender could guarantee that all users have, in principle, access to a cheap and easy means of payment.” [ECB \(2019a, p.3\)](#)

Thus, as response to the challenge of global payment systems, the ECB seems to believe that it is sufficient to offer a new payment object. But outside the cash payment system, there is no natural coincidence of payment systems and payment objects. As we have shown in section 2.1, successful payment systems have the ability to deal with different payment objects that can also be denominated in different currencies. Thus, for a comprehensive analysis of CBDC the differentiation between payment object and payment system is of crucial importance.

Figure 1: The CBDC pyramid



The CBDC pyramid maps consumer needs (left-hand side) onto the associated design choices for the central bank (right-hand side). The four layers of the right-hand side form a hierarchy in which the lower layers represent design choices that feed into subsequent, higher-level decisions.

Source: [Auer and Böhme \(2020, p.87\)](#)

From the systemic perspective, CBDC concepts can be presented in two separate but interrelated ways. CBDC can be discussed from the perspective of

- **new payment or settlement objects** made available by central banks to the broader public that are used within the existing payment systems,
- **new payment infrastructures or systems** operated by central banks.³

Combining these two dimensions leads to the following institutional arrangements for CBDC (Table 2):

Table 2: **Options for digital central bank projects**

		New payment system operated by central banks	
		No	Yes
New central bank payment objects	No	Status quo	Central bank digital retail payment system
	Yes	CBDC: Bindseil (2020) or “direct CBDC”	e-krona, Kumhof and Noone (2018)

Some CBDC proposals, e.g. the proposal by [Bindseil \(2020\)](#) envisage the creation of a new payment object that would be used in the existing payment systems. Under such an arrangement, which [Auer and Böhme \(2020\)](#) label as “direct CBDC”, central banks would assume some functions of a commercial bank and compete with existing commercial banks.

The e-Krona ([Sveriges Riksbank 2018](#)) and the proposal by [Kumhof and Noone \(2018\)](#) envisage the creation of a new payment system within which the new CBDC payment objects can be used. The proposal by Kumhof and Noone deliberately excludes the convertibility between CBDCs on the one hand and traditional bank accounts and central bank reserves on the other hand.

The “digital euro” project of the ECB is difficult to classify. As we will discuss in section 6.1, it is not clear, whether the ECB envisages a new payment object only or whether it also plans to establish a new payment system.

From the perspective of central banks’ control over the monetary sphere and the safeguarding of efficient payment systems, our systemic approach opens the view for solutions where central banks concentrate on **competing with private payment service providers** (e.g. PayPal) by establishing a new retail payment system (Central bank digital retail payment system). For this approach it is not required that central banks issue new payment objects. The decision by 16 European banks to launch the **European Payments Initiative** can be regarded as a privately organized alternative. The initiative aims to create a unified payment solution for consumers and merchants across Europe, encompassing a payment card and a digital wallet and covering in-store,

³A similar differentiation is made by the [Bank of England \(2020, p.25\)](#): “There would be two main elements to any CBDC: (1) the CBDC itself (i.e. access to a new form of central bank money) and (2) the CBDC infrastructure that allows CBDC to be transferred and used for payments.”

online and person-to-person payments as well as cash withdrawals ([European Payments Council 2020](#)).

2.3 CBDC as payment objects

For a comprehensive taxonomy, **different design options for CBDC objects** must be considered. We differentiate between “token-based” and “account-based” CBDC as well as “payment” and “store of value” solutions:

- **“Token-based CBDCs”** are a substitute for cash. They are deposits stored on cash cards or other electronic media (wallets) that enable anonymous payments on a peer-to-peer basis. The ECB report envisages a digital euro which can be used offline.
- **“Account-based CBDCs”** are a substitute for cash but also for deposits held with commercial banks. They constitute deposits held in a central bank account. Among such CBDCs, one can differentiate between
 - deposits that can be used primarily for payments, but also (although only to a limited extent) as a store of value (**“payment CBDCs”**) and
 - deposits that can only be used as **store of value (“store of value CBDCs”)** so that payments can be made only between the own traditional bank account and the CBDC account. In the literature, this CBDC option is not discussed explicitly. It underlies the concept of “indirect CBDC” ([Auer and Böhme 2020](#)) where narrow banks hold deposits with the central bank in the form of 100% reserves. The same applies to proposals for synthetic CBDCs where a payment service provider uses CBDC accounts as a backing for the deposits of its customers ([Adrian and Mancini-Griffoli 2019](#)).

A differentiation can also be made between “retail CBDC” and “wholesale CBDC”:

- **“Retail CBDCs”** are generally accessible.
- **“Wholesale CBDCs”** are only available to selected users, such as larger companies or the operators of payment systems, which could thus offer 100% coverage by central bank deposits for balances held with them (synthetic CBDCs; [Adrian and Mancini-Griffoli \(2019\)](#)). It could also be used by **narrow banks**, which specialize in creating “safe assets” for depositors by depositing 100% of the deposits they receive with the central bank.

Table 3: Design options for CBDC objects

		Retail CBDCs	Wholesale CBDCs (Large companies and payment service providers)
Token-based CBDCs: (peer-to-peer payments)		Money cards (‘e-money’), digital wallets	–
Account-based CBDCs	Means of payment	All-purpose CBDCs (Direct CBDC)	All-purpose CBDCs
	Store of value	Store-of-value CBDCs (‘safe assets’)	Indirect CBDCs (narrow banks) Synthetic CBDCs

By combining table 2 (differentiating between payment system and payment objects) with table 3 (design options for CBDC objects), a comprehensive taxonomy of CBDC design options can be derived (Table 4, in the appendix). The taxonomy makes it possible to classify concrete CBDC proposals and to evaluate them in a systematic way.

3 Evaluation of CBDC design options

For our microeconomic evaluation, we use two criteria. From an allocative point of view, one has to ask whether a market failure can be identified that justifies the supply of a specific CBDC design option by the central bank. From the users’ point of view, we ask whether a specific CBDC design option is able to compete successfully with existing payment objects and/or payment systems.

3.1 An allocative perspective on CBDC

With each form of payment CBDC, central banks would compete with commercial banks or other payment service providers. Token CBDCs are a substitute for prepaid cards, which are offered by private companies. Account CBDCs are a substitute for traditional bank deposits. If central banks develop a separate CBDC payment system, it is a substitute for private payment system providers. If central banks decide to create a new retail payment system without a system specific payment object, they would compete with credit card systems or payment service providers like PayPal.

Some CBDC proponents, e.g. Bindseil (2020, p.26) do not consider the competition between the central bank and private financial service providers a major problem:

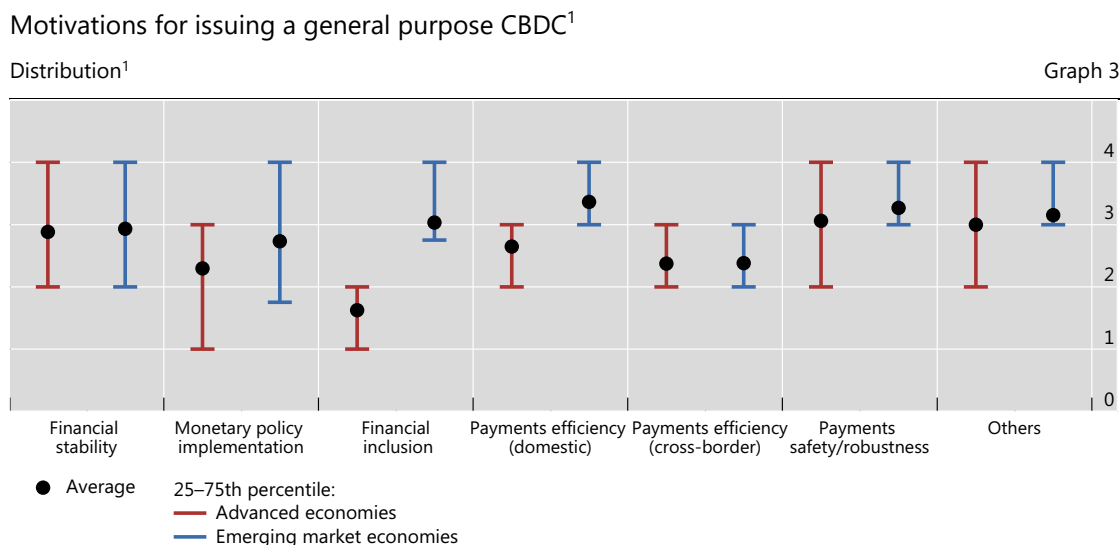
“In the long run, this should however not matter, i.e. if the provision of certain services is possible at low unit costs for CBDC accounts also because of the large number of accounts, then the central bank may conclude that it is legitimate to offer these services, even if it is in competition with commercial banks.”

In the following, we discuss the main arguments and motives of central banks for the introduction of CBDC under the perspective of a possible market failure that could justify such activities.

3.1.1 Stability and efficiency of the payment system

The survey by [Boar, Holden and Wadsworth \(2020\)](#) shows, that central banks consider CBDCs as an opportunity to increase the stability and efficiency of the financial system, to improve financial inclusion, and to create new forms of monetary policy implementation, thereby strengthening control over the monetary policy transmission mechanism (Figure 2).

Figure 2: Motivation for central banks for issuing CBDC



¹ Not so important" (1); "Somewhat important" (2); "Important" (3); and "Very important" (4).

Source: Central bank survey on CBDCs.

Source: [Boar, Holden and Wadsworth \(2020, p.4\)](#)

While these are obviously important public goods, it is not clear whether there are currently major problems with these goals and if so, whether CBDC could contribute to a better performance. The lack of a convincing justification for CBDC has been described very clearly by [Panetta \(2018, p.5\)](#):

“But the set of tools that permit almost frictionless and instantaneous payments is already large: today we can make a digital payment by wire transfer (through online banking), with credit or debit cards, using Paypal or Apple pay (to name just a few); we can do it via computers, smartphones or smartwatches, by simply putting our wrist close to a point of sale. Competition in the supply of payment services is already high, and the efficiency of the system will increase with the introduction in many jurisdictions of instant payments – yet another alternative to cash. From this vantage point the advantages of a CBDC are at best unclear: its potential benefits in terms of improving the ease of transactions are probably insufficient to justify the involvement of central

banks in an activity that is well served by private suppliers.”⁴

Given the prominence of these targets as motivation for central banks’ CBDC efforts, it is surprising that so far, no attempt has been made to **identify specific problems in the international payment landscape**. In addition, the growing CBDC literature has so far not explicitly discussed how CBDC could contribute effectively to possible flaws in this landscape.

3.1.2 Declining role of cash

The most important motivation for central banks’ CBDC initiatives seems to be the **declining importance of cash** as a means of payment. This explains the specific efforts of the Swedish central bank, which is facing a significant decline in the amount of cash in circulation. But with an increasing digitalization of the entire economic system, a declining role of cash in payments transaction is by itself not yet an obvious problem that would require CBDC in the sense of remedying a market failure. The [ECB \(2020, p.10\)](#):

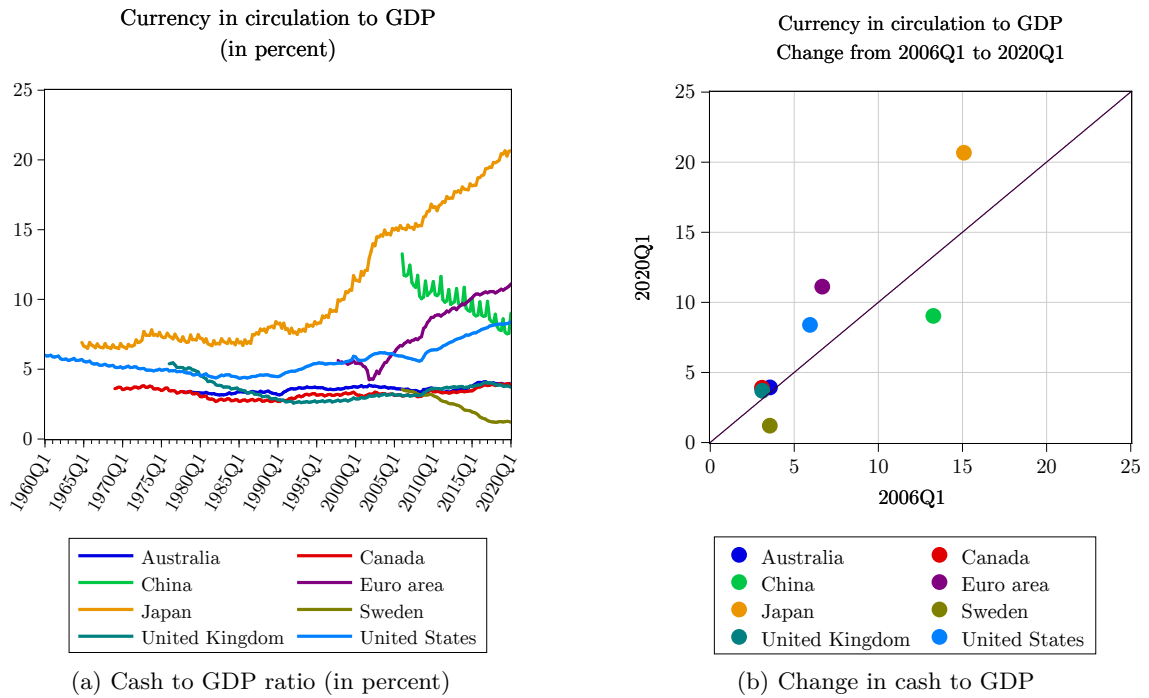
“A decline in the use of cash in the economy would imply increasing dependence on private forms of money and private payment solutions in the euro area. Beyond a certain point, such a trend could endanger the sustainability of the cash infrastructure and hamper the provision of adequate cash services. European citizens would thus encounter difficulties in accessing the only means of payment that is provided by the public sector and that takes account of their needs, regardless of any commercial perspective.”

However, so far there is **no evidence of a widespread collapse in the demand for cash**. On the contrary, as figure 3 in line with the analysis by [Bech et al. \(2018\)](#) shows, in advanced economies the relation of cash to GDP has even increased in the past decades. Sweden is obviously an outlier.⁵ Similarly, the developments in China can also be regarded as an exception as we discuss below.

⁴This view is also shared by the [BIS \(2020, p.16\)](#): “Today, vast sums flow within and between economies every day using the arrangements already in place. With a mandate for stability, central banks’ introduction of CBDC should complement these preexisting systems. In broad terms, these pre-existing domestic retail payment systems work well. In the jurisdictions of the central banks contributing to this report, the current systems offer low-cost, fast and safe payments domestically through a mix of commercial banks, other payment service providers and cash.” See also the Bank of Canada: “we have concluded that there is not a compelling case to issue a CBDC at this time. Canadians will continue to be well-served by the existing payment ecosystem, provided it is moderni[s]ed and remains fit for purpose.” ([Lane 2020, p.5](#))

⁵[Armelijs, Claussen and Reslow \(2020\)](#): “rather than being ahead of the curve, a unique combination of events and policy measures have led to the falling cash demand in Sweden.”

Figure 3: Cash demand across countries



Source: National central banks, FRED St. Louis FED, Bank for international Settlement, own calculations

But even a collapsing demand for cash would not justify the introduction of CBDC. As long as cash is not abolished altogether, CBDC are not required to maintain the access of private households and firms to the central bank balance sheet. Of course, with a very low demand for cash in normal times private suppliers could be no longer willing to support an effective nationwide **infrastructure for cash withdrawals**. In this case, central banks would have to subsidize such a network as a public good.⁶

A case in point is a **Swedish draft law**⁷ requiring credit institutions and branches that provide payment accounts with basic functions to consumers in Sweden to provide adequate cash withdrawal services to all consumers holding such accounts throughout Sweden. In an opinion of November 26, 2019, the [ECB \(2019b, p.3\)](#) explicitly “welcomes the core objectives of the draft law, namely to facilitate the continued use of cash in Swedish society by ensuring an adequate level of access to cash services throughout Sweden.”

[Auer and Böhme \(2020, p.86\)](#) justify CBDCs with the risk that in crisis periods cash might not be longer generally accepted:

⁶In fact, the [ECB \(2020, p.19\)](#) considers subsidizing intermediaries supplying CBDC: “At this stage, it cannot be ruled out that the Eurosystem might even have to subsidise the services offered by these providers in order to ensure that the holders of digital euro do not have to bear any costs, by analogy, again, with the distribution of banknotes.”

⁷Government Offices for Sweden, Govt Bill 2019/20:23 “Skyldighet för kreditinstitut att tillhandahålla kontant-tjänster”

“Today, even consumers who normally prefer to pay electronically are confident that, if an episode of financial turmoil were to threaten, they could shift their electronic money holdings into cash. This flight to cash has been seen in many crisis episodes, including recent ones. The main concern is that if, in the future, cash were no longer generally accepted, a severe financial crisis might create further havoc by disrupting day-to-day business and retail transactions.”

The evidence for this argument is also not clear. So far, severe economic crises did not affect the functioning of retail payment systems. As the authors state, the demand for cash typically goes up in crisis situations. Thus, it is not very likely that even with wide-spread digitalization, retailers would repudiate cash payments. On contrary, the **“flight to cash”** would incentivize cash payments. If the crisis has the effect that electronic payments systems are temporarily not functioning, this would also affect CBDC payments. The only way to avoid this would be a completely isolated CBDC payment system. While this would be useful in an extreme **emergency situation**, it is a severe disadvantage in normal times. But as the [Bank of England \(2020, p.16\)](#) states, *“CBDC would still be vulnerable to a large-scale outage of electricity and data networks, unless some kind of offline payments functionality is developed”*.

For this reason, the [ECB \(2020, p.33\)](#) considers an offline version of the digital euro.

“A digital euro based on infrastructures existing in parallel to those of other payment solutions could help to withstand extreme events such as cyber incidents and attacks, natural disasters, and pandemics.”

However, it is not clear why in **extreme situations**, an offline e-euro would be more useful than cash. The cash payment system has the advantage that it does not even require electricity. And for cash as well as an offline digital euro object, payments in extreme events are only possible if sufficient precautionary holdings have been built up in normal times.

While central banks in advanced economies envisage a coexistence of CBDC and cash, the **People’s Bank of China** is a special case as it explicitly aims at the abolition of cash. E.g. [Yifei \(2020\)](#) speaks of *“a pressing need to digitalise cash and coins (M0) because: i) cash and coin issuance, printing/production, withdrawal and storage are expensive; ii) cash and coin circulation is based on multiple layers; iii) cash and coins are not very convenient to use; iv) it is relatively easy to counterfeit cash or coins, and they are used anonymously and thus may be used for illegal purposes.”*

In China, the aim of **a better monitoring of private transactions** is obvious:

“(…) the operating agencies should submit transaction data to the central bank via asynchronous transmission on a timely basis. This would allow the central bank to keep track of necessary data to implement prudent regulation and crack down on money laundering and other criminal offences, as well as easing the workload for commercial banks.” (Yifei 2020)

In sum, the declining role of cash in retail payments is not a compelling reason for the introduction of CBDC. First, the evidence for major currencies shows that this does not imply that the overall demand for cash is declining. Second, the access to central bank money can be maintained, even if the demand for cash is very low. This requires that central banks safeguard a nationwide infrastructure for cash-dispensers. Even if this might require subsidies, it would most likely be cheaper than the establishment of a stand-alone CBDC payment system. In extreme situations cash would still be superior to offline CBDC, as cash payments do not even require electricity.

3.1.3 Competition with private currencies

The **activities of Facebook** with its Libra system are repeatedly mentioned by central bankers as an argument for the introduction of CBDCs. The [ECB \(2020, p.9\)](#) puts this as follows:

“A digital euro could be issued (...) if there is significant potential for foreign CBDCs or private digital payments to become widely used in the euro area”

From the point of view of allocative efficiency, a market failure can be identified when it comes to payment service providers. The [BIS \(2020, p.5\)](#) notes:

“Payment systems, like other infrastructure, benefit from strong network effects, potentially leading to concentration and monopolies or fragmentation. Payment service providers have the incentive to organize their platforms as closed-loop systems. When a small number of systems dominate, high barriers to entry and high costs (especially for merchants) can occur.”

But as we will show in the following, the adequate response to such initiatives is not “central bank deposits for all” or a “digital euro”. The solution is the introduction of a supranational payments system operated or orchestrated by central banks that does not necessarily require genuine payments objects and that is not tied to a specific currency.

3.1.4 Fostering the international role of the euro

In its report on a digital euro the [ECB \(2020, p.14\)](#) argues that the introduction of a CBDC could help to foster the international role of the euro:

“The issuance of CBDCs by major foreign central banks could enhance the status of other international currencies at the expense of the euro. In such a situation, the Eurosystem might consider issuing a digital euro in part to support the international role of the euro, stimulating demand for the euro among foreign investors.”

While the benefits of a stronger international role of the euro are not obvious, this aim could not be reached with a retail payment CBDC. There could be a strong interest of foreign investors to keep large amounts of money directly with the ECB. But this would require the willingness of the ECB to allow the use of CBDC as a store value. As we will discuss in the following, the ECB is strongly opposed to the use of the digital euro as an investment vehicle.

Thus, except for network externalities there is no obvious market failure that would require central bank action. At the same time, it is not clear how specific CBDCs can make a substantial contribution to the goals that central banks want to achieve with CBDC. This also applies to the reasoning of the [ECB \(2020, p.9\)](#) that a digital euro would support

- “the digitalisation of the European economy” and
- “improvements in the overall costs and ecological footprint of the monetary and payment systems”.

3.2 A user perspective on CBDC

In the intensive discussion among central banks about CBDC, the user perspective has remained largely unconsidered. As a rule, it seems to be taken for granted that any CBDC proposal would be readily accepted by private households and companies. However, this is anything but self-evident.

The user perspective has two dimensions:

- CBDCs as **new payment objects** would compete with existing payment objects, especially bank deposits and cash.
- CBDC as **new payment system** would compete with the traditional bank transfers, credit card networks and payment system providers like PayPal.

Of course, central banks could start to operate as fully-fledged online banks and offer the same services as the private suppliers at a lower price. This would enable CBDCs to penetrate the market quickly. From an allocative point of view, however, such a solution is not justifiable.

For the **reputation and credibility of central banks**, it is important that any CBDC solution is attractive enough for potential users to adopt it.⁸ This is in line with the ECB’s assessment that “if individual holdings of digital euro were too low, either because of rigid constraints or because of disincentives applied above a relatively low threshold, then the digital euro would be less attractive as a means of payment and less competitive than alternative instruments” ([ECB 2020, p.18](#)).

A unique feature that all CBDC objects can offer over traditional bank deposits is that they are a 100% “**safe asset**”. However, this advantage is only relevant for deposits above 100,000 euros, since up to this limit, bank deposits are also absolutely safe due to deposit insurance systems.⁹ Thus, for the retail sphere, this key feature of CBDC is of no relevance.

The allocative perspective and the user perspective make it possible to **evaluate concrete CBDC design options** that we derived in our systemic taxonomy:

⁸The ECB wants to ensure “that payments in the euro area meet the highest standards and are conducted under its (the Eurosystems) direct control” ([ECB 2020, p.12](#))

⁹Therefore, CBDC is not needed to provide the general public with “safe money”. If [Armelius et al. \(2020, p.81\)](#) argue “that it is simply a duty of the state to provide 100 per cent safe money” this is not necessarily an argument for CBDC but for an effective deposit insurance scheme.

- **Retail payment CBDC** (token CBDC and account CBDC) **without** a stand-alone payment system (Chapter 4)
- **Store of value CBDC** (retail, for deposits exceeding 100.000 euro and wholesale) **without** a stand-alone payment system (Chapter 5)
- **Retail payment CBDC** (token CBDC, account CBDC) **with** a stand-alone payment system (Chapter 6)
- **Central bank operated retail payment system** without new payment objects (Chapter 7)

Table 4 in the Appendix provides a comprehensive overview over the different proposals and their evaluation in terms of our two criteria “allocative perspective” and “user perspective”.

4 Evaluation of retail payment CBDC objects without a stand-alone payment system

The most basic version of CBDC is a solution where central banks make new payment objects available that can be used like cash or commercial bank deposits within the existing payment system. According to our taxonomy two design options can be discussed: token CBDC and account CBDC.

4.1 Token CBDC

Token CBDC is a substitute for cash as a payment object. Without a stand-alone CBDC system, token CBDC would be a form of electronic money (e-money) that allows users to make cashless payments with money stored on a card, a phone, or over the internet.

Tokenization of assets can to some extent be compared to **securitization**. A token is a digital representation of an asset, good, right, or currency. Similar to securitization, this allows to trade the ownership or part-ownership of the underlying asset. Although securitization itself is not new, the encryption mechanism of distributed ledger technology could allow for a higher degree of anonymity. While the token is a unique representation of the underlying assets, the owner of the token remains anonymous. Thus, one can be sure about the validity of the token and avoid a potential “double-spending” problem, while preserving the anonymity of the owner. However, due to technological and legal restrictions, token CBDCs cannot mimic the anonymity features that cash payments provide as we discuss below.

From an **allocative perspective** the supply of digital cash by central banks could be justified as the provision of cash is one of their traditional core businesses. CBDC would allow them to perform this function in an increasingly digitalized payments ecosystem.

From a **user perspective** there are currently three motives for holding cash and using the cash payment system:

- Cash can be used for **regular payments and is widely accepted**.
- Cash can be used for **payments in the shadow economy** because of its anonymity
- Cash can be used as a **store of value** because of its safety. This function becomes especially relevant in a banking crisis (bank-run) where people distrust the safety of bank deposits.

Although, cash must be accepted as legal tender, contactless payments using radio frequency identification (RFID) technology and near-field communication (NFC) will speed-up the decline of cash as a regular means of payment. The Corona pandemic will accelerate this trend so that sooner or later the motive for using cash in regular payments will become irrelevant.

Therefore, the competition between token CBDC and cash will concentrate on the two other motives. While it might be possible to design a token CBDC that allows **anonymous peer-to-peer payments**, it would never have the same degree of anonymity as cash.¹⁰

The [Bank of England \(2020, p.47\)](#) explains this as follows:

“In digital form, neither an account-based approach nor a token-based approach would enable cash-like transfers, where a payment can be made without reference to any third party or intermediary. In an account-based system, the accounts of the payer and payee need to be debited and credited by the operator(s) of the ledger. And in a token-based system, in order to prevent double-spending, ownership of tokens needs to be recorded in a ledger, which will need to be updated to reflect any changes in ownership.”

In addition, there are strong **legal restrictions** that limit the potential of token CBDC. With the 5th Anti-Money Laundering Directive, the conditions under which electronic money products can be issued anonymously are extremely strict ([European Parliament and Council 2018](#); [PayTechLaw 2018](#)):

- The maximum top-up amount for e-money that can be issued anonymously was reduced from 250 euros to 150 euros. In addition, the maximum cash redemption amount was capped at only 50 euros. German legislators have set the limit to 100 euros and 20 euros, respectively.
- Online payments conducted via anonymous electronic money products will not be allowed to exceed 50 euros.
- Acquirers may only process payments using anonymous prepaid cards from a third country if these cards were issued in the third country with similar restrictions.

[Fernández de Lis \(2018, p.50\)](#) describes the trade-off for central banks as follows:

¹⁰[Armelius et al. \(2020, p.87\)](#) make the same point: *“However, despite being bearer instruments, a token e-krona is digital and thus requires all transactions to be recorded in a register or a ledger to avoid the risk of fraudulent use or double spending. The ledger is in all relevant senses also a form of account. This is a contrast to other bearer instruments like cash which, once withdrawn, can circulate from user to user outside the banking system with no records of what it has been used for or by whom.”*

“It is very difficult that the same central banks that require commercial banks to implement costly mechanisms to prevent money laundering and the financing of terrorism (the AML/CFT regulation) are issuing at the same time the means to carry such activities. One may argue that this is already the case with cash. But anonymity is intrinsic to cash, whereas in the case of CBDCs it would be a deliberate decision.”

Accordingly, in its e-krona project, the [Sveriges Riksbank \(2018\)](#) explicitly states that its token-based CBDC should be traceable. The only exception for non-traceable transactions are cash/ prepaid cards, *“used as cash and handed over from one user to another.”* ([Sveriges Riksbank 2018](#), p.16)¹¹

With these tight restrictions, it also seems unlikely that token CBDCs would be used at a large scale as a **store of value** in general, but also crisis times.

The prospects for account CBDC in **offline payments** as envisaged by the [ECB \(2020\)](#) and [BIS \(2020\)](#) are also questionable. If cash is still provided to the public, offline CBDCs constitute to some degree a parallel structure to the cash payment system as well as to that of other electronic payment solutions ([ECB 2020](#), p.34). As discussed above, especially in case of extreme events, the robustness of an electronic device that also works offline compared to cash is uncertain and it is at least unclear why an offline CBDC solution is preferable to cash, as long as cash remains legal tender and can always be deposited at one’s bank account or perhaps at a future CBDC account.

In sum, the case for token CBDCs is not very clear. For regular payments, very convenient digital payment systems are already available as a digital alternative to cash and the cash payment system. For payments in the shadow economy and as a store of value, the existing regulations make it very unlikely that token CBDC could become an attractive substitute for cash as long as cash is not totally abandoned.

¹¹The [ECB \(2020, p.30\)](#) makes a similar statement: *“In the case of payments using bearer instruments, the central bank’s requirement that only legally entitled users participate in a transaction would mean that all payment devices would require users to validate their identities. The device could, for instance, record information on physical attributes of the intended user (known as biometrics, e.g. fingerprint and iris recognition) and the user must provide matching elements when initiating a payment”*

Box: “The digital, programmable euro”: A use case for CBDC?

The [FinTech Council \(2020\)](#) of the German Ministry of Finance has developed the model of a “*digital, programmable euro*” based on a blockchain which could be issued as a CBDC.

In their report on a programmable euro, the FinTech Council lists several reasons for a programmable digital euro based on blockchain technology: enhancing fast (cross-border) payments, automation, allowing for micro-payments, integration of payment and compensation (Delivery versus Payment), digital representation of values/rights, improving overall IT stability. Furthermore, they argue that only blockchain-based systems are able to achieve all of these simultaneously.

But as a report by the [BIS \(2016\)](#) shows, the development and implementation of fast payment systems is proceeding quickly and reduces delays between payment initiation, execution, and finalization. In their report on distributed ledger technology (DLT), the [BIS \(2017, p.12\)](#) even notes that: “(...) *DLT arrangements may take longer to achieve settlement when compared with real-time gross settlement (RTGS) systems*”. It is also not clear whether DLT improves cross-border payments. The [BIS \(2018, p.29\)](#) argues that “*(r)ecent studies of the application of this technology to payments by central banks and others have identified a number of technical, legal and regulatory obstacles that will take time to overcome. It could thus be a while before the use of DLT results in significant improvements to cross-border retail payments.*”

Apart from faster payments, the report of the [FinTech Council \(2020\)](#) remains rather ambiguous on applications and benefits of programmable money. It also not clear whether DLT is a prerequisite or whether existing payment systems could also allow for these applications. For example, micro payments appear to be more of a legal question. Technically, payments with very small amounts of money are possible already within existing payment systems. Programming tokens so that they can be spent only for certain products would not require a programmable euro. It would be necessary to classify and label all products. But then the payment could be made with cash cards or account-based CBDCs with existing payment systems.

In sum, the existing payment systems already allow for fast payments and for programmable payments (e.g. in the case of limit orders). While fast payment systems are already operating in several countries, the blockchain so far still has to prove its capability to work efficiently as a large-scale payment system. At the same, the authors of the report do not elaborate in detail, how the programmable digital euro could provide a concrete contribution to the targets that they enumerate in their report.

Finally, the report leaves it open, which specific role CBDC should play in this regard and why private suppliers might not also be able to provide a “*digital, programmable euro*”.

4.2 Account-based CBDCs without new payment system

For the sake of analytical clarity, we discuss in this section a model where CBDC is offered as a deposit with the central bank, but it still is used within the existing RTGS system. In Chapter 6 we discuss CBDC options with a stand-alone payment system, especially the Swedish e-krona proposal. With the digital euro of the ECB it not clear whether it envisages a stand-alone payment system or not. Without a stand-alone payment system, the following analysis, which discusses the CBDC model developed by the ECB Director General Ulrich Bindseil (2020), would also apply to the digital euro.

The Bindseil proposal is designed in a way that the usage of CBDC as a store of value is strongly discouraged. Therefore, it envisages a **two-tier structure for the remuneration of CBDCs**:

- For **deposits up to an amount of 3.000 Euro** the interest rate would equal the rate of remuneration of excess reserves, however with a zero lower bound applying.
- For **deposit exceeding 3.000 Euro** the interest rate would be two percentage points below the remuneration of excess reserves, however with zero as a ceiling.

This mechanism should ensure that CBDC is attractive as means of payment for private households, as tier-one CBDC is remunerated with a competitive rate. The store of value function would be assigned to tier-two and would be dis-incentivized through a prohibitive remuneration rate. With the 3.000 Euro threshold this CBDC option would not be attractive for firms.

Bindseil justifies the prohibitive rate for the store of value function with the argument that central bank money should not become a large-scale store of value. This would imply that the central bank becomes an investment intermediary of the economy, for which it is not particularly qualified.

From an **allocative perspective**, the case for such a CBDC model is not clear. There is no obvious market failure in the provision of bank accounts and services supplied by commercial banks to their customers that would justify a competition between the central bank and commercial banks in this market.

From the **user perspective** a central bank account “for all” should provide the same services as an account with a commercial bank. But such accounts are not only a means of payment. Instead, they offer a comprehensive bundle of financial services. Bindseil (2020, p.26) puts this as follows:

“The attractiveness of CBDC for payment purposes does not only depend on the amount of CBDC that would be remunerated at a fairly attractive level, but also on other features of the use of CBDC as means of payment. It will matter in particular whether account services of CBDC include the services that deposit accounts with commercial banks typically offer, like remote internet access, mobile phones and cards, periodic payments to other accounts, debit orders, user-defined maximums for different types of transfers.”¹²

¹²See also Carletti et al. (2020, p.107)

At least for the introductory phase, Bindseil (2020, p.26) assumes for CBDC deposits that “*there would therefore still be a difference relative to the breadth of services by commercial banks*”.

But if central banks are not providing the full spectrum of such services, which is difficult to justify under allocative considerations, it is not clear why private households and firms would be willing to substitute a traditional bank account for a CBDC account. If they hold CBDC accounts in parallel to traditional bank accounts, the payments process would become more complicated. Depositors must avoid negative balances in the traditional account which implies high interest rates. At the same time, the lack of overdraft facilities in the CBDC account could lead to the refusal of direct debits, which is also very costly.¹³

While payment CBDCs offer less services than traditional bank accounts, their advantage as a **safe asset** does not count in the retail sphere, as bank accounts are protected by deposit insurance schemes. This negative assessment is reinforced by the design of the specific CBDC proposals.

In sum, it is not obvious why a CBDC account should be attractive for a private household:

- The **absolute safety** of the central bank account is irrelevant as traditional bank deposits up to 100.000 Euro are fully protected by the deposit insurance.
- CBDC provides no **interest rate advantage**, as the tier-one interest rate would be zero today and thus not different from the interest rate for smaller sight deposits with private banks
- The **account services** of CBDC would be rudimentary and not competitive with the services offered by traditional commercial banks or online banks.
- Especially if the central bank deposit does not include an **overdraft facility**, depositors must permanently **monitor and manage** their accounts in order to avoid that direct debits on CBDC accounts are not executed, which is associated with high costs.
- The **3.000 Euro threshold** also requires an active account management in order to avoid the **prohibitive interest rate** for tier-two deposits.
- Holding a **CBDC account in parallel** to a traditional bank account does not facilitate the management of payments for private households. It makes it more complicated.

However, compared to CBDC proposals with a stand-alone system, which will be discussed in Chapter 6, the model discussed here has at least the advantage that the CBDC deposits could be used in the existing payments networks like an ordinary bank deposit. Thus, interoperability problems can be avoided. But at the same time, with such a modest CBDC approach it would hardly be possible that “*CBDC offers a number of advantages with regards to the convenience, efficiency, stability and accessibility of retail payment.*” (Bindseil 2020, p.5).

¹³The “*waterfall*” model as suggested by the ECB (2020, p.28) for absolute thresholds of CBDC holdings is also an unsatisfactory solution. If one’s central bank account is credited beyond the threshold of e.g. 3,000 euros, the excess amount is transferred to a bank account. The benefits of such a central bank account are at least unclear.

In sum, there are no obvious reasons why a private household or a firm should be interested to open and to manage a CBDC account as it has been developed in the Bindseil model. In principle, this finding corresponds with the allocative analysis where no significant market failures in the payment system could be identified that would warrant such an interference of the central bank in the payment system.

5 Evaluation of store of value CBDC design options

The model of a CBDC that is only used as a store of value has so far received little attention (Bofinger 2019). Conceptually, a store-of-value CBDC would allow a depositor only two-way transactions between her own traditional bank account and her CBDC account. As a store-of-value CBDC would not be used for payments, it has no systemic dimension, i.e. it would be used within the existing payment system.

There are different **design options** for store-of-value CBDC.

- It could be designed as **retail CBDCs “for all”**, e.g. private households and firms. However, due to the deposit insurance the absolute safety compared to a bank account is irrelevant for deposit below 100.000 euro.
- The access to a retail store-of-value CBDC could be limited to **deposits exceeding 100.000 euro**.
- A **wholesale store-of-value CBDC** could be used as a backing for narrow banks (“indirect CBDC”) and for payment service providers (“synthetic CBDC”). Such proposals implicitly assume the existence of store-of value CBDC.

If the ECB envisages to increase the **international role of the euro** by creating a digital euro, this could only be achieved with a **store-of-value CBDC**. International investors would hardly be interested in ECB accounts with a prohibitive interest rate for deposits exceeding 3,000 euro.

5.1 Allocative perspective: Only central banks can supply safe assets

From an **allocative perspective**, the provision of store-of value CBDC could be justified more easily than the provision of retail payment CBDC. The global demand for safe assets is high. There are studies showing that after the global financial crisis, the demand has increased well beyond its supply (Habib, Stracca and Venditti 2020). In fact, the supply of safe assets has been negatively affected as large bank deposits have lost their safe asset status with the **Banking Recovery and Resolution Directive (BRRD)**, which was adopted in spring 2014. According to the BRRD bank depositors must be bailed-in if a bank resolution is required.

Assets with a 100% nominal value guarantee can only be supplied by central banks. This explains the attractiveness of cash as a store value and the increasing demand for cash issued by major

central banks (Figure 3). In large countries where government debt is denominated in the national currency, e.g. the United States or Japan, it is the implicit backing by the central bank which makes government bonds a safe asset. The supply of store-of-value CBDCs could therefore be justified by a **shortage of safe assets** that cannot be met by private suppliers. In this regard, a market failure could be identified.

While retail store-of-value CBDC would compete with time and saving deposits supplied by commercial banks and with short-term government bonds, the competition is less problematic than in the case of retail CBDCs. For daily transactions private households and firms would still need to hold deposits at a traditional bank account. In addition, there would be no need for the central banks to engage in specific account services that would be required to make retail payment CBDCs somehow competitive vis-à-vis traditional bank accounts.

5.2 User perspective: The demand for safe assets is high

From a **user perspective**, one can assume that large firms, wealthy private investors, and financial market participants would in principle be very interested in such a new safe asset. In fact, as already mentioned a central bank account is only attractive for deposits exceeding 100,000 euro. The decisive factor for the demand for CBDC is the interest rate for store-of-value CBDCs. As the Bindseil proposal shows, it is always possible to remunerate such deposits with a prohibitive interest rate, so that the demand will be very low.

However, in a full-blown banking crisis, it is not clear whether this mechanism would really work. If investors fear a significant loss on their commercial bank deposits, they could be willing to accept very negative interest rates on the CBDC account. For instance, if an immediate loss of 10 percent is expected, investors would be willing to accept even a 100% p.a. negative interest rate on the CBDC, if it allows them to keep their money safe, say, for one month.

A different approach, which would allow central banks a perfect control over the amount of store-of-value CBDC, would be an **auctioning process** for the determination of the interest rate. Successful bidders would be entitled to hold a certain amount of CBDC for a certain period, e.g. one year, with the option to transfer them back and forth to their traditional bank within this period at their own discretion. The auctioning mechanism would prevent uncontrolled shifts from the bank deposits in CBDC with negative effects on financial stability. It would also fulfill the ECB's requirement to retain full control over the quantity of CBDCs in circulation (ECB 2020, p.18).

As store-of-value CBDCs would not be used for retail payments, problems of interoperability cannot arise.

5.3 Synthetic CBDCs: A hybrid of traditional reserves and CBDC

While store-of-value CBDC are not explicitly classified in the CBDC literature, they are the cornerstone for synthetic CBDC proposals (Adrian and Mancini-Griffoli 2019). In such schemes,

central banks offer payment service providers access to their reserve accounts as a backing for the deposits that are held with these institutions.

[Adrian \(2019\)](#) gives three justifications for such a solution:

- “Through **effective supervision** [emphasis added], central banks could check that eMoney issuance is fully backed; there goes risk number one.”
- “(...) eMoney holdings would become **extra safe and liquid** [emphasis added] for customers, especially if reserve accounts were protected from other creditors of eMoney providers in case of bankruptcy. That would take care of risk number two, minus the hassle of claiming one’s funds.”
- “(...) central banks would ensure **interoperability** [emphasis added] between eMoney issued by different providers by offering a common settlement platform between trust accounts; down with risk number three.”

[Adrian \(2019\)](#) argues that synthetic CBDC “outsources several steps to the private sector: technology choices, customer management, customer screening and monitoring including for “Know Your Customer” and AML/CFT (Anti-Money Laundering and Combating the Financing of Terrorism) purposes, regulatory compliance, and data management — all sources of substantial costs and risks.” Thus, the role of central banks is reduced to the settlement between trust accounts, and to the regulation and close supervision including e-money issuance.

The model of synthetic CBDC is already under operation in **China**. Since January 14, 2019, all of China’s third-party payments providers have been required to deposit their reserve funds with the PBOC, when previously they had been placed with commercial banks. This regulation especially aims at the two payment giants, Alipay and Tencent who account for 93% of the Chinese mobile payments market ([The Economist 2020](#)).

From the **allocative perspective** the concept of synthetic CBDC could be justified as a regulatory response to the **Libra project** of Facebook. The most serious shortcoming of the Libra design is the unclear legal status of Libra holders. While Libra promises a 1:1 backing for Libra deposits with highly liquid reserve assets, this is not a legally binding convertibility commitment comparable to the legal obligation of banks to convert sight deposits at any time into cash. The second Libra white paper published in April 2020 explicitly states that Libra holders cannot expect a 100% convertibility in “severe stress scenarios” ([Libra Association 2020](#), p.14). In such situations the following measures can be adopted:

- “Redemption stays, which would delay Libra Coin redemptions and allow for additional time to liquidate the Reserve’s assets during a window of time without incurring large fire-sale losses.” ([Libra Association 2020](#), p.14)
- “Early redemption haircuts, which would impose a fee for instant redemptions and require coin holders to internalize their negative externality (i.e. fire-sale losses) in a run.” ([Libra Association 2020](#), p.14)

In the case of a regular bank, the inability to pay out depositors would be a clear case of illiquidity which would trigger a resolution procedure.

Therefore, the regulatory approach to Libra could be a clear legal obligation that Libra holders are entitled to **full convertibility of their Libra deposits at any time**. In order to secure this obligation Libra should be obliged to keep its reserves in the form of deposits with central banks. In fact, Libra has explicitly mentioned this option in the second white paper:

“Moreover, our hope is that as central banks develop central bank digital (CBDCs), these CBDCs could be directly integrated with the Libra network, removing the need for Libra Networks to manage the associated Reserves, thus reducing credit and custody risk. As an example, if a central bank develops a digital representation of the US dollar, euro, or British pound, the Association could replace the applicable single-currency stablecoin with the CBDC.” [Libra Association \(2020, p.11\)](#)

But if synthetic CBDCs are used as a backing for deposits with payment service providers, they would become economically not very different from **traditional bank reserves** held with the central bank. Libra would become a **narrow bank**.

Thus, from an **allocative perspective**, synthetic CBDCs can be justified in the same way as central bank reserves. This traditional monetary policy instrument generates a stable demand for base money, which is an important precondition for the control of the central bank over the process of money creation by commercial banks. If payment service providers are obliged to hold a 100% reserve, they are not able to create money autonomously and would operate as **“narrow banks”**. Such a regulation could be justified for the sake of financial stability.

The [BIS \(2020, p.4\)](#) argues that *“(s)ynthetic CBDC” is not a CBDC*, which is in line with its definition of CBDCs as *“a direct liability of the central bank”* ([BIS 2020, p.3](#)). While the BIS does not exclude the possibility to allow for such arrangements, it sees the risk of a potential liquidity mismatch between payment service providers’ holdings of central bank reserves and their corresponding deposit liabilities. This could *“result in users selling them at a discount to the par value of the currency”* ([BIS 2020, p.4](#)). But such processes are only possible, if deposits are not fully backed with central bank deposits.

The ECB also defines CBDC only as direct claims on the central bank. It sees a role for *“supervised private intermediaries”* providing *“ancillary, user-facing services and to build new business models on its core back-end functionality.”* ([ECB 2020, p.4](#)). The option of a synthetic euro is not envisaged by the ECB.

From a **user perspective**, it is not clear whether payment service providers are interested in a 100% backing by CBDC. The example of PayPal and of credit card systems shows that successful payment service providers do not need an access to the central bank balance sheet for their business models.

6 Account-based CBDCs with a stand-alone payment system

So far, we have discussed CBDC options where central banks make it possible for private households and firms to open a central bank account that can be used in the same way as a commercial bank account. Thus, within the euro area, payments from the central bank account to a commercial bank account would be made via the TARGET system. This would also be the case for token CBDC in the form of e-money.

The ambition of several central banks goes beyond this basic solution. For transactions with CBDC objects they envisage a stand-alone retail payment system. In contrast to existing payment systems (credit cards and PayPal), such a system could not operate transactions with other payment objects, above all deposits on commercial bank accounts.

In this regard, such CBDC models are similar to the Libra project which is designed as a payment system for transactions based on deposits held with Libra but not with deposits held with commercial banks.

6.1 The ambiguous design of the digital euro

In the report on the digital euro it is not clear whether the ECB envisages the creation of a new **payment object** only or whether it also plans to establish a **new payment system**.

The [ECB \(2020, p.6\)](#) defines the digital euro as a **payment object**:

“In this report, the term digital euro denotes a liability of the Eurosystem recorded in digital form as a complement to cash and central bank deposits.”

From this definition one could conclude that the ECB does not consider creating a new payment system. This view is supported by the following statement:

“The issuance of a digital euro would not inevitably lead to the introduction of yet another end-user solution in the already heterogeneous European landscape of retail payments. On the contrary, in line with the retail payments strategy of the Eurosystem, the digital euro could make use of – and thereby strengthen – existing pan-European payment solutions for consumers and merchants across Europe.”(ECB 2020, p.20)

The ECB also mentions the problems that would be associated with a specific payment system for the digital euro:

“A parallel infrastructure would also run counter to the aim of issuing a digital euro in order to improve the cost and environmental footprint of payments.”(ECB 2020, p.34)

But in other parts of the report the ECB explicitly speaks of a **separate payment infrastructure** for the digital euro that “*would de facto be parallel to that of other electronic payment solutions.*” (ECB 2020, p.34)

“In order to improve the overall resilience of the payment system, the digital euro should be widely available and transacted via resilient channels that are separate from those of other payment services and can withstand extreme events.”(ECB 2020, p.14)

And without creating a new payment system the ECB could hardly argue:

“It [the digital euro] should offer the basis for providing functionalities that are at least as attractive as those of the payment solutions available in foreign currencies or through unregulated entities.”(ECB 2020, p.12)

For our evaluation we deal with this ambiguity as follows. If the digital euro is regarded as a **CBDC object without a new payment system**, we have discussed this option already under the Bindseil model. In fact, Ulrich Bindseil is the ECB’s Director General Market Infrastructure and Payments.

If the digital euro represents a model that consists of a **new payment object plus a new payment system**, an evaluation is difficult as the ECB report is not very specific on the details of such a system. While the ECB mentions the option to introduce its CBDC via intermediaries, it does not discuss in detail whether these intermediaries would use existing payment systems or develop a new payment system based on the ECB CBDC.

As we could only speculate about the design of the payment system for the digital euro, we focus in this paper on the e-krona model of the Swedish central bank. For this model, which aims at a solution where the e-krona is embedded in a new payment system, already quite concrete plans are available.

6.2 CBDC model with a stand-alone payment system (e-krona proposal of the Sveriges Riksbank)

For an evaluation of the e-krona proposal the main arguments against the Bindseil proposal also apply. Compared to cash the lack of anonymity is a serious disadvantage. The safety of a central bank deposit is irrelevant for small sums. However, it is unclear whether the Riksbank considers a ceiling for e-krona deposits or a two-tier interest rate scheme, to deter major investors.

As a **competitor with private payment systems** (e.g. PayPal), the e-krona has the serious disadvantage that the system would not be fully connected with the existing payments ecosystem. For the Swedish central bank, the provision of **an independent payment system** plays an important role:

“In the medium term, Sweden would no longer have a domestic infrastructure for retail payments, given the dominance of global card schemes, pan-European clearing and the

ECB's trend towards multi-currency settlement systems.”(Gnan and Masciandro 2018, p.19)

Therefore, the e-kronor system is designed as **stand-alone-system**:

- *“All transactions in the e-krona network occur separately from existing payment networks, which, as stand-alone systems provide added robustness in the event of problems with the existing payment infrastructure. Payments occurring in the e-krona network will take place without the involvement of RIX, but the supply or redemption of e-kronor will be done via RIX.” (Sveriges Riksbank 2020)*
- *“To be able to use e-kronor for payments, the digital wallet must first be activated at a participant connected to the e-krona network. After activation, the user can, for example, receive e-kronor as payment from another user, pay a retailer with e-kronor, make transfers from their bank account to the digital wallet (and vice versa), and check their e-krona balance.” (Sveriges Riksbank 2020)*

This solution would have the disadvantage that e-krona account holders could use them only for payments to other CBDC account holders. [Armelijs et al. \(2020, p.85\)](#) describe this as follows:

“However, when a holder of e-kronor wants to pay to a recipient who does not have e-krona accounts or who does not wish to increase their e-krona holdings, there is a need to exchange e-kronor for commercial bank money, i.e. to go outside the e-krona accounts. This requires settlement in RIX.”

This would be different with a CBDC option without a stand-alone system which we discussed in Chapter 4. In this model, a CBDC account would not be fundamentally different from other bank accounts so that it could be used for payments to all other banks via the RTGS system.

The [Bank of England \(2020, p.23\)](#) makes this point very clear:

“CBDC should be designed to avoid creating closed-loop payment systems, in which payments can only be made between users of the same payments provider. Instead, CBDC payments should be interoperable, allowing payments between users of different providers, and between users of CBDC and users of deposit accounts.”

The lack of interoperability is even more problematic for payments abroad (tourism or purchases on the internet). The **domestic focus** is a more general problem of most CBDC projects. As [Auer, Cornelli and Frost \(2020\)](#) show, almost all of them are either focused nationally or in the case of euro area member states focused on their own currency area.¹⁴ For a small country like Sweden, the national range of the network is especially disadvantageous.

¹⁴ *“Finally, while most of the projects in our sample are focused on domestic use, several of them – by the ECB, the central banks of France, Spain and the Netherlands, and the ECCB – are by construction focused on crossborder use among the members of a multi-country currency area.” (Auer, Cornelli and Frost 2020, p.20)*

From an **allocative perspective** the case for a CBDC with a stand-alone system is not clear. While a token CBDC with offline functionality could be justified as a safety net for emergency solutions, this is not obvious for an account CBDC that requires a functioning internet connection. The “*added robustness*” (Sveriges Riksbank 2020) is also questionable as the e-krona system relies on the connection with the RIX system. A “*domestic infrastructure for retail payments*” (Gnan and Masciandro 2018, p.19) is a political argument for CBDC, but for a small country like Sweden, it is unrealistic that such infrastructure would be competitive with large global payment system providers.

From a **user perspective** the establishment of a stand-alone system makes a central bank account even less attractive for private households or firms. By transferring funds from a commercial bank account to the central bank account, their liquidity declines drastically as they can only be used for payments to other CBDC holders. Especially in the introductory phase with a small number of account holders, this problem would be huge and probably unsurmountable.

With the stand-alone solution, the e-krona payment system is not competitive with the existing payment system providers (e.g. VISA, Mastercard or PayPal). The key advantage of **credit card systems** is their ability to connect payers and payees with different deposit accounts from different countries and with different currencies. In other words, the usage of the system does not require holding **system specific accounts** and it is not limited to a **specific currency**.

This also applies to **PayPal**, which requires that payer and payee must be registered with PayPal. But in contrast to the e-krona, the payer does neither need a PayPal account nor a positive PayPal balance, as she can use a credit card as underlying payment instrument or directly a bank account as payments object for the payment.

While it is unclear how a **digital euro** would be designed, the problems of a stand-alone system are obvious. Adrian (2019) puts the problem caused by a lack of interoperability as follows:

“If eMoney issued by different providers is not interoperable, only the largest providers will survive. The fat cats will eat the nimble and potentially more innovative mice. Even regulation mandating common technological standards will not resolve the issue.”

6.3 The model of an inconvertible CBDC payment system (The Kumhof and Noone model)

While the e-krona model already suffers from an insufficient interoperability, the proposal by (Kumhof and Noone 2018) deliberately tries to establish an isolated CBDC payment system. Their concept is characterized by the following features:

- CBDC pays an adjustable interest rate.
- CBDC and reserves are distinct and **not convertible into each other**.

- No guaranteed, on-demand convertibility of bank deposits into CBDC at commercial banks (and therefore by implication at the central bank).
- The central bank issues CBDC only against eligible securities (principally government securities).

With this institutional framework, Kumhof and Noone try to design a CBDC system that avoids the **risk of a digital bank run**. The scheme would prevent bank depositors from exchanging their credit balances for CBDCs at any time in the same way that they are able to exchange bank deposits for cash.

However, the price for this protective measure is high. It implies that the CBDC payment system is not integrated with the settlement system for reserves. In the words of [Kumhof and Noone \(2018, p.21\)](#):

“We take as given that a market for reserves with an RTGS system is present and that it operates separately from the CBDC system.”

The lack of interoperability is a fundamental difference between the Kumhof and Noone proposal and the e-Krona project, where integration with the RIX settlement system is envisaged.

Therefore, direct payments between traditional bank accounts and CBDC accounts would not be possible. This is a **strange design for a payment system** as the existing payment ecosystem is characterized by a high degree of interoperability of its subsystems. [Ugolini \(2017, p.24\)](#) puts this as follows:

“In practical terms, this means that payment systems (unlike shopping arcades) can hardly work in isolation. New payment systems can emerge and enter the industry only as long as their connection to the ‘global’ payment system (the one that allows the final, legally recognized settlement) is provided.”

From a **user perspective**, it is unlikely that such a CBDC payment system would be able to compete successfully with the existing national or international payment systems. It is not clear why the authors believe their system would provide *“much greater functionality for retail transactions”* ([Kumhof and Noone 2018, p.4](#)). In sum, the attempt to create CBDC without risks for macroeconomic stability has led to a solution that would be completely unattractive for private households or firms.¹⁵

As the authors focus on the macroeconomic dimension of CBDC, they do not explicitly discuss issues that would be relevant from an **allocative perspective**.

¹⁵Therefore, the ECB report mentions as a “core guiding principle” for the digital euro: *“(...) a digital euro would be just another way to supply euro, not a parallel currency. It should therefore be convertible at par with other forms of the euro, such as banknotes, central bank reserves and commercial bank deposits.”* ([ECB 2020, p.7](#))

6.4 The Libra model

In the context of CBDC payment systems, Facebook’s Libra plan is an interesting project as it also envisages a stand-alone payment system that can only be used for Libra deposits.

The **lack of interoperability** has so far not received very much attention in the discussion on Libra. But as our analysis of the e-krona has shown, this could prove to be a major disadvantage compared to other payment systems. It implies that a transaction with the Libra system requires a Libra deposit and it can only be made to the holder of a Libra account. In addition, if a private household cannot execute all transactions via Libra it must still hold deposits on a traditional bank account. This is different with credit card systems without system specific payment objects and with PayPal where the payer does not need a positive balance on her PayPal account for using the system.

7 Evaluation of options for a retail payment system for multiple currencies

In the debate on CBDC the need to develop **an alternative to Libra** and other global payment platforms is often mentioned.¹⁶ E.g. [Weidmann \(2020\)](#) argued that retail CBDC *“is often seen as an alternative to commercial payment initiatives. There are concerns that international bigtech companies could come to dominate the European markets for payment services, thereby gaining stronger footholds in markets outside their own core domains.”*

The differentiation between payment objects and payment systems in this paper opens the view for the option of introducing a **retail payment system organized or orchestrated by central banks** without a need to introduce retail CBDC as a payment object. So far, this option has received little attention in the debate about CBDC.

7.1 Features of successful retail payment systems

Effective payment systems can function **without specific payment objects** that are held within the system. This is especially the case for credit card systems like VISA or Mastercard. While it is possible to hold deposits on a credit card account, users typically do not use this option. Instead, for all transactions a commercial bank account is used. The same applies to PayPal. In this system users can also hold deposits, but even without a positive balance, transactions can be carried out using an underlying bank account or credit card account.

¹⁶In the digital euro report, the [ECB \(2020, p.11\)](#) justifies its CBDC initiative as follows: *“(...) private actors – possibly outside the supervision of European financial authorities – including large technology firms, are developing payment solutions not denominated in euro (such as global “stablecoins”) that could achieve a global footprint and become widely used for European retail payments. Such developments would foster innovation but could also threaten European financial, economic and, ultimately, political sovereignty. It is worth noting that recently some global “stablecoin” initiatives have suggested that CBDCs could also be made available via their (private) infrastructure.”*

The ability to perform transactions without the need to hold system specific balances is a general advantage of payment systems. Users can **avoid the parallel holding** of sight deposits that can be costly if it leads to an overdraft of the commercial bank account. As already mentioned, the Libra initiative is special in this regard as this system is designed on a stand-alone-basis so that only Libra deposits can be exchanged. However, this disadvantage can be at least partially compensated by the fact that 2.6 billion people are actively using Facebook on a monthly basis.

Thus, if central banks plan to develop an alternative to existing and projected global payment systems, a CBDC model based on a stand-alone system and a national currency (or the euro) only, is not the adequate solution. Instead a competitive payment system must be open for

- international transactions so that it can perform transactions where the **country** of the payer and the payee differ
- different currencies so that it can perform transactions where the **currency** of the payer's and the payee's account differ
- different payment objects, so that it can perform transactions where the **payments objects** (i.e. deposits on specific bank accounts) of the payer and the payee differ.

7.2 Allocative perspective: Network effects justify central bank intervention

As already mentioned, from an **allocative point of view** a market failure can be identified when it comes to payment service providers. The externalities that are associated with network effects could justify a larger role of central banks as a provider of a retail payment system.

Weidmann (2020) has argued that central banks could also act as a catalyst in this field so that innovative payment solutions can be developed by the private sector. A model for this is the “European Payments Initiative” launched by a group of 16 major euro area banks with the aim of a unified card and digital wallet that can be used across Europe (European Payments Council 2020).

7.3 User perspective: PayPal as best practice

From a **user perspective**, the standard for an attractive payment international system is currently set by PayPal, which in the 2nd quarter of 2020 had almost 350 million active users. It is surprising that central banks repeatedly refer to the Libra initiative when justifying their CBDC activities, but almost never to PayPal.

A closer look at PayPal's business model provides useful insights about the features of a successful international payment system. This is especially relevant for the ECB which wants to “*ensure that European citizens have access to payments at the technological frontier*” (ECB 2020, p.12) and which accordingly defines its requirement R3 as follows:

“It [the digital euro] should offer the basis for providing functionalities that are at least as attractive as those of the payment solutions available in foreign currencies or through unregulated entities.” (ECB 2020, p.12)

An obvious advantage of PayPal is its distinctive **interoperability**.¹⁷ It allows the usage of the system without having a credit balance at PayPal. PayPal transactions can be made by using a traditional bank account or a credit card account. In contrast to the e-krona proposal, there is no need for double coincidence of accounts. A customer can pay to the merchant’s PayPal account even without being registered with PayPal. The interoperability also applies to international payments. According to its own information, PayPal is available in more than 200 countries/regions and it supports 25 currencies.

Recently, [PayPal \(2020\)](#) has announced the “*launch of a new service enabling its customers to buy, hold and sell cryptocurrency directly from their PayPal account, and signaled its plans to significantly increase cryptocurrency’s utility by making it available as a funding source for purchases at its 26 million merchants worldwide.*” This adds another payment object and another currency that can be held and used within the PayPal payment system.

A special feature of PayPal is its **simplicity and versatility**:

- Accounts can be opened **without identity check**. PayPal only requires an e-mail address and a mobile telephone number.
- Instead of an IBAN, account number users are **identified by their e-mail addresses**. For most people abstract numbers are harder to remember than names.
- In contrast to credit cards, PayPal can be used for private, i.e. **non-commercial transactions** (like a bank account).
- For transactions, a **TAN is not required**, so that transfers, e.g. within a circle of friends, can be easily made.
- Credits are **booked immediately**, which accelerates the processing of online transactions.
- There are **no fees for non-commercial use**, which provides a contribution to **financial inclusion**.
- PayPal is accessible for users with a **bad credit history**, which would not be able to obtain a credit card.

Especially in **online-trade**, PayPal offers a wide range of **additional services**.

- **Buyers** receive insurance coverage for faulty deliveries if the payment is made via the PayPal account. In addition, PayPal undertakes 12 times a year the costs for the return of goods ordered online.

¹⁷E.g. with PayPal PLUS, merchants’ customers can pay with the four most popular payment methods PayPal, direct debit, credit card and purchase on account - even customers without a PayPal account.

- **Merchants** receive insurance protection if goods are lost during shipping. In addition, they can easily obtain credits, which they can repay with their PayPal cashflows. The granting of credit depends on the account history with PayPal. So, there are no inquiries with credit bureaus that could have a negative impact on the credit score of the merchant. In addition, PayPal evaluates customer transaction data and uses it to create marketing analyses that are made available to merchants.

In sum, if central banks want to provide a competitive alternative to global payment system providers the benchmark should not be Libra but PayPal. In addition to the advantages of simplicity and comprehensive services especially for online-trade, PayPal shows that a successful payment system should be open for payment objects that are not system-specific and for payers that do not even have a system-specific account.

This implies that CBDC initiatives so far go into the wrong direction. Schemes that focus on new payment objects and on payment systems that can only operate with system-specific objects in the domestic terrain (e-krona) are misguided. It is unlikely that such efforts will lead to solutions that are able to withstand the competition with global payment system providers.

8 Conclusion

So far, the debate on CBDC has been dominated by a technical and a macroeconomic perspective. But the more fundamental questions are microeconomic issues. What are the market failures that justify central bank activities that compete directly with the business of commercial banks and other payment service providers? Are the solutions discussed and planned by central banks attractive enough to assert themselves in the competition with sophisticated private payment solutions? Without a positive answer to these questions, the debate on macroeconomic implications of CBDC is of little practical relevance.

This paper discusses CBDC under the perspective of allocative efficiency and attractiveness for users. This allows an evaluation of different design options for CBDC. We derive these options with a taxonomy that is based on a systemic perspective. It explicitly differentiates between payment objects and payment systems. Thus, CBDC can be designed as a new payment object, which is used in existing payment systems. It can also be designed as a new payment system within which CBDC objects can be transferred. The systemic perspective also opens the view for a retail payment system operated or orchestrated by central banks which not necessarily requires a system specific payment object.

A narrow CBDC approach is the provision of CBDC objects that are used within the existing payment systems, above all the RTGS systems operated by central banks. Such CBDC can be designed in a way that they are mainly suitable as a payment object. From the allocative perspective there is no obvious market failure that could justify the provision of an ordinary bank deposit by a central bank. From a user perspective, there are no obvious advantages of having a direct

account with the central bank, as bank deposits below 100.000 euro are protected by the deposit insurance schemes. The case for a token CBDC that could serve as a digital substitute for cash is also not obvious. While the allocative perspective would justify that central banks provide a digital substitute for cash for which they have a monopoly, the need to comply with AML regulations sets very rigid quantitative limitations for such products. Accordingly, from a user perspective the demand for token CBDC will be very low as they would not provide a substitute for cash, which is especially attractive for payments in the shadow economy and as a store value in periods of financial instability.

An option that has received little attention so far is a CBDC that is designed solely as a store of value. Such a CBDC could only be used for payments to and from the commercial bank account of its holder. From the allocative perspective the supply of such a CBDC could be justified by the need of (nominally) safe assets that can only be provided by central banks. The demand for store-of-value CBDC would come from firms and large investors with bank deposits of more than 100.000 euros which would be bailed-in in the case of a bank restructuring. From the user perspective this demand would depend on the interest rate for such deposits. Central banks could auction store-of-value deposits which would give them a perfect control over their amount.

Store-of-value CBDC could also be designed as collateral for large payment service providers. In China, Alipay is required to hold deposits with the central bank. For Libra, a similar requirement could be imposed. This would make Libra deposits 100% safe and it would prevent that the Libra system gets disconnected from central banks and their control over the monetary system. From an allocative perspective, such central bank intervention can be justified as it would de facto include payment service providers under the umbrella of the central bank's reserve requirements and hence improve financial stability.

More ambitious CBDC models, like the Swedish e-krona, envisage a stand-alone system within which CBDC objects can be transferred. For the attractiveness of a CBDC bank deposit this is not necessarily an advantage. Without a specific payment system, CBDC deposits could be used like a commercial bank deposit. With a stand-alone payment system, CBDC deposits can only be used for payments to other CBDC accounts. Especially in a small country like Sweden, the domestic focus is a serious drawback of a CBDC payment system.

Therefore, if central banks want to develop a serious answer to the dynamic activities of global payment service providers, they must rethink their whole approach to CBDC. Instead of national schemes that can only operate with the national currency and can only make transactions with system specific accounts, the solution must be supranational with a multicurrency operability and an openness to payment objects that are not system specific. While a "digital euro" has the advantage that it is by design supranational, it is questionable whether this is sufficient to compete with internationally operating systems. But even if central banks realize their task is not to develop a digital substitute for cash but a digital alternative for global payment systems, it will be difficult for them to achieve the high level of sophistication that these global players can offer to their users.

But in contrast to narrow CBDC models, from an allocative point of view there would be an obvious justification for retail payment networks operated by central banks.

Bibliography

- Adrian, Tobias.** 2019. “Stablecoins, Central Bank Digital Currencies, and Cross-Border Payments: A New Look at the International Monetary System.” *Remarks by Tobias Adrian at the IMF-Swiss National Bank Conference, Zurich*, May 14. <https://www.imf.org/en/News/Articles/2019/05/13/sp051419-stablecoins-central-bank-digital-currencies-and-cross-border-payments>.
- Adrian, Tobias, and Tommaso Mancini-Griffoli.** 2019. “The Rise of Digital Money.” *IMF Fintech Notes*, July, 19/01.
- Armelius, Hanna, Carl Andreas Claussen, and André Reslow.** 2020. “Withering cash: Sweden seems special rather than ahead of the curve.” *VoxEU.org*, September 12. <https://voxeu.org/article/withering-cash-sweden-seems-special-rather-ahead-curve>.
- Armelius, Hanna, Gabriela Guibourg, Stig Johansson, and Johan Schmalholz.** 2020. “E-krona design models: pros, cons and trade-offs.” In *Sveriges Riksbank Economic Review - Second special issue on the e-krona*. Vol. 2020:2. Sveriges Riksbank.
- Auer, Raphael, and Rainer Böhme.** 2020. “The technology of retail central bank digital currency.” *BIS Quarterly Review*, March, 85–100.
- Auer, Raphael, Giulio Cornelli, and Jon Frost.** 2020. “Rise of the central bank digital currencies: drivers, approaches and technologies.” *BIS Working Papers*, August, No. 880.
- Bank of England.** 2020. “Central Bank Digital Currency - Opportunities, challenges and design.” *Discussion Paper*, March.
- Bech, Morten, Umar Faruqui, Frederik Ougaard, and Cristina Picillo.** 2018. “Payments are a-changin’ but cash still rules.” *BIS Quarterly Review*, March, 67–80.
- Bindseil, Ulrich.** 2020. “Tiered CBDC and the financial system.” *ECB Working Paper Series*, January, No. 2351.
- BIS.** 2016. “Fast payments – Enhancing the speed and availability of retail payments.” *Report by Committee on Payments and Market Infrastructure*, November.
- BIS.** 2017. “Distributed ledger technology in payment, clearing and settlement – An analytical framework.” *Report by Committee on Payments and Market Infrastructure*, February.
- BIS.** 2018. “Cross-border retail payments.” *Report by Committee on Payments and Market Infrastructure*, February.
- BIS.** 2020. “Central bank digital currencies: foundational principles and core features.” *Joint report by The Bank of Canada, European Central Bank, Bank of Japan, Sveriges Riksbank, Swiss National Bank, Bank of England, Board of Governors of the Federal Reserve and Bank for International Settlements*, October 9. <https://www.bis.org/publ/othp33.pdf>.

- Boar, Codruta, Henry Holden, and Amber Wadsworth.** 2020. “Impending arrival – a sequel to the survey on central bank digital currency.” *BIS Papers*, January, No. 107.
- Bofinger, Peter.** 2019. “Central-bank digital currencies: proceed with caution.” *SocialEurope*, October 29. <https://www.socialeurope.eu/central-bank-digital-currencies-proceed-with-caution>.
- Brunnermeier, Markus K., Harold James, and Jean-Pierre Landau.** 2019. “The Digitalization of Money.” *NBER Working Paper Series*, September, No. 26300.
- Carletti, Elena, Stijn Claessens, Antonio Fatás, and Xavier Vives.** 2020. “The Bank Business Model in the Post-Covid-19 World.” *The Future of Banking 2, CEPR Press*, June. <https://voxeu.org/content/bank-business-model-post-covid-19-world>.
- ECB.** 2019a. “Innovation and its impact on the European retail payment landscape.” *Note by the ECB for the Economic and Financial Affairs Council (Ecofin) on the retail payment landscape*, December 19. <https://www.ecb.europa.eu/pub/pdf/other/ecb.other191204-f6a84c14a7.en.pdf>.
- ECB.** 2019b. “Opinion of the European Central Bank of 26 November 2019 on the requirement for certain credit institutions and branches to provide cash services.” *Opinion by the ECB (CON/2019/41)*, November 26. <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52019AB0041&from=EN>.
- ECB.** 2020. “Report on a digital euro.” October 2. https://www.ecb.europa.eu/pub/pdf/other/Report_on_a_digital_euro~4d7268b458.en.pdf.
- ECB.** n.d.. “Payment instruments.” <https://www.ecb.europa.eu/paym/pol/activ/instr/html/index.en.html>.
- European Parliament and Council.** 2018. “DIRECTIVE (EU) 2018/843 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL.” *Directive (EU) 2015/849 on the prevention of the use of the financial system for the purposes of money laundering or terrorist financing, and amending Directives 2009/138/EC and 2013/36/EU*, May 30. <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L0843&from=EN>.
- European Payments Council.** 2020. “EPI: towards a new European payment solution?” September 9. <https://www.europeanpaymentscouncil.eu/news-insights/insight/epi-towards-new-european-payment-solution>.
- Fernández de Lis, Santiago.** 2018. “Central bank digital currencies: features, options, pros and cons.” In *Do we need central bank digital currency? Economics, technology and institutions.*, ed. Ernest Gnan and Donato Masciandro, pp. 46–55. SUERF Conference Proceedings 2018/2 by SUERF/BAFFI CAREFIN Centre Conference.
- FinTech Council.** 2020. “Der digitale, programmierbare Euro.” *FinTechRat beim Bundesministerium der Finanzen, Stellungnahme 01/2020*. https://www.bundesfinanzministerium.de/Content/DE/Downloads/Finanzmarktpolitik/2020-07-08-fintechrat-digitaler-euro.pdf?__blob=publicationFile&v=3.

- Füssel, Anca, and Tom Kokkola.** 2010. “Key Concepts - Payments.” In *The Payment System - Payments, Securities and Derivatives, and the role of the Eurosystem.* , ed. Tom Kokkola, pp. 25–64. European Central Bank.
- Gnan, Ernest, and Donato Masciandro.** 2018. “Do we need central bank digital currencies? Economics, Technology and Institutions - Findings from a conference organized by SUERF - The European Money and Finance Forum and BAFFI CAREFIN Centre, Bocconi University - Milan, 7 June 2018.” In *Do we need central bank digital currency? Economics, technology and institutions.* , ed. Ernest Gnan and Donato Masciandro, pp. 8–22. SUERF Conference Proceedings 2018/2 by SUERF/BAFFI CAREFIN Centre Conference.
- Habib, Maurizio Michael, Livio Stracca, and Fabrizio Venditti.** 2020. “The fundamentals of safe assets.” *ECB Working Paper Series*, January, No. 2355.
- Hayek, Friedrich August von.** 1976. *Denationalisation of Money: An Analysis of the Theory and Practice of Current Currencies.* Institute of economic affairs.
- Hicks, John R.** 1935. “Annual survey of economic theory: the theory of monopoly.” *Econometrica*, 3(1): 1–20.
- Kumhof, Michael, and Clare Noone.** 2018. “Central bank digital currencies — design principles and balance sheet implications.” *Bank of England Staff Working Paper*, May, No. 725.
- Lane, Timothy.** 2020. “Money and Payments in the Digital Age.” *Remarks by Timothy Lane, Deputy Governor, at CFA Montréal FinTech RDV2020, Montréal, QC*, February 25. <https://www.bankofcanada.ca/2020/02/money-payments-digital-age/>.
- Libra Association.** 2020. “Cover Letter - White Paper V2.0.” April. https://libra.org/en-US/wp-content/uploads/sites/23/2020/04/Libra_WhitePaperV2_April2020.pdf.
- Panetta, Fabio.** 2018. “21st century cash: Central banking, technological innovation and digital currencies.” In *Do we need central bank digital currency? Economics, technology and institutions.* , ed. Ernest Gnan and Donato Masciandro, pp. 23–32. SUERF Conference Proceedings 2018/2 by SUERF/BAFFI CAREFIN Centre Conference.
- PayPal.** 2020. “PayPal Launches New Service Enabling Users to Buy, Hold and Sell Cryptocurrency.” October 21. <https://newsroom.paypal-corp.com/2020-10-21-PayPal-Launches-New-Service-Enabling-Users-to-Buy-Hold-and-Sell-Cryptocurrency>.
- PayTechLaw.** 2018. “AML5 update: 5th Anti Money Laundering Directive adopted.” by *Dr. Matthäus Schindele*, July 3. <https://paytechlaw.com/en/aml5-update/>.
- Sveriges Riksbank.** 2018. “The Riksbank’s e-krona project - Report 2.” October.
- Sveriges Riksbank.** 2020. “Technical solution for the e-krona pilot.” February 20. <https://www.riksbank.se/en-gb/payments-cash/e-krona/technical-solution-for-the-e-krona-pilot/>.

- The Economist.** 2020. “Do Alipay and Tenpay misuse their market power.” August 6. <https://www.economist.com/finance-and-economics/2020/08/06/do-alipay-and-tenpay-misuse-their-market-power>.
- Ugolini, Stefano.** 2017. *The Evolution of Central Banking: Theory and History*. London:Palgrave Studies in Economic History, Palgrave-Macmillan.
- Weidmann, Jens.** 2020. “On the future of money and payments.” *Panel statement at the Bundesbank virtual autumn conference 'Banking and Payments in the Digital World', Frankfurt am Main*, September 11. <https://www.bundesbank.de/en/press/speeches/on-the-future-of-money-and-payments-843720>.
- Yifei, Fan.** 2020. “Some thoughts on CBDC operations in China.” *centralbanking.com*, April 1. <https://www.centralbanking.com/fintech/cbdc/7511376/some-thoughts-on-cbdc-operations-in-china>.

A Evaluation of CBDC proposals

Table 4: **Evaluation of CBDC proposals** (We assume here that the digital euro would be established with a stand-alone payment system)

	Payment CBDC						Store of value CBDC (No separate payment system)		Payment system without objects
	Without separate payment system		With separate payment system				Retail	Wholesale	
	Token CBDC	Account CBDC (Bindseil)	Digital euro token (Offline)	Digital euro Account based	e-Krona	Kumhof/Noone		Synthetic CBDC	
Can a market failure be identified?	<ul style="list-style-type: none"> Declining use of cash in payments is no justification for CBDC. In most countries, the demand for cash is rather stable Access to central bank balance sheet does not require CBDC, but nationwide infrastructure for cash dispensers No evidence for deficiencies in national and international retail payment systems that would require CBDC In situations with extreme events, a digital euro is not a better solution than cash 						Lack of safe assets which cannot be provided by private banks	See retail store of value CBDC plus: Central bank control over payment service providers	Natural monopolies of US and Chinese internet platforms. Lack of a European platform
Use case in relation to cash and bank accounts	Relative to cash: Means of payment: Cash provides absolute anonymity. Store of value Cash can be held without limits. Extreme cases: Cash functions without electricity and internet access	Relative to cash: see token CBDC Relative to bank deposits: Deposits below 100.000€ are insured. Banks offer more services (e.g. overdraft) Prohibitive CBDC interest rate above 3.000€	See Token CBDC	See Bindseil	See Bindseil Unclear whether restrictions (ceiling or tiered interest rates) will be applied	See e-Krona	Relative to cash and bank accounts; Provision of a liquid and safe asset for deposits > 100,000€	Collateral for stable coins and payment system providers De facto identical with central bank reserves	Usage of existing payment objects. CBDC objects are not required
Use case in relation to other payment systems	No advantage compared to pre-paid debit cards.	No advantage compared to traditional bank account	Need for offline use is not obvious. Unclear whether merchants must open e-euro accounts	Details of digital euro system are unclear. Unclear whether merchants must open e-euro accounts	National use only Specific account for using the network is required	Very low due to inconvertibility and a lack of interoperability	Usage within existing payment systems		Lower costs of public retail system compared to a private platform