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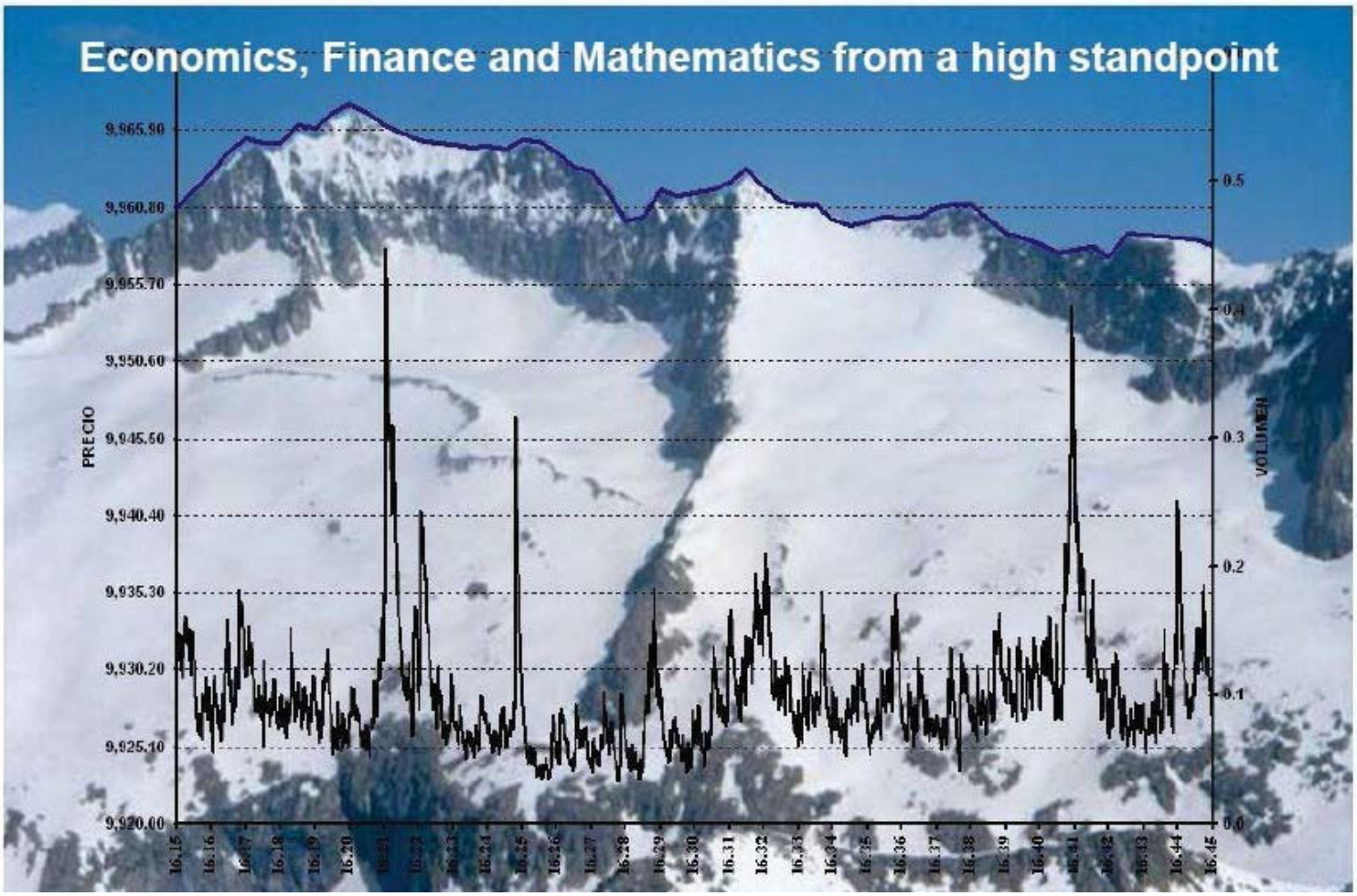

Private and Central Bank Digital Currencies: a storm in a teacup? A Post-Keynesian appraisal

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Private and Central Bank Digital Currencies: a storm in a teacup?

A Post-Keynesian appraisal

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Abstract

The emergence of private digital currencies (DCs) poses a threat to payment systems and monetary policy because they challenge all functions of money as we know them. In this paper we focus mainly on the banking and monetary policy issues raised by stablecoins and CBDC in the light of endogenous money theory. We begin by describing the current working of bank-centered payment systems. We next touch upon cryptoassets and focus on the domestic and international impact of stablecoins. We then deal with CBDC by discussing the pros and cons, their possible impact on monetary and banking policy and some international issues. We also discuss the CBDC presumed similarities with the "Chicago Plan" (or "narrow banking"). In terms of monetary policy, the impact of CBDC depends on the degree of disintermediation they would bring about in the banking system. At one extreme, if CBDC represent an e–surrogate for banknotes, they do not entail any disturbance to existing banking and monetary policy. The other extreme of a full conversion of deposits into CBDC would radically change the working of the central bank interest rate policy. A limited migration of bank deposits into CBDC will not affect monetary policy, either based on the standard corridor or on the floor system. In all cases, the endogenous money creation by banks would not be affected in principle as long as the central bank automatically provides reserves when deposits are converted into CBDC. This may however require stricter controls by the central bank when it comes to bank lending.

Keywords: Stablecoins, CBDC, Endogenous money, narrow banking, payment system, banking intermediation, financial instability

JEL Classifications: E40, E50, G10, G30, O30

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Introduction[1]

The emergence of private digital currencies (DCs) poses a threat to our monetary and payment systems because they challenge all functions of money as we know them: they are a new unit of account; they can be used to settle debts through new channels based on crypto technologies without using central bank reserves; and even their function as a store of value is affected since they are not backed by a central bank.

Three types of digital currencies can be roughly identified: (i) unbacked cryptoassets, which are speculative digital currencies that can be a source of financial instability; (ii) asset-backed *stablecoins*, which can pose a challenge to traditional payment systems, monetary policy and financial stability; and (iii), *central bank digital currencies*, or CBDC, a public response to private digital currencies that may also create problems in the traditional banking system. On top of this, the international spread of public and private digital currencies may interfere with the monetary independence of weaker countries and pose geopolitical strain even among developed regions.

In this paper we focus mainly (albeit not exclusively) on the banking and monetary policy issues raised by stablecoins and CBDC in the light of endogenous money theory. Given our expertise, we will not go into the (quite relevant) technical aspects of digital currencies, in particular with regard to the management of their circulation (on circulation architectures for CBDC, see e.g. Auer, Cornelli and Frost 2021; BIS 2021a).

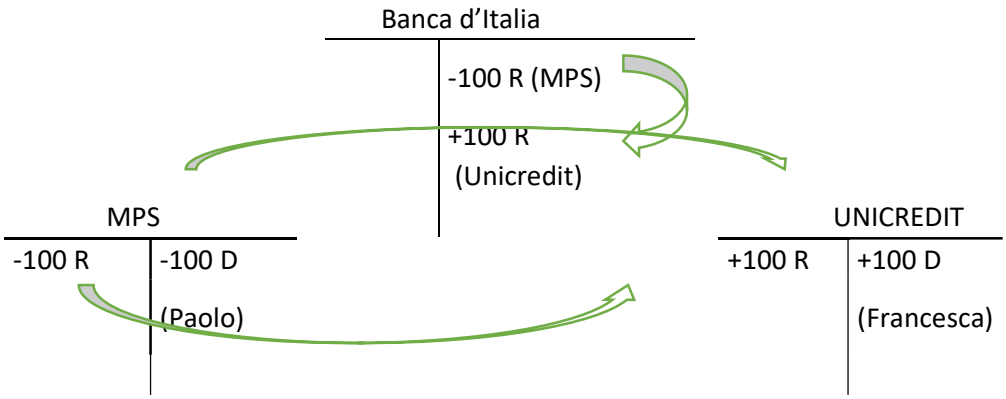
"There is great chaos under heaven," said President Mao Zedong. Digital currencies have given rise to two opposing sides with their corresponding reactions: the alarmed, who see impending dangers of domestic or foreign origin that must be addressed through the establishment of central bank digital currencies (CBDC): *si vis pacem, para bellum*; and the relaxed, who believe that issues can be resolved through public regulation and do not necessarily require central bank involvement.

Section 1 will illustrate the current working of bank-centered payment systems. Section 2 touches upon cryptoassets and focuses mainly on the domestic and international issues surrounding stablecoins. Section 3 deals with CBDC discussing its pros and cons, looking at the possible impact on monetary and banking policy, introducing its presumed similarities with the "Chicago Plan" (or "narrow banking"), and examining several international issues. Appendix 1 sums up, for the reader's convenience, the functioning of monetary policy in normal times (and without CBDC), while appendix 2 extends the comparison between full disintermediate CBDC and the Chicago Plan.

1. Banking payment systems and e-money

Traditionally most payments are made using bank transfers. These are brokered by the banking system, which in turn carries out its transactions through the mediation of the central bank. In short, a pyramid system. In Figure 1 Paolo, who has his current account at Bank A, transfers 100€ to Francesca's account at Bank B. The transaction is settled by a transfer of reserves from the reserve accounts held at the central bank by Paolo's bank and Francesca's bank, respectively.

Figure 1: Bank-centered payment system



Note: R: Reserve; D: Deposits.

Unless one goes to the local bank branch in person to order a money transfer, nowadays the whole operation is normally carried out online. Notably, the banking payment system that now runs on digital platforms — reserves are actually a digital currency — was in use well before the current advent of new digital currencies.

If, on the other hand, the payment is made in banknotes, it does not require any intermediation — except indirectly through the trust both sides place in the banknotes issued by the central bank.

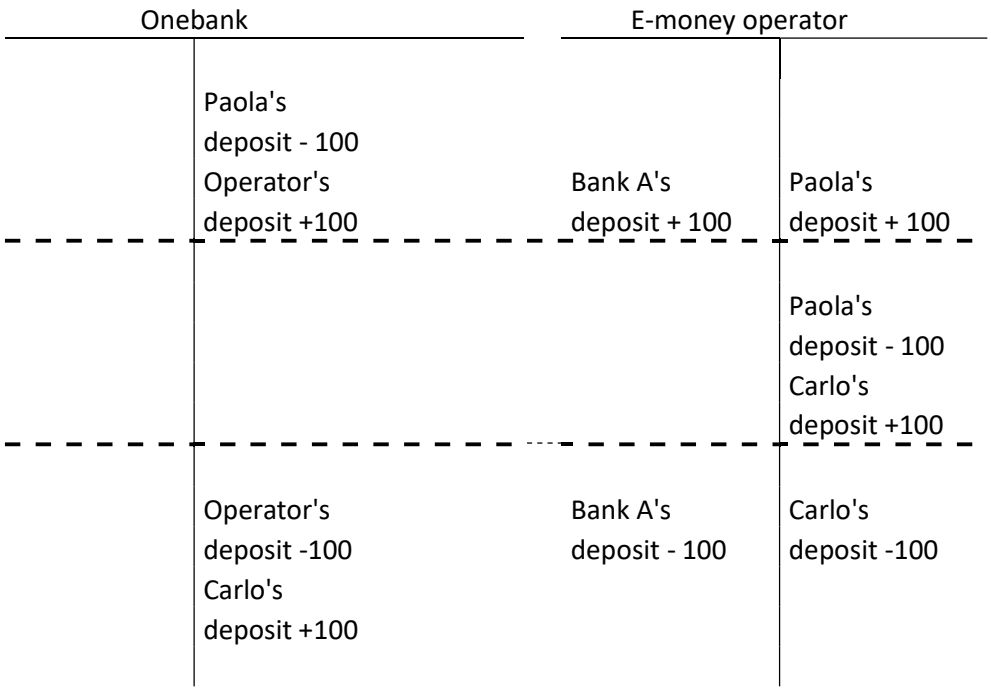
Alternatively, when we use a *credit card* for payments, the card issuer advances the payment to the seller for us; at the end of the month the payment is settled by a transfer from our account to the card issuer's account. The latter has thus granted us a temporary credit, which is why the use of the card involves commissions (partly paid by the seller). This payment system basically continues to make use of the traditional banking system, i.e. with payments ultimately completed by deposit transfers. The same thing happens with *prepaid cards*. When we load one, it is as if we had made a withdrawal from an ATM. Unlike banknotes, however, prepaid card payments are an order to our bank to transfer a certain amount from our account to the account of the payee, within the limits of course of what we have loaded on the card. Credit and prepaid cards are therefore instruments that ultimately make use of the traditional banking payment system.

For at least a couple of decades new forms of payment based on so-called electronic money (such as PayPal, Alipay, etc.), have become established, offering a variety of additional services. In Asia, and also in some African countries, retail payments via mobile phone (e-wallet) have become very popular, using a service offered in China by operators such as Alipay, that are now also available in Europe. In this region, however, the use of cash — except in Sweden where it is disappearing — and credit cards is still widespread. In Europe, PayPal is instead very popular for online payments for its presumed advantages over the use of a traditional credit card, including its ease of use, supposedly greater security, the possibility of sending and receiving money

transfers and payments to other PayPal account holders, and insurance in case of the non-delivery of purchases.

Be that as it may, the use of these forms of e-money is comparable to banknotes. Let's examine why. In the example shown in figure 2, Paola transfers 100 euros from her deposit at *Onebank* (which, for simplicity's sake, is the only existing bank) to the account of the e-money operator. She then makes a payment to Carlo, a seller who also has an account with this operator. Carlo might in turn make other e-money payments or transfer his deposit to *Onebank*. In the figure we have supposed this, but it should be clear that the 100 euros Paola initially transformed into e-money could have been used indefinitely for payments through the operator (Carlo could have paid Filippo with e-money, Filippo could have paid Antonia, and so on, and each of them could have returned the money to his or her bank deposit account). So e-money circulates just like banknotes that are drawn from a bank deposit, and can be turned back into them. Moreover, e-money operators are obliged (at least in Europe) to convert their currencies 1 to 1 into legal tender (and this makes them attractive), they cannot make loans and must hold only very liquid assets.

Figure 2: Payments using e-money



Summing up, although e-money systems differ from payments using bank transfers, they are not a disruption of the traditional payment system (see for instance Bilotta and Botti (2021, p.19).

2. Private digital currencies

Two types of private digital currencies can be distinguished: *unbacked cryptoassets*, which are an asset for its issuer but a liability for nobody (Bitcoin is the most famous example), and *backed cryptoassets* or *stablecoins*, which are a liability for its issuer conditioned to the receipt of an asset from its future user. In short, the former are usually known as *cryptoassets*, whilst the latter are deemed *stablecoins*.

2.1. Unbacked cryptoassets

It is well known that cryptoassets are an asset for its issuer and a liability for no one. These digital currencies are not backed by financial or real assets, so their value is merely determined by the price that the market is willing to pay at any given time. Hence, cryptoassets are not designed mainly as a means of payment, although they can also be used for this purpose, often to cover illicit transactions.

As a result of their design, the value of unbacked cryptoassets is extremely volatile. "Cryptoassets have grown by roughly 200% in 2021, from just under $800 billion to $2.3 trillion today", Cunliffe (2021, p. 2) documents, compared with $250 trillion of global financial assets. 95% of these $2.3 trillion, Cunliffe (ibid, p. 3) adds, is made up of unbacked cryptoassets. The number of individuals who invested in cryptoassets is not irrelevant, 2.3 million in the UK alone (ibid, p. 4), although financial institutions, especially banks, are much less directly involved. The volatility of cryptoassets can obviously lead to direct losses for holders, but also for other parts of the financial market (especially those who take leveraged positions) where, for example, "a severe fall in the value of cryptoassets could trigger margin calls on crypto positions forcing leveraged investors to find cash to meet them, leading to the sale of other assets and generating spillovers to other markets" (ibid, p. 5).

Prevailing neo-liberalism may have suggested a broad tolerance for cryptoassets in the name of market freedom, despite the evident waste of material energy and intellectual resources on purely speculative and often illicit pursuits. The ECB's view leaves no room for doubt:

> In spite of the substantial sums involved, there is no sign that cryptoassets have performed, or are performing, socially or economically useful functions. They are not generally used for retail or wholesale payments, they do not fund consumption or investment, and they play no part in combating climate change. In fact, there is clear evidence that they do the exact opposite: cryptoassets can cause huge amounts of pollution and damage to the environment. And they are widely used for criminal and terrorist activities, or to hide income from the eyes of the tax authorities. Moreover, they provide legitimate investors with no protection whatsoever against IT or cyber risks. On the whole, it is difficult to see a justification for the existence of cryptoassets in the financial landscape (Panetta 2021e; see also Bindseil, U., Papsdorf, P., and Schaaf, J. 2022).

We might ask whether action will be taken.

Keeping the purposes of this paper in mind, and leaving financial instability aside, cryptoassets do not seem to present particular challenges to the banking and monetary systems. For this reason, we conclude our exploration of this topic here.

2.2. Asset-backed stablecoins

2.2.1. Description

Stablecoins are one step further away from e-money. Like e-money, they promise full and stable convertibility into legal tender, but they differ from it in that the unit of account has a different denomination from legal tender, in the payment methods (token based) and in services offered.[2]

Issuance of stablecoins is very simple. Let's take a stablecoin, call it "Goofy" and assume an exchange parity of 1€ : 1 Goofy. In the example below, a household transfers 100€ from a commercial bank deposit to the Goofy operator, acquiring 100 Goofies. The sequence of figure 3 does not appear to differ significantly from figure 2 concerning e-money. However, in addition to the denomination, the electronic platform through which stablecoins circulate may differ, as well as the services provided by that platform.

Figure 3: Issuance of stablecoins.

Commercial bank		Goofy operator (G)		Household (H)	
	Deposit (H) -100€			Deposit -100€	
	Deposit (G) +100€	Deposit +100€	Goofy +100	Goofy +100	

Note: 1€ = 1 "Goofy"

Regarding the endogenous money view, Aramonte et al. (2021, p. 25) single out the difference between "liability-driven" stablecoins and an "asset-driven" banking system: unlike banks that issue liabilities (deposits) by creating assets (loans), issuers of stablecoins create liabilities (stablecoins) when they receive assets.

Fed Governor Christopher Waller (2021b) appropriately assimilates fully backed stablecoins to "narrow banks" which "hold only liquid, very safe assets that back up their liabilities 100% (…)" and "do not make loans or hold risky securities".

We will circle back later to narrow banking.

2.2.2. Stablecoins and financial stability

As long as stablecoins remain a fringe phenomenon, as they are today, possible financial problems remain only marginal. In the event of their development, however, doubts have emerged in the literature and among authorities as to whether such currencies really guarantee full convertibility (Arner, Auer and Frost 2020, p. 10-12; Aromonte, Huang and Schrimpf 2021, p. 5; Hohanan 2021; Velasco 2021; Waller 2021c, p. 6). Panetta suggests (2020, 2021e) that the absence of robust guarantees

and therefore the possibility of runs on stablecoins could generate direct and indirect financial instability. He labels them "unstablecoins". Amongst other risks, Panetta mentions the possibility of destabilizing markets where safe assets backing stablecoins are traded; additionally, if stablecoins are used as a store of value, "a large shift of bank deposits to stablecoins may influence banks'operations and the transmission of monetary policy" (Panetta, 2020). Diez de los Rios and Zhu (2020) point out the difficulty of the central bank to act as lender of last resort in the event of a liquidity crisis in a scenario where the financial system is run by private digital currencies. Eichengreen and Viswanath-Natraj (2020) do not trust the assurances provided by the proponents of Libra about a "Libra Reserve, made up of cash and short-term securities that serve as stablecoin backing": if stablecoins are not 100% backed by riskless, highly liquid assets, it is not certain that stablecoins can be fully converted into official currency. They also have doubts "about whether the Fed will be a compliant lender of last resort to the market in LibraUSD".[3] Memories are evoked of American free banking anarchy in the 19th century:

> In the event of a run on the Reserve, … rather than forcing the Libra Network to convert its securities into cash and incur fire-sale losses, the Libra Network might adopt redemption stays (delays in providing cash) and early redemption haircuts (additional fees for redemption). Financial historians will recognise these devices for what they are. They resemble the clearinghouse certificates issued by bank groups in the US in the 19th century in response to bank runs and financial crises. This practice created a situation where not every dollar was as good as every other dollar. It was this unsatisfactory state of affairs that led to the establishment of the Federal Reserve System in 1913 (ibid).

2.2.3. Stablecoins and lending activities

Further problems may arise related to bank activities and to monetary policy if stablecoins begin to include credit activity, since this would transform stablecoin operators into issuers of fiat (non-asset-backed) money. From a historical point of view this is a well-known temptation (Arner, Auer and Frost 2020, p. 15, Frost, Shin and Wierts, 2020). Aromonte et al. (2021, p. 25) hold that the size of the stablecoin issuers' balance sheets is driven "more by the appetite of investors to hold the stablecoins than by any desire of the issuers to acquire more assets". They also add that financial history shows that managers of stablecoins tend to play an active role in the issuance of liabilities (they issue deposits when they grant loans) to finance asset purchases when these liabilities become widely accepted as means of payment (*ibid*, footnote 7).

Returning to our example above, if the operator makes credits in (say) "Goofy", we can see at least two problems.

Firstly, the deposits that it creates (in Goofy) would not be fully guaranteed by a central bank, but merely by the assets that the operator owns, so that crises of confidence in private money issued would be very likely. This would be a return to the monetary anarchy of the 19th century when each bank issued its own currency, a system that culminated in the establishment of central banks that were granted the exclusive right to issue legal tender, as a mechanism to avoid financial instability

caused by over-issuance of loans and bank money (Eichengreen 2019; Gorton and Zhang 2021, p. 23 and passim; Bordo 2021a). [4]

A parallel might be drawn here between the strides made by central banks to keep wild private banking under control, and the establishment of CBDC and regulations to keep unregulated stablecoins in check.[5] Gorton and Zhang (2021, p. 5) point to two government options:

> (1) convert stablecoins into the equivalent of public money by (a) bringing stablecoins within the insured-bank regulatory perimeter or (b) requiring stablecoins to be backed one-for-one with Treasuries or reserves at the central bank; or (2) introduce a central bank digital currency and tax private money out of existence.

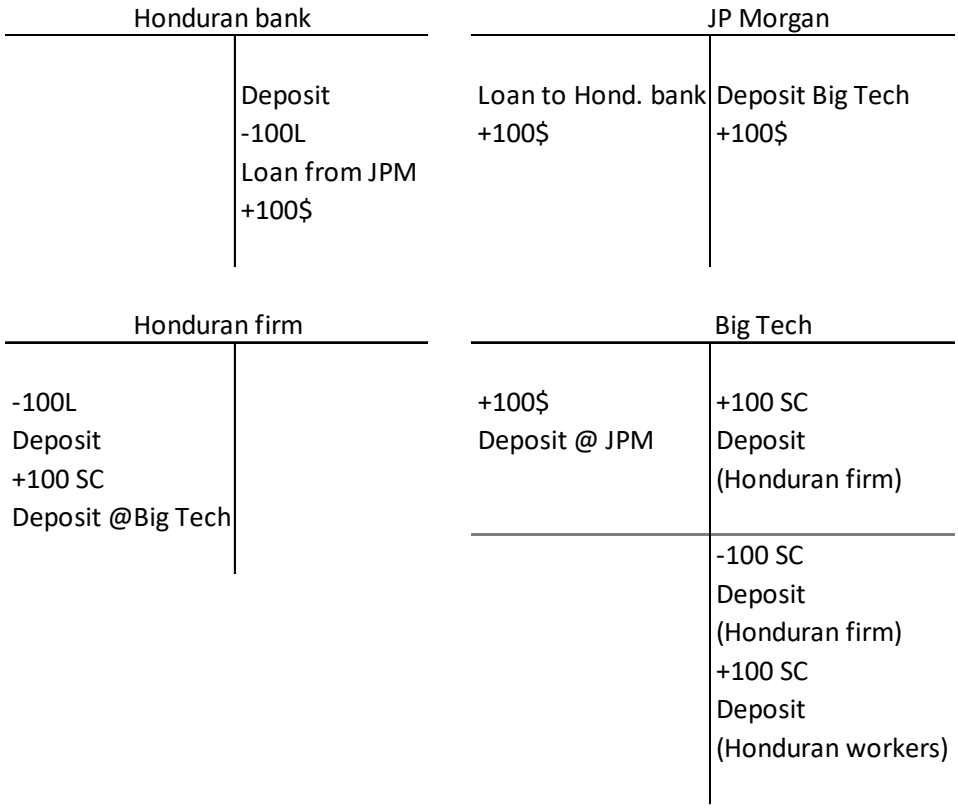
Secondly, if stablecoin operators begin to lend in stablecoins and agents sign contracts in the new unit of account (Brunnermeier *et al.*, 2019, p. 28), the monetary policy transmission mechanism may also be affected. If a stablecoin reaches the status of parallel currency, the central bank will have little to no influence on the interest rate that platforms would charge to loans granted in a different unit of account.

2.2.4. International consequences of stablecoins.

Two alleged advantages of stablecoins are lower costs for financial transactions, especially those involving cross-border payments, and easier accessibility for households than bank accounts, thus increasing financial inclusion. These advantages may be more relevant in countries with a weak monetary and banking system or frequent episodes of high inflation, and whose monetary authority lacks credibility (IMF 2020). However, a key difficulty in those countries is that, very often, the local currency is not directly convertible into stablecoins, which are provided globally by non-resident Big Techs. Consequently, the benefits that may come with the introduction of global stablecoins will be accompanied by risk and vulnerability for the local currency: particularly, financial instability as a consequence of larger and more volatile capital flows, and limits to the monetary policy transmission mechanism under currency substitution.

We deal with the international consequences of the spread of a global stablecoin in a peripheral economy with the help of figure 4, which captures the steps by means of which a local entrepreneur, who might be Honduran, pays her workers with a global stablecoin (see Araud, 2021).

Figure 4: Cross-border issuance of stablecoins



N.B. The currency of the peripheral bank is L (for Honduran Lempiras), and the core country currency is $ (for US dollars). For simplicity's sake, it has been assumed that 1L = 1$ = 1 SC; SC stands for stablecoins.

Suppose a Honduran bank has created a deposit in local currency (Honduran Lempiras) in favor of a local firm, which then wishes to convert it into stablecoins. To that end, the local bank will need foreign currency (say, US dollars) to fund the purchase of stablecoins; in our example, we assume that it borrows US dollars from, say, JP Morgan, which works as its correspondent bank in the US. In turn, JP Morgan, the bank that has made a loan to the Honduran commercial bank, credits the account that the Big Tech has with this bank. Then, once the Big Tech has collected a deposit, it creates a certain amount of stablecoins (SC) in favor of the Honduran firm, which can finally pay its workers by transferring its deposit or by transferring e-tokens into their e-wallets.

In this context of cross-border flow, we see two problems. The first one is related to financial instability driven by potentially massive gross capital flights. When residents of a peripheral country exchange bank deposits, in local currency, for stablecoins that are issued abroad, there is a gross capital inflow (matched by the holding of a foreign asset, so there are no net flows). If the demand for stablecoins is relatively large, commercial banks may end up highly indebted in a foreign currency with non-residents, thus increasing the probability of a sudden stop and a capital flow reversal (see for instance Calvo, 1988). In such a situation, debtor countries usually end up having to adopt austerity measures and wage devaluation at home, in exchange for

some external financial aid, very often from the IMF (see Diaz Alejandro, 1985). Central banks might have to accumulate higher amounts of international reserves to prevent this problem: IMF (*ibid*, p. 27).

The second problem, which is related to the first, is that if Big Techs's stablecoins achieve the role of a true parallel currency in their respective jurisdictions, local monetary authorities will lose their power to manage monetary policy. Again, this is more likely in countries with a weak currency (IMF, *ibid.*, p. 13-14, Box 2 in pp. 22-23 and Annex 2 in pp. 39-40, Levy Yeyati, 2006; see also Bannister et al., 2020).[6]

To some extent this situation reminds of the dollarization process in certain Latin American and Asian countries.[7] As Dullien (2009, pp. 16-22) explains, in the case of dollarization, under full currency substitution (i.e. banks grant loans and make deposits in a foreign currency, which plays the role of unit of account, store of value and means of payment), central banks do not play any role at all, as reserves can only be imported (the country is almost fully dependent on the financial account). Even the role of lender of last resort becomes impaired if banks are indebted in a foreign currency. If there is partial currency substitution, the autonomy of the central bank to decide its monetary policy might relay on the country's exchange rate regime. Under a fixed exchange rate, the interest rate is limited to what is compatible with the exchange rate target. However, contrary to the so-called Mundell-Fleming trilemma, even with a floating exchange rate, the central bank's room of maneuver is quite limited as well if banks and the government are indebted in the foreign currency (on this, see Rey, 2013, section VIII; see also Borio *et al.*, 2011, pp. 54-56). For instance, an expansive monetary policy at home might lead to a depreciation of the national currency, which in turn would increase the burden of external debt and shrink domestic aggregate demand.[8] Conversely, a higher official interest rate at home might entail an appreciation of the local currency, thus loosening the access of local banks to cross-border borrowing in a foreign currency (Bruno and Shin, 2014), which would foster bank credit.

The spread of a stablecoin speeds up currency substitution at a pace that increases with depreciation of the exchange rate and inflation in local currency as an alternative to keep the purchasing power of residents' savings stable. In a country whose currency cannot fund the outright purchase of that asset but which has to be converted into a foreign currency first, currency substitution driven by stablecoins limits the independence of the central bank as in the case of partial dollarization. On the one hand, the central bank cannot provide the banking system with reserves denominated in stablecoins; as such, banks will take as a reference for the interest on the loans that they grant the cost of borrowing foreign currency (US dollars in Latin American countries), and not the interest on central bank reserves (see the Appendix 1). On the other hand, as residents demand more stablecoins and fewer bank deposits denominated in domestic currency, banks become increasingly indebted to non-resident agents in a foreign currency. Hence, independently of the exchange rate regime, the domestic central bank has less autonomy to implement its own monetary policy.

The spread of stablecoins will have international consequences for advanced countries as well, with stable monetary systems and credible institutions. The risks outlined above (including convertibility, financial stability, deposit insurance, etc.) increase when the issuer of stablecoins is a private firm that is based beyond their borders, because it will be out of reach from supervisors and regulatory authorities. An additional problem is that some of the payments using a global stablecoin issued abroad will not take place in the traditional clearing and settlement scheme, centralized at central banks. This lack of control may allow the financing of illegal activities (money laundering, tax evasion, terrorism activities, etc). Further, there will be a loss of control over private firms that will gather huge amounts of personal data, thus threatening user privacy and conditioning access to the platform for some vulnerable groups.

From a geopolitical standpoint, stablecoins issued abroad will pose a threat to the international payment system as a tool for sanctions and embargoes at the international level (the main international payment system is US-managed SWIFT): the threat of being disconnected from the international payment system network is an extremely powerful weapon. As Fantacci and Gobbi (2021, sections 3 and 4) put it, the proliferation of stablecoins should be seen in the light of international tensions, as a strategy to avoid being disconnected from international clearing and settlement systems. Furthermore, stablecoins may even challenge the status of the US dollar as *the* international currency.

2.2.5. *Just a question of regulations?*

As we have seen, Waller (2021c, p. 6) likens strictly regulated stablecoins to "narrow banks". He maintains that "despite the jargon surrounding stablecoins, we can also understand them as a new version of something older and more familiar: the bank deposit". In this sense he is in favor of well-regulated stablecoins as "a source of healthy competition for existing payment platforms that can help the broader payment system reach a wider range of consumers".[9] He also dismisses the idea that the issuance of stablecoins be restricted to banks, precisely because "it serves as a viable competitor to banking organizations in their role as payment providers" (ibid, p. 9).[10] In particular, regulation should ban lending activities:

> If an entity were to issue stablecoin-linked liabilities as its sole activity; if it backed those liabilities only with very safe assets; if it engaged in no maturity transformation and offered its customers no credit; and if it were subject to a full program of ongoing supervisory oversight, covering the full stablecoin arrangement, that might provide enough assurance for these arrangements to work (ibid, pp. 9-10).

Arner, Auer and Frost (2020, p. 123) are more skeptical of stablecoins, maintaining that traditional financial institutions and/or a CBDC may well perform the same new functions stablecoins supposedly carry out.

Eventually, strictly regulated stablecoins, whose issuers would be prohibited from lending, would not differ much from the e-money already described in Section 2. As the BIS (2021a, p. 67) puts it:

> To the extent that the purported backing involves conventional money, stablecoins are ultimately only an appendage to the conventional monetary system and not a game changer.

(See also Ferrari and Ferrero 2020, pp. 38-40). Indeed, this seems to be the direction in which the European authorities are moving: regulating the sector but leaving room for innovative solutions in the payment system (including the introduction of CBDC).

2.2.6. Final thoughts on stablecoins

Summing up, there are two interrelated problems with stablecoins that may lead to central banks offering CBDC. Firstly, we cannot be 100% sure that stablecoins will be one-to-one convertible into fiat currency (Panetta, 2020). The fluctuating value of the reserve assets, especially in a run on stablecoins, raises this possibility. The situation will prove to be even more problematic if providers of stablecoins shift from narrow banks to "free banks", granting credit, and thus creating more stablecoins than safe reserve assets. A further consequence, in countries with weak currencies and monetary authorities without credibility, is that the stablecoin platforms might create a *parallel currency* which could pose a threat to financial stability and the central bank's authority and control of the economy.

The second problem is that due to the intrinsic nature of the platform's business, (economies of scale and scope, externalities as a result of more people participating in the same network, ability to manage vast amounts of data from a large number of users) there is a natural tendency for big platforms to become even larger leading to an oligopoly market structure with a few large corporations dominating the world market. The dynamic is reinforced by the rapid pace of technological innovations occurring in the payment system.

The combination of both problems may lead to large platforms (which are already very big) that are able to create a parallel monetary system, difficult for central banks to keep under control (see quotation from Brunnermeier *et al.*, 2019 in footnote 7 in this paper) and difficult for clients to leave although they may have to pay a non-competitive price for the platform's services. Monetary authorities have two (not necessarily alternative) options: either regulating platforms or issuing their own CBDC. Efforts at regulation might have to face the economic and political power of proponents, as well as the difficulty of controlling issuers based offshore. In short, the problem is in the potential threat that platforms may create to central banks behaving as issuers of a non-official currency: a problem of authority and power. Let us now turn to the alternative option of CBDC.

3. CBDC

3.1. Definition

A CBDC can be defined as the possibility for the private non-financial sector to hold current accounts at the central bank, or "reserves for all", as Niepelt (2021b) put it.[11]

In formal terms, CBDC is issued as shown in the following table:

Figure 5: Issuance of CBDC.

	Commercial bank		ECB		Non financial PS	
Step 1	Reserve	Deposit		Reserve	Deposit	
	- 100 €	-100 €		- 100 €	-100 €	
				CBDC	CBDC	
				+ 100 €	+ 100 €	
Step 2		Refinancing	Refinancing			
	Reserve	loan	loan	Reserve		
	+ 100 €	+ 100 €	+ 100 €	+ 100 €		

Note: PS: private sector.

In step 1, the deposit at the commercial bank, held by the non-financial private sector, is converted into a deposit at the central bank, in CBDC; the deposit then disappears from the liability side of the commercial bank's balance sheet and, simultaneously, the central bank transfers an equivalent amount of reserves from the bank's current account to the CBDC account of the non-financial private sector. Next, in step 2, the central bank replenishes the volume of reserves that the commercial bank is required to hold (or in any case necessitates for payments) by means of a refinancing loan. In this process, the liability side of the commercial bank's balance sheet has changed: the deposits are replaced by central bank refinancing loans.

A number of reasons have been provided for the introduction of CBDC. The following seem to be the main ones, accompanied by the objections raised by some economists who deny their real necessity.[12]

3.2. Motivations: pros and cons

3.2.1. The demise of cash

Although in many ways it is a relic of bygone days, cash plays an important role as the ultimate backing for bank deposits. Fatás (2021, pp. 51-52) talks of "physical currency" as the cornerstone of trust on private money since: "Private forms of money – bank deposits – coexist with physical currency, but individuals always have an option to redeem those assets for cash". As Panetta (2021d) explains:

> People's confidence in private money is underpinned by its convertibility on a one-to-one basis with the safest form of money in the economy – central bank money […] By providing a monetary anchor, central bank money plays a key role in maintaining a well-functioning payment system and financial stability and ultimately

trust in the currency. This in turn is a pre-condition for preserving the transmission of monetary policy, and hence for protecting the value of money.

CBDC should be seen, in this sense, as the natural evolution of cash whose use declines over time. After all, CBDC would be nothing more than a form of digital cash that would substitute physical cash as an anchor for private money (Meaning et al. 2018, pp. 4-5).[13] As we shall see, this opens the question of a CBDC that is "too successful", given the actual possibility that deposits at the central bank displace deposits at commercial banks, although this is less likely if CBDC *qua* e-surrogates of banknotes do not pay any interest rate.[14]

3.2.2. Further motivations

Other standard justifications for the introduction of CBDC and their respective cons include micro- and macroeconomic aspects.

Micro:

- *Transaction costs of domestic and international payments might fall by reducing intermediation*. These can however be improved without the introduction of CBDC (Cecchetti and Schoenholtz 2021, p. 61; Waller 2021b p. 122; Andolfatto 2021, p. 130).

- *Greater safety of CBDC accounts*. However, although safety is a cause of concern for the public, bank deposits are already generally insured and surveilled (Andolfatto 2021, p. 129).

- *More people can access the financial system.* This might however also be obtained through appropriate policies to facilitate access to banking services (Cecchetti and Schoenholtz 2021, p. 61; Waller 2021b, p. 122; Andolfatto 2021, p. 129).

Incidentally, it is generally held that the physical management of current accounts in CBDC should be left to commercial banks, which also have more experience in providing the various payment services (Passacantando 2021, p. 116; BIS 2021, pp. 78-79), while centralizing CBDC management at the central bank would lead to obvious inefficiencies (Bindseil 2020, p. 9). See also Box on synthetic CBDC, below.

- *CBDC would compete with stablecoins*. The problem of regulation nevertheless remains. In fact, Waller 2021b/c regards well-regulated stablecoins as an alternative to CBDC.

- *Combat evasion and criminal activities* (CBDC can facilitate effective payment tracking). However, the problem with private digital currencies or pseudo currencies remains.

Macro:

- *CBDC might facilitate monetary transfers to the people* (so-called "helicopter money", or QE for the people). Through a CBDC, the government could make direct fiscal transfers from its treasury account at the central bank to the accounts of citizens, thereby avoiding doing so through commercial banks, which is a disturbance to monetary policy.[15] On the critical side, BIS (2020, p. 7) points to a threat to the independence of central banks: "If fiscal transfers were made through CBDC, there is a

risk of blurring the separation between monetary and fiscal policy and a potential reduction in the independence of monetary policy". Post-Keynesian economists would look at this objection with little conviction.

- If cash disappears, *CBDC might facilitate a policy of negative interest rates*, overcoming the zero lower bound (Bordo 2021a/b, Brunnermeier and Landau, 2022, pp. 30-31). In the extreme hypothesis that a CBDC would completely replace cash, it would lead to a broadening of the instruments of monetary policy by allowing the central bank to impose negative interest rates on reserves and deposits to encourage spending. Presently, even if the central bank wanted to induce banks to bring the rates on bank deposits into negative territory to encourage spending, this would be met with a possible flight over banknotes (which have a zero rate by definition).[16]

- *Protect uniform currency* (Brunnermeier and Landau, 2022, p. 16): although most currency is created by private banks, it is perceived as safe because it can be exchanged for central bank currency at par. A main rationale for a CBDC (ibid. p. 22) would be to prevent a fragmented monetary system, with different types of currency becoming imperfect substitutes, “creating a fundamental uncertainty about the value of money (p. 16).

Finally, CBDC might be justified by geopolitical consideration:

- *Geopolitics*: CBDC should be introduced in a timely manner in case of a challenge to domestic payment and monetary systems from foreign (read Chinese) CBDC. Critics consider the importance of this threat to be overvalued. For instance, Waller (2021b, p. 124) doubts that a Chinese CBDC would challenge the status of the US dollar because this would mean that non-Chinese firms would agree to have their financial transactions monitored by the Chinese government. Similarly, Andolfatto (2021, p. 132) rejects that the US dollar’s status as a world reserve currency would be in jeopardy if the United States does not follow the lead of China: first, a world reserve currency supplier must stand prepared to run potentially very large current account deficits. And second, growth in the global demand for US dollars, treasury securities and dollar-denominated assets continues unabated.

The international impact of CBDC will be examined further at the end of this section.

3.2.3. General assessment of the opportunity to introduce CBDC

All in all, there is still great uncertainty around the opportunity to introduce CBDC, as pointed out by Honohan (2021):

> When asked why they are studying CBDC, responses from central banks do not focus on a single reason. The safety or robustness of the payment system, financial stability, efficiency of payments, implementation of monetary policy and the goal of greater inclusivity in accessing payment systems by lower income populations—all seem to be considered at least somewhat important. Lacking a single vision of what they want to accomplish, central bankers seem to be afflicted by a generalized sense of unease. Though scenarios can be only vaguely delineated, shifting sands in the payments and monetary landscape suggest to central banks that, if they do not

provide a digital currency, they could find themselves isolated and weakened in unfamiliar ways. Having sufficient control over the retail payments system might, they suppose, prove to be essential for ensuring the stability and efficiency of the monetary and payments system.

Similarly, Bofinger and Haas (2021) doubt the necessity of a CBDC from a *microeconomic* point of view, because, they argue, there is no market failure in the payment system that justifies the introduction of CBDC: already existing deposit insurance schemes render the safety argument irrelevant, and the central bank cannot compete with commercial banks in the provision of a wide spectrum of services.

But let us now turn to *macroeconomic* problems with CBDC. Motivated or not, CBDC faces at least two formidable obstacles. The first of these concerns the possible displacement of the traditional banking system and related changes to the conduct of monetary policy in general; the second has to do with the effects that the international diffusion of CBDC may have on the monetary systems and related monetary policy in the most fragile countries.

In the following subsections we shall first deal with the possible disintermediation of the banking system due to a migration of bank deposits to CBDC. We will next discuss the impact of this migration on monetary policy and then on the lending activities of banks. In dealing with each aspect, we shall assume both a (more plausible) partial disintermediation first, and a (less likely) full disintermediation later. The last case will lead us to examine in Section 4 similarities with the famous Chicago Plan.

3.3. Disintermediation of the banking system and remedies for avoiding it

The problem most often evoked with CBDC is that of the disintermediation of the banking sector, which is a possible transmigration of deposits from commercial banks to CBDC accounts, and of potential bank runs in the event of distrust of the banking system.

Disintermediation will only occur if CBDC accounts at the central bank compete with traditional bank deposits in terms of interest returns and services. On the contrary, the more CBDC resemble banknotes, i.e. they are a form of e-cash, yielding a zero interest rate without offering old or new banking services, the more unlikely disintermediation will happen.[17]

In the case of interest-bearing CBDC, banks may have to raise interest rates on deposits to retain them, which would increase the cost of credit or decrease bank profitability (Bindseil 2020, p. 9; Bank of England 2020, p.35-37; Waller 2021b p. 123 and many others). The literature has suggested two remedies (setting aside the option of not introducing CBDC): the first is a ceiling in the amount of funds each subject can hold in CBDC; the second is a two-tiered remuneration system differentiating between a higher remuneration of bank reserves (which are already a CBDC) and a lower return on the general public CBDC (Bindseil, 2020, pp. 22-26).

With regard to the first remedy, this has been authoritatively proposed by ECB representatives to limit free access to current CBDC accounts to amounts up to EUR 3,000 (a mini-CBDC), penalizing higher amounts with negative interest (Bindseil 2020,

Bindseil and Panetta 2020, Panetta 2021b, Passacantando 2021, p. 122-4). However, a mini-CBDC would be irrelevant if the aim is to compete with private payment systems. But perhaps this is not the problem as mega projects beyond Libra/Diem are controllable by regulatory measures (but see Baker et al. 2022),[18] and the challenge lies elsewhere, as noted above, in preparing for the possible global 'invasion' of foreign CBDC.

With regard to the second remedy, Meaning et al. (2018, p. 26) endorse the two-tiered remuneration system on, respectively, "universally accessible CBDCs" and "restricted access central bank reserves":

> The primary rate of monetary policy would be the rate paid on reserves, while the rate paid on CBDC would be used to control demand for CBDC relative to bank deposits. …In this world, reserves (the first form of CBDC) would continue to function as they currently do, being used to settle between banks but could not be used to pay for goods, services and assets in the wider economy. They would also continue to be at the heart of setting monetary policy (…). E-cash (the second form of CBDC) would not be used in setting monetary policy, but rather as a means of establishing an efficient and safe payments system.

BIS (2021, pp.80-81) and Panetta (2021e) also endorse this two-tier remuneration system.

3.4. CBDC and monetary policy[19]

3.4.1. CBDC and monetary policy with negligible disintermediation (non-interest bearing CBDC)

To begin with, a non-interest bearing CBDC is not likely to induce a flight from deposits to CBDC, so disintermediation is negligible and CBDC can be fully assimilated to e-cash. Further, with zero-remuneration on CBDC, they could not be used as a monetary policy tool (Meaning et al. 2021, p.8; see also Bank of England 2020, p. 38).[20] A withdrawal of bank deposits exchanged with CBDC would be treated by the central bank in the same way as a withdrawal of banknotes from an ATM.

If noninterest-bearing stablecoins are severely regulated, and the deposit safety of banks is safeguarded, a noninterest-bearing CBDC might be introduced without much consequence.[21] As the same authors note: "if the objectives of the policymaker were to improve payment efficiencies and financial inclusion, it is not essential that a CBDC pays interest" (ibid, p. 8).[22]

The case might be different with an interest-bearing CBDC.

3.4.2. Monetary policy with CBDC and partial disintermediation

An interest-bearing CBDC might induce bank disintermediation, although monetary authorities may still limit flight from deposits to CBDC. Partial disintermediation is the most likely case. Meaning et al. (2018, p. 12) recognize that although a large substitution from deposits into CBDC could mean a threat to the sustainability of bank business models, that scenario is not likely at least in the short to medium run, because central banks can regulate the attractiveness of CBDC relative to deposits (through remuneration, services provided, and the ceilings imposed on central bank accounts).

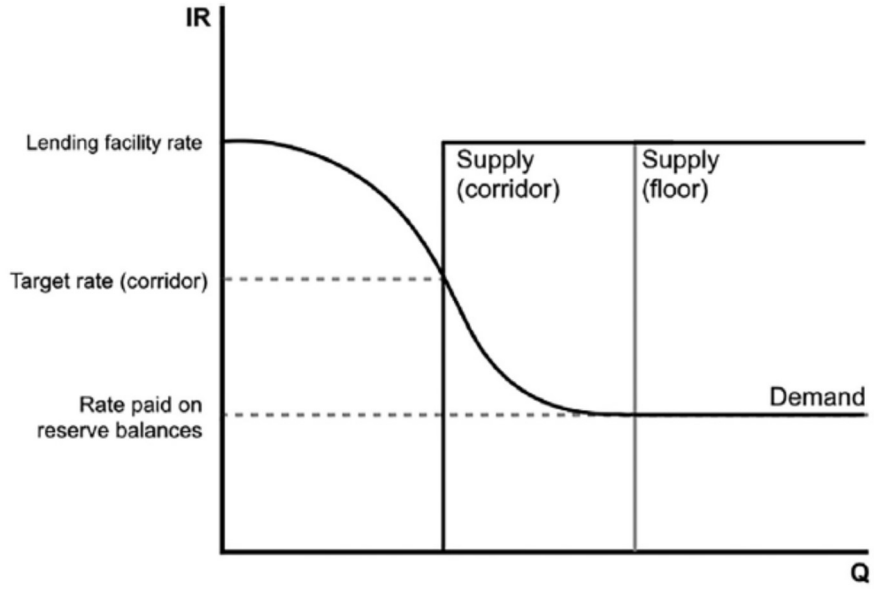
Meaning et al. (2021, p. 3) also hold that with partial disintermediation, monetary policy would not change much:

> a universally accessible, interest-bearing, freely convertible CBDC could be used for monetary policy purposes in much the same way that central bank reserves are now. On the margin, there may even be reason to believe that the monetary transmission mechanism would be stronger for a given change in policy instruments (ibid, p. 3).

As a first approximation, these authors (ibid, pp. 10-12) assume universal access to CBDC, free conversion into other forms of central bank money and bank deposits, and uniform remuneration for all forms of central bank money to all holders of CBDC (no two-tiered remuneration system). Moreover, they assume that the management of CBDC is decentralized at commercial banks, which also retain the lending function to the non-financial private sector.

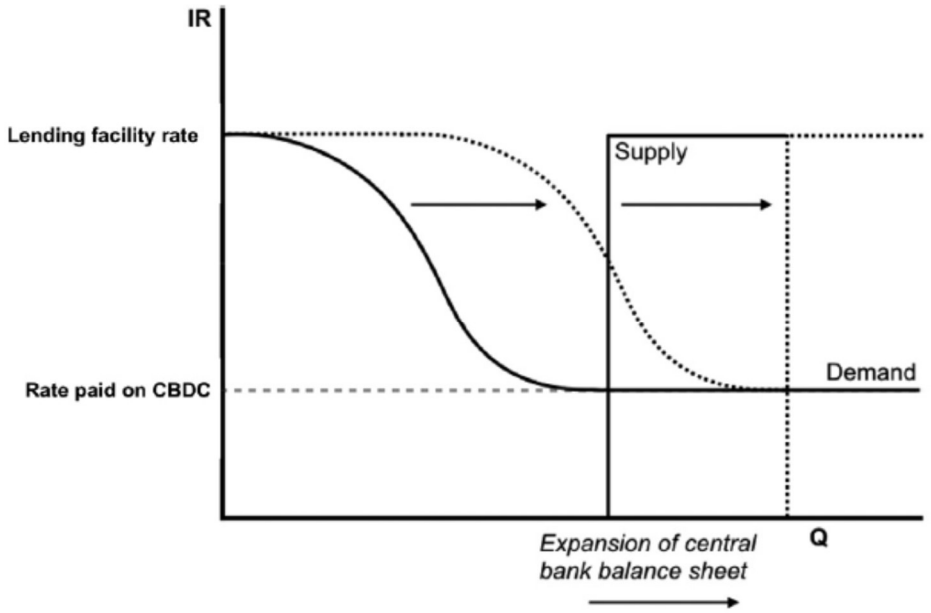
Figures 6 and 7 (from Meaning et al. 2021, p. 14) summarize the results. These figures show the operation of monetary policy without CBDC under the two regimes, traditional "corridor" and "floor" systems (see Appendix 1).[23]

Figure 6: Secondary market for reserves without a CBDC.



Source: Meaning et al. (2021, p. 14, Figure 1). Note: IR = interest rate, Q = reserves.

Figure 7: Secondary market for reserves with a CBDC.



Source: Meaning et al. (2021, p. 14, Figure 2). Note: IR = interest rate, Q = reserves.

In figure 7, the demand curve for funds shifts to the right, which illustrates not only the demand for CBDC/reserves from banks, but also for CBDC/deposits from the public; any shift from bank deposits to CBDCs will be promptly accommodated by the central bank, just as it currently does with shifts to and from banknotes.

Although a corridor system could be implemented (ibid. p. 17-18), the increased volatility of the demand for CBDC from the non-bank public (ibid, p. 16) would be a less trouble in a floor system, as Meaning et al (ibid., p 18) note: "a more volatile demand curve might make a floor system more attractive as an operational framework than a corridor".

The main difference as compared with the extreme case of a full migration from deposits to CBDC (examined in the next subsection) is that the public will continue to employ deposits for payments, along with banknotes and CBDC. Therefore, the interbank market for reserves does not disappear and with it Borio's obscure corner of monetary policy remains relevant (see Appendix 1).

A change in the target rate would have a *stronger* influence on market rates as it would not only affect the interbank rate, but would also have a direct effect on bank deposit rates. With the launch of a universally accessible, remunerated CBDC:

> the funding costs of banks would likely become more sensitive to changes in policy rates. This should strengthen the bank lending channel. (…) If the policy rate which is paid on CBDC is increased, then this could result in a fall in demand for bank deposits, while if the policy rate is cut, this could drive demand from CBDC into bank deposits. […]To the extent that pass-through from policy rates to deposit and wholesale rates has been estimated to be currently less than one, CBDC is likely to strengthen this stage of transmission. (…) This increased sensitivity of both funding costs and lending

rates to changes in the policy rate could act to strengthen the bank *lending* channel (ibid, p. 22, pp. 25-26).[24]

Summing up, the degree of displacement of bank deposits does depend on the interest rate paid on CBDC. If the rate is zero and they are not convertible into reserves, the CBDC would be akin to cash, and not much would happen in terms of monetary policy. On the other hand, if CBDC are remunerated and convertible into reserves, the central bank would still be perfectly able to conduct its monetary policy, particularly in a floor system, even with reinforced control of lending interest rates.

3.4.3. Monetary policy with CBDC and full disintermediation

In the context of the endogenous money view, full disintermediation means that banks grant loans by creating deposits, and those deposits are then converted into CBDC whilst the central bank replenishes the reserves that banks have lost, as illustrated in figure 5 above. In this process, banks are now liable to the central bank and not to depositors. In this extreme case, the central bank completely *funds* the credit activities of banks. As Niepelt (2021b, p. 39) puts it:

> In principle, a central bank can completely neutralise the effects of CBDCs on bank balance sheets and macroeconomic outcomes when certain conditions are met. The main element of the neutral central bank policy is a refinancing operation in which the central bank funds banks at terms that keep both their financing costs and their incentives unchanged. Effectively, under the neutral policy the central bank re-channels CBDC funds back to banks, keeping their choice sets unchanged. Banks continue to engage with the real sector, in particular extending credit; only the composition of their liabilities changes as household and firm deposits are substituted by central bank loans (…).[25]

In this extreme case of full disintermediation, the interbank market for reserves has disappeared, and with it Borio's "obscure corner of the financial markets" and the related short-term market interest rate which is the lever of monetary policy (Section 3.2.4). The origin of this corner-market is indeed in the use of reserves to settle interbank payments (see Section 1 above and Appendix 1). With access to central bank money, the non-banking private sector executes its payments with CBDC to which it now has full access. Monetary policy would act directly by setting the interest rate on refinancing loans at which central banks provide reserves to commercial banks. This would directly influence bank lending rates.

Finally, in the case of the demise of cash, with interest-bearing CBDC, the adoption of a floor system would no longer be necessary to bring the policy interest rate into negative territory.

3.5. CBDC and bank lending activities

3.5.1. CBDC and bank lending activities with negligible or partial disintermediation

As we have seen, the introduction of interest-bearing CBDC may cause some disintermediation of banks (changes in the composition of the liability side of banks' balance sheets). Nonetheless, according to Meaning et al. (2021) with partial disintermediation, not much would change in terms of banks' lending activities. Notably, these authors fully realize that banks "lend by issuing new deposits":

> Banks are crucially involved in money creation in the economy, because they lend by issuing new deposits, in effect creating new money and purchasing power (…) (ibid, p. 27). [26]

With the provision of CBDC, they add:

> credit creation by the banking system would continue as now even with the existence of a universally accessible CBDC, with new loans initially matched by newly issued bank deposits, and money creation would continue to be sensitive to changes in monetary policy. Of course, once those new deposits are created, though, it would remain the optimal portfolio choice of nonbanks as to how much of the newly created bank deposits were converted to CBDC, as is now the case with regards to the substitution between deposits and central bank notes (ibid, p. 27). [27]

As in the case of cash, if some (or at the extreme all) of the deposits are transformed into CBDC, the central bank will have to provide the banks with a counterpart of reserves, using the liability substitution we have already discussed.[28]

In short, as long as CBDC are a form of e-cash, a digital substitute for banknotes rather than for deposits, and are differentiated from bank reserves in terms of remuneration and from bank deposits in terms of services, not much would change for the banking system.

3.5.2. CBDC and bank lending activities with full disintermediation

This extreme and quite hypothetical case, in which all deposits are transferred to the central bank, would be a special case of "narrow banking"[29] in which the banking system could continue its credit-generating activities by creating deposits. However, these deposits would migrate out of the banking system into the more secure form of deposits with the central bank (CBDC), as seen in Section 3.4.3. The central bank would have to allot to the banks a counterpart of reserves, so that ultimately the credit granted by banks is 100% matched by central bank refinancing loans, (although the "logical" sequence of conventional narrow banking is inverted). The banks would then become mere operational arms or branches of the central bank. Their power to create deposits in this case would depend on the expectation of the central bank's ex post willingness to allot them as many reserves as they will lose (after the newly created deposits are transformed into CBDC). This would likely imply that the central bank will wish to closely monitor the lending activities of banks.[30]

3.5.3. Similarities between full-disintermediating CBDC and the Chicago Plan (narrow banking)

A parallel has often been posited with the famous "Chicago Plan", a proposal that banks should operate with a 100% reserve ratio, which has been circulating for almost a century and periodically resurfaces — most recently see Benes and Kumhof (2012). The proposal is aimed at curbing the extensive power banks have to create credit ex nihilo.

It is useful to distinguish between two versions of the Chicago Plan. In the *hard version* of the Chicago Plan (or *rigid narrow banking*) banks carry out an intermediation function, collecting reserves first (by attracting deposits or obtaining additional reserves from the central bank), and lending a corresponding amount later. Instead, in the milder, *flexible* version (*flexible narrow banking*) a bank *deliberates* a loan first, and is supported later by the central bank, which fully accommodates its reserve needs (likely after a monitoring activity over lending criteria); after receiving these reserves the lending operation is actually implemented (a deposit is created that is covered by 100% reserves). In short, in the rigid version, reserves must come *before* a loan *deliberation*, while in the flexible version they will come *afterward*.

The case of full-disintermediating CBDC is analogous to that of flexible narrow banking. The difference is that in the former case, deposits disappear from bank balance sheets.

In the case of *full-disintermediating CBDC,* commercial banks lend by creating deposits, but then holders convert those deposits into CBDC so that the central bank has to lend as many reserves as needed to the commercial banks allowing a liability substitution.

In the case of *flexible narrow banking*, banks still deliberate and grant loans, but the actual implementation of the operations is conditioned upon the receipt of a corresponding amount of reserves from the central bank. Ultimately, the two cases are equivalent.

Figure 5 above illustrates the first case. Once a bank has extended credit to the private non-financial sector by creating a deposit, the latter transfers the whole deposit at the commercial bank to the central bank. For this purpose, the central bank (say, the ECB) transfers outstanding reserves from the account held by the commercial bank to a newly created account at the disposal of the non-financial private sector, denominated in CBDC. Next, the central bank lends the reserves to the commercial bank (at an interest of its choosing) in order for the latter to comply with the reserve requirement. This argument shows that although the credit transaction was instructed by the commercial bank, the financing was ultimately supported by the central bank — the liability substitution consists of the replacement of deposits with ECB loans.[31]

Figure 8 shows an example of flexible narrow banking. In this case, in view of a lending operation that has already been deliberated and about which it has probably received adequate information, the central bank provides the corresponding amount of reserves (step 1). Once the bank has received them, it makes the corresponding loan (step 2).

Figure 8: Flexible narrow banking.

	Commercial bank		ECB		Non financial PS	
Step 1	+100 Reserves	+100 Loan (from CB)	+100 Loan (to CB)	+100 Reserves		
Step 2	+ 100 Loan (to NFPS)	+100 Deposit (NFPS)			+100 Deposit (CB)	+ 100 Loan (from CB)

Note: CB: Commercial bank; NFPS: non-financial private sector

It should be noted from the figure above that if the owner of the deposit at the commercial bank decides to convert it into CBDC, the final outcome will be similar to the one in figure 5. In this situation we would have: a 100% reserve system, banks as brokers that allocate reserves toward investment projects, and a CBDC that is available to citizens.

In both cases, that of full-disintermediating CBDCs and of flexible narrow banking, it is the central bank that ultimately takes the lending risk by generating the amount of credit through lending the corresponding reserves, either directly (flexible narrow banking) or indirectly (full-disintermediating CBDC) (Ferrari and Ferrero 2020, pp. 41-3). Plausibly then, the central bank will exercise a strict monitoring of bank lending activities. Note also that while with rigid narrow banking (that is, a proper Chicago Plan) banks can only intermediate market funds — whether this is plausible is discussed in the next section— with flexible narrow banking and full-disintermediating CBDC banks still generate credit according to the principles of endogenous money (bank money is created first, while fractional or full reserves are created later). In this sense, flexible narrow banking and full-disintermediating CBDC, through closer central bank supervision, limit but do not remove the power of banks to create money.

Finally, notice that, as seen in Section 3.3.3, with full-disintermediating CBDC (and therefore flexible narrow banking) monetary policy would act directly by fixing the interest rate on reserves for banks, thus affecting the lending rate.

In Section 4 we dwell on the plausibility of a proper Chicago Plan (rigid narrow banking).

Box: Stablecoins as synthetic CBDC.

To be sure, CBDCs are not exactly a reprise of the Chicago Plan. CBDCs imply that the public can hold deposits at the central bank (as in figure 5); the Chicago Plan implies that deposits at commercial banks are covered 100% by reserves (as in figure 8). There are, however, strong similarities between the two systems, especially if the public turns all deposits into CBDC. Private *stablecoins*, called "synthetic CBDC", have also been proposed, with 100% coverage by reserves at the central bank (Figure 9 below shows how a deposit is converted into stablecoins backed by corresponding reserves at the central bank). An authoritative report relegates them to a sub-species of narrow-bank money à la the Chicago Plan (BIS 2020, p. 4; see also Adrian and Mancini-Griffoli 2019). Bindseil (2020), who calls these synthetic CBDC "narrow bank digital currency" (NBDC) (ibid., p. 30), concludes that "Stablecoins backed by central bank deposits [...], NBDCs and CBDCs appear to have identical implications for the financial order" (ibid., p. 31).

Figure 9: Stablecoins as synthetic CBDC.

Central bank		Commercial bank		BigTech	
	-100€ Reserves (bank) +100€ Reserves (BigTech)	-100€ Reserves	-100€ Deposit (non-financial private sector)	+100€ Reserves	+100 stablecoins (non-financial private sector)
+100€ Refinancing Loan (bank)	+100€ Reserves (bank)	+100€ Reserves	+100€ Refinancing Loan		

Note: 1€ = 1 stablecoin

Panetta (2021e) is critical of synthetic stablecoins:

“The risks posed by stablecoins would be reduced if reserve assets could be held entirely in the form of risk-free deposits at the central bank. However, this would limit monetary sovereignty as one of the key tasks of the central bank – money creation – would in effect be delegated to private operators. They would perform that task with the aim of maximizing profits, rather than fulfilling public interest objectives such as inflation control and the cyclical stabilization of the economy. Furthermore, the use of money would become expressly or implicitly onerous. This would affect access to a vitally important service which central banks have been providing to citizens for centuries on behalf of the State for free and in the general interest”.

3.5.4. A trade-off

Meaning et al. (2018, pp. 26-27) point out a possible trade-off between the pairs.

(a) full-disintermediation/reinforcement of monetary policy and
(b) limited-disintermediation/preservation of autonomous banks' lending functions.

The first case, which is "more likely when a CBDC is a close substitute for bank deposits", will "strengthen the real interest rate channel" since the central bank can affect lending rates directly through the remuneration of CBDC. The cost is to "*weaken the bank lending channel by disintermediating banks"*. This is instead preserved in the second case in which "CBDC [are made] very unattractive relative to deposits. The choice may depend on *the viability of nonbank finance to provide credit to the economy in lieu of a diminishing banking sector* and the central bank's ultimate motivation for introducing CBDC." The authors conclude that: "It would seem likely that if the motivation for CBDC is purely to provide a secure digital payment system with no need to affect monetary policy, then it is unnecessary to make CBDC an attractive substitute for *interest-bearing* deposits, especially when weighed against the risk of disintermediating the banking sector" (our italics).[32]

Insofar as we agree that central banks can manage the implementation of monetary policy in the presence of CBDC, we are critical of the two italicized passages in the above quotation.

With regard to the weakening of banks' lending channels (the conversion of bank deposits into CBDC, and the former being replaced by liabilities to central banks, as explained in Section 3.4.3), bank liabilities become more expensive because the cost of refinancing loans is generally higher than that of deposits. Thus, either banks shift the higher costs of their liabilities to the interest on loans or their profits will decline. If banks lend at a higher interest rate, in general, the volume of credit granted will decline (as described by a negatively sloped demand for credit by creditworthy borrowers). However, what are the consequences of shrinking bank profits on bank credit?

On the one hand, if bank profits decline, their market value will end up declining as well. Does this limit the ability of banks to grant additional credit? According to Borio and Disyatat (2009, p. 19), "the main exogenous constraint on the expansion of credit is minimum capital requirements" (as defined, for instance, through the BIS capital adequacy ratios). However, as it is well known, Keynes already held in his *Treatise on Money* that in a closed, cashless banking system, and where reserves do not pose any constraint "there is no limit to the amount of bank money which the banks can safely create *provided that they move forward in step*" (Keynes, 1930, chapter 2, p. 26, italics in the original).

When a large portion of the banking system is granting credit, as in a boom, the probability of a bank being in need of reserves, because its deposits are being transferred to other banks, is offset by the probability of receiving deposits from other banks and, therefore, obtaining additional, excess reserves.

From a post-Keynesian standpoint, the notion of bank equity does not affect the process of creating deposits when a bank grants a loan, if we consider the banking system as a whole: in that context, the most relevant factor is the creditworthiness of the borrower (Fullwiler, 2013, p. 173, 176). Nevertheless, when considering a single bank, the capital adequacy ratio may be relevant as it will affect the conditions required by lenders of reserves in the interbank monetary market in the event that such bank has to refinance its loans (when created deposits are transferred to another bank). If only one bank, or just a few, decides to grant credit whilst the rest of the banks do not follow suit, it is quite likely that it will have to turn to the interbank money market (or else borrow reserves in the credit facility – or the discount window – offered by the central bank). If the capital adequacy ratio of this bank in need of reserves in the interbank money market is too low, this might be considered by potential lenders of reserves as a signal that this bank will be in trouble when it has to repay its debts (a low ratio might be interpreted as a consequence of defaulted loans or bad management). That is, in our view, the reason why Lavoie (2014, p. 199) has criticized bank capital as a constraint for the granting of credit, arguing, among other reasons, that it would only be binding for those banks that pose the greatest risk.[33]

The second italicized passage evokes the idea advanced by supporters of the Chicago Plan, that credit activity can be carried out by non-banking institutions in some way. This is also contradictory to the endogenous money view that Meaning et al. (2018, 2021) also hold with regard to the lending activity of banks. To be sure, "the market" may provide some financing, but this might only be *final finance*, which had to be previously "fed" by initial finance, only provided by banks. However, in Appendix 2 we shall show that "outside money" creation by the central bank in favor of the government (another case of initial finance) might eventually create deposits in the banking system which, in this case, will be capable of granting loans.

Be this as it may, we have seen that the monetary authorities have the means to limit the migration of bank deposits to CBDC which, as long as it is more similar to banknotes, would not bring about a bank disintermediation. The ECB doesn't seem to have made a decision in this regard yet although it would likely wish to discourage a major conversion of deposits into CBDC.

The next section expands upon the comparison between full disintermediate CBDC and the Chicago Plan (narrow banking).

3.6. International consequences of CBDC (CBDC as a response to foreign stablecoins)

As in the case of stablecoins, the advantage of CBDC for users is that it can help to reduce costs in cross-border transactions, and also to increase financial inclusion beyond national borders. In contrast, CBDCs entail less risks of convertibility into official currencies (because they do not face the risk associated with reserve assets that support stablecoins), in addition to not having to face the problems of misuse of data, or of anonymity (usually linked to the funding of illegal activities). One disadvantage, however, is that central banks are usually less experienced in the provision of additional services and in innovation.

But, again, advantages come hand-in-hand with risks, which are especially relevant in countries with a weak domestic currency that risks increase *pari passu* with the degree of adoption of the foreign currency, and also with the number of global currencies (IMF 2020; BIS 2021b). The main risks, for CBDC, shared by stablecoins, are those associated with bank funding risks (as bank deposits would be replaced by cross-border liabilities, often in the form of debt), more volatile cross-border capital flows (a stronger contagion mechanism; a more volatile exchange rate; higher exposure to foreign investors leading to sudden stops; runs on the domestic banking sector and currency) and currency substitution (which limits the effectiveness of domestic monetary policy).

Two additional, interrelated points are the consequences of CBDC on competition among international reserve currencies. Firstly, we must question whether issuing a national CBDC is a good strategy for the defense of monetary sovereignty at home (against foreign -or even domestic- global stablecoins or other CBDC) and its role as an international currency at the global level. And secondly, should we expect a *single* CBDC for a global economy?

Regarding the first question, Brunnermeier and Landau (2022) have argued that bank deposits are fully accepted because of their convertibility into central bank currency at par. This, they note, is because of the existence of a deposit insurance scheme, the willingness of the central bank for being the lender of last resort, and the strong regulation and supervision of banks. However, this "uniform currency" would be broken by the spread of a currency which is not issued by the central bank, either a stablecoin or a CBDC, issued at home or abroad (ibid. p. 16). A non-official currency (especially if it is issued abroad) would violate these requirements (no deposit insurance, no lender of last resort and no supervision), thus creating "a fundamental uncertainty about the value of money […] reflected in the 'exchange rates' that would arise between different types of domestic money. […] The monetary system would be transformed and behave more like the broader financial system where the creditworthiness of every single instrument is constantly re-assessed and priced" (p. 16). They compare the disruption of this "uniform currency" with the Free Banking Era in 19th-century United States. The loss of monetary sovereignty (when citizens widely use a foreign currency) implies that the central bank cannot act on the economy, because its reserves are not used anymore by banks, nor its banknotes by the public. Then, they are in favour of issuing a CBDC because this would help to preserve the role of public money in a digital environment. In the same line of thought, Diez de los Rios and Zhu (2020) point out that "Issuing a central bank digital currency (CBDC) could potentially counter the use of Libra [a foreign stablecurrency] […] If consumers are willing to accept some currency risk along with the convenience of Libra, this digital currency could gain substantial market share […] Central banks could respond to this threat by allowing private companies to build applications for the CBDC".

In the same vein, we find Niepelt (2019) to be quite sensible: "a private currency issuer such as Libra […] can be regulated and monitored […] But as experience shows (certainly in the case of Facebook), this is hard in practice when interests are

sufficiently misaligned". Thus, if it is not easy to keep a big corporation under control, issuing an official digital currency that competes with it may be a good alternative. The Bank of England (2020, p. 17) seems to share this opinion: "Stablecoins will only be widely adopted if they provide functionality and efficiency benefits over existing payment systems. But given the risks they could pose, it may be worth asking if CBDC can be designed to better meet those needs. CBDC may be able to provide better payment services, backed by risk-free central bank money, and reduce the demand for new privately issued money-like instruments".[34]

Fantacci and Gobbi (2021, p. 20) expand on the risks posed by foreign stablecoins to the geopolitical sphere, when they argue that China's support for stablecoins is a cause of concern for US authorities:

> "From the point of view of defense economics, the Chinese conduct indicates the Chinese objective of building a state-of-the-art financial system in order not to have to depend on other countries and to create means and channels of payment that allow it to circumvent US sanctions. From the point of view of the economy warfare, the creation of a Chinese cryptocurrency could be seen as an instrument of currency warfare which aims to undermine the role of the dollar in international markets. The intensification of trade between China and developing countries, often characterized by very fragile financial systems and poor infrastructures, could be facilitated by a user-friendly Chinese CBDC. Indeed, the Chinese economic penetration in these countries could rebalance the use of the dollar that traditionally characterizes developing countries. Given that China has such a level of economic relations with the US that it does not fear disconnection from SWIFT, the launch of a Chinese CBDC can be read as a signal of a de-dollarization strategy".

On the other hand, BIS (2021b, p. 18) holds that "the advent of CBDCs may accelerate change to the configuration of reserve currencies, but may not change it dramatically over a short period". The reason is that the internationalization of a currency depends on the credibility of institutions, the degree of financial openness, and the rule of law, as well as geopolitical forces (*ibid.* p. 17). Consequently, the US dollar, and to a lesser extent the euro, could even become more dominant, although it could not be ruled out that other currencies might become more widespread if their corresponding issuers offer advantages in terms of costs and services (see also Bindseil et al, 2021, Section 5, who argue that this competitive process is more than a zero-sum game).

Concerning the second question, the launch of CBDCs is seen as an "opportunity to start with a 'clean slate'" (Auer *et al.* 2021b, p. 21): a good occasion to implement a system of international payments that works more efficiently than the present one. Nevertheless, this does not mean that we should expect a unique CBDC for international payments because this would indicate that central banks which do not issue that currency would have to renounce their autonomy to implement monetary policy at home.

4. Conclusions

Let us now take stock of this long review by providing the logical throughline and related conclusions we have drawn. We focused upon *stablecoins* and *CBDC* leaving aside speculative *cryptoassets,* to which we do not attribute any positive economic or social value and which we believe should be banned.

Fully backed and strictly regulated stablecoin platforms may not pose big problems either to the central bank or to the monetary and payment system. The problem is that platforms may become powerful (and politically influential) oligopolistic financial agents (issuers), threatening and displacing (public) legal currency. Further, full convertibility is not 100% guaranteed, due to the mismanagement of the assets that back stablecoins, and can be amplified if stablecoin issuers get engaged in lending activities. Strict regulation of issuers of stablecoins, in particular concerning the safety of their assets and the banning of lending activities, might be a solution, if politically possible (Niepelt, 2019). However, the recent collapse of Libra/Diem has shown that issuers of stablecoins may prefer to give up before accepting the conditions imposed by regulators.

CBDC are often seen as the monetary authorities' answer to stablecoins. It is not clear, however, if their presumed advantages could be achieved by innovation in the current banking system, especially if cryptoassets are prohibited and stablecoins are kept in an ancillary position by strict regulations. In fact, CBDC introduce their own troubles into the banking and monetary systems, mainly with regard to a possible migration of bank deposits to CBDC.

In this regard, we examined three cases in the light of endogenous money theory. At one extreme a CBDC that represents e-banknotes; the intermediate cases in which the authorities discourage a full migration of deposits to CBDC and conversion is partial; and finally the extreme case of a full conversion of bank deposits into CBDC.

- *Zero-remunerated CBDC* representing an e-surrogate of banknotes do not create a disturbance in the existing banking and monetary policy, or no more so than when we withdraw banknotes from an ATM (a limit is that in this case it will become an effective ZLB).

- *Remunerated CBDC* might instead induce a massive shift from bank deposits, obliging banks to raise the remuneration of deposits, likely translating into higher lending rates. This may be prevented by keeping the remuneration of CBDC sufficiently low, or by quantitative limits to CBDC holdings. In this case, monetary policy, either based on the standard corridor or on the floor system, will not change fundamentally.

- The *extreme case* of a full conversion of deposits into CBDC would indeed change the working of the central bank interest rate policy. The central bank would in fact be obliged to replenish the bank's reserve accounts with the liquidity lost as a result of the deposit migration to CBDC (a liability substitution for banks). This implies that the central bank can influence the banks' lending rate by fixing the interest rate on reserves, and not by acting through the interest rate corridor or the floor systems, since the interbank money market, where reserves were traditionally re-distributed, no longer carries out this function.

In all these cases, the endogenous money creation by banks, the generation of deposits by granting credit, would not be affected in principle as long as the central bank automatically provides reserves when deposits are turned into CBDC. This may however imply a stricter control of the central bank on bank lending.

We also carried out a comparison between full disintermediating CBDC and the Chicago Plan (or narrow banking) case. We distinguished two versions of the Chicago Plan (or of narrow banking):

- a mild/flexible version in which the central bank accommodates the loan decisions of commercial banks by lending them 100% reserves. This case is similar to the CBDC with full-disintermediation case.

- a hard/rigid version in which banks can only lend after having received deposits/reserves. We study how the banking system can work under this regime of "sovereign money" (with the central bank as the only issuer). We distinguish two cases in which banks receive reserves and can thus lend. In the first case the central bank generates reserves by financing government spending. The second is the central bank *motu proprio* provision of reserves to banks, a case that recalls the discredited monetary multiplier logic.

-The similarity of the two cases (mild and hard narrow banking, and *full disintermediating CBDC*) is that the central bank is the ultimate decisions maker about lending. The difference is that in the *mild narrow banking* and *full disintermediating CBDC* cases, banks create loans first (and the central bank accommodates the reserve supply later); while in the *hard narrow banking* case the central bank is the first money mover.

Be this as it may, full disintermediating CBDC can be avoided by the aforementioned measures which limit a full conversion of deposits into CBDC. In the *negligible or partial cases,* not much would change with regard to monetary and banking policy. One might wonder, however, whether a mini-CBDC would be a sufficient deterrent against the challenge of politically and financially well-supported stablecoins, or from the challenge of foreign CBDCs. This last point leads us to the international aspects of digital currencies.

From the point of view of a user country, a foreign digital currency, either a CBDC or a stablecoin, would pose some challenges, which would increase with its global diffusion and with the relative weakness of the local currency. The first challenge is the lack of regulation and supervision of the issuer of a foreign currency by the local monetary authority. This has consequences when it comes to the convertibility of the digital currency into domestic currency (especially stablecoins), the use of the data provided by users of the digital currency, and the identity and purpose of transactions (tax evasion, terrorism, etc.). The second of these has to do with currency substitution, which poses a limit to the ability of the local central bank to manage its monetary policy and reduce monetary sovereignty, because part of the payments are not made using legal tender. An additional problem, which is especially relevant for countries with weak currencies, is that the local central bank cannot play the role of lender of last resort if local banks are indebted to the rest of the world in foreign currencies. Thirdly, capital flows would become more volatile, with consequences on the

management of gross external debt, the exchange rate and, again, the autonomy of the central bank to manage the official interest rate.

In this light, the launch of an official CBDC in advanced economies could be seen as a defensive reaction to potential threats by foreign stablecoins, and not as the outcome of market failures or deficiencies in the payment system in its present form.

APPENDIX 1

Monetary policy in a nutshell. Normally (say, before the GFC and without CBDC), the ECB mainly creates reserves in favor of banks, which pledge securities as collateral, through weekly operations called *main refinancing operations* (MRO). Another channel of creation for reserves are the *longer-term refinancing operations* (LTRO) that will become progressively more important during the crisis. If a bank is short of reserves, it can always resort to an emergency window at the central bank under which it can borrow overnight. Formerly known as the discount window, the ECB calls it the *marginal lending facility* (MLF). If, on the other hand, a bank has excess reserves, it can always park them in a dedicated current account with the ECB, known as the *deposit facility* (DF). Correspondingly, at its meetings, the GC of the ECB decides on three interest rates which will shape the so-called interest rates *corridor*: the ceiling is the rate on the emergency MLF; the rate on the MRO is in the middle; the floor is the rate paid to the banks that park excess reserves in the DF. The rate on the MRO is the short-term rate that the ECB expects to prevail in the interbank market (this is defined as the official or policy target-rate. In actual fact, in normal times banks would exchange their reserves in this market at a market rate that approximates the MRO rate. This rate, called Eonia[1] in the euro area, is the operative target of the ECB. The reason for the convergence of Eonia toward the MRO rate is rather simple and is illustrated as follows (adapted from Cesaratto 2020, pp. 201-202).

Let us consider a "normal" pre-crisis situation. Table 1 indicates, for example, that in mid 2007, the interest rate on main refinancing operations was 4%. The marginal lending facility (5%) and the deposit facility (3%) interest rates represent the ceiling and the floor, respectively, of the so-called interest rate "corridor".

Table 1 ECB interest rates, 13 June 2007

Marginal lending facility	5%
Main refinancing operations	4%
Marginal deposit	3%

Source: ECB

In this situation, *Bank A*, a bank short of reserves, could obtain a very short-term (24-hour) marginal loan from the ECB at an interest rate of 5%. *Bank B*, a different bank with excess reserves, could park its surplus liquidity in a deposit facility at 3%. Assuming the two banks trust each other, it is natural to think that *Bank A* would be willing to offer *Bank B* a little more than the 3% it receives if it keeps the money in the deposit facility. At an interest rate of less than 5%, *Bank A* would save money and avoid the stigma for having applied to the MLF. On the other hand, *Bank B* would be happy to earn more than 3% on its surplus reserves. One does not have to be an economist to guess that the two banks will agree to an interest rate around 4%, which

[1] Euro Overnight Index Average

is precisely equal to the MRO rate targeted by the ECB. This is the rate at which *Bank B* lends its surplus reserves to *Bank A*. And that is precisely the short-term interest rate that the ECB hoped would prevail on the interbank market where the central bank exerts its influence. This rate becomes the keystone of all the interest rates in the economy. As Claudio Borio of the Bank for International Settlements writes: "It is in this relatively unglamorous and often obscure corner of the financial markets that the ultimate source of the central banks' power to influence economic activity resides".[2]

A variation of the corridor system is the "floor system" which is adopted (officially or de facto) when the central bank adopts quantitative easing measures to influence long-term interest rates. In this case, the abundance of liquidity would push the monetary interest rate at the rate on deposit facility which became the new policy target.

[2] Borio (1997), p. 14.

APPENDIX 2

The Chicago Plan and CBDC: an expanded comparison. The Chicago Plan was proposed as a response to the Great Depression during the banking reform of Roosevelt's New Deal. Taking up a proposal already formulated a few years earlier by Frederick Soddy, a Nobel Prize winner in Chemistry, the plan was formulated by leading economists at the University of Chicago in 1933 under the leadership of the famous Frank Knight. Later, other famous economists such as Henry Simons, Irving Fisher, and Milton Friedman endorsed the proposal. This re-emerged, after the Great Recession of 2008, with the objective of controlling the amount of money that banks can create. They have the common characteristic that bank deposits must be 100% backed by central bank reserves.[3] Their purpose is to pose a limit on the ability of banks to create money, and alleged benefits include better control of business cycles, the elimination of bank runs, a reduction in debt burden for the government, and reduction of private debt (Benes and Kumhof, 2012).[4]

In Sections 3.5.2 and 3.5.3 we discussed the analogy between a *full-disintermediation CBDC* and the Chicago Plan (narrow banking), restricting the similarities to a *flexible (or fully accommodated) narrow banking* and not to a full-fledged Chicago Plan (*full-reserves narrow banking*). In the *full-disintermediation CBDC* and *flexible narrow banking* cases, commercial banks retain the power to create deposits and the central bank accommodates their reserve necessities. Therefore, banks retain the full capacity to create money, perhaps under stricter surveillance by the central bank which takes the ultimate credit risk. Both cases, full-disintermediation CBDC and flexible narrow banking, are rather implausible since in the first case the monetary authorities will discourage full disintermediation, while the second would be a fake or mild Chicago Plan, failing to deprive banks of their money creation power. But would a proper, hard version of the Chicago Plan (non-accommodating narrow banking) work? Does it share any similitudes with CBDC? In this more rigid version, banks cannot lend by creating deposits, but can only lend once they have received a deposit (and the corresponding amount of reserves). A single bank can however receive a new deposit only from another bank or from the State, either as State spending in favor of the non-banking private sector, or as additional central bank reserves. The first private banking channel hides the idea that banks intermediate savings, collecting them and financing investment (as in the loanable funds theory). This channel is however ineffective in term of net lending, since if the receiving bank can expand loans after receiving a deposit, the sending bank must correspondingly cut its lending (Jakab and Kumhof 2015, p. 10). [5]

[3] E.g. Benes and Kumhof (2012); other proposals under the umbrella of full reserve banking are Dyson *et al*. (2011); Dyson *et al*. (2016); Jackson and Dyson (2012); Positive Money (2012); a survey can be found in Sigurjónsson (2015); and for a critical review, see for instance Fiebiger (2014) and Fontana and Sawyer (2015).

[4] In general, authors who are sympathetic to proposals in favor of controls on the volume of bank credit agree with the endogenous money view. It is precisely because of this fact that they support quantity controls.

[5] In this regard, Wray (2014) argues that it is one thing to criticize the excesses of financial institutions and of Wall Street, and quite another to endorse misguided theories of banking when he writes: “the proposal is based on a fundamentally flawed view of the saving-

Let us consider the two channels through which the State can inject reserves into the banking system.

(i) State spending (indirect) channel of reserve provision

In formal terms, this channel can be described as follows:

Figure 10: Creation of money 100% full reserve. Initial finance: government spending funded with credit from the central bank.

	Central bank		Bank		Trust fund	
Step 1	Loan (gov)	Dep (gov)				
Step 2		-Dep (gov) + Reserve	+ Reserve	+ Dep (H)		
Step 3				- Dep (H) + Dep (TF)	+ Dep (TF)	+ Bonds
Step 4				- Dep (TF) + Dep (F)	- Dep (TF) + Loan (F)	

N.B.: H: Household, TF: Trust fund, gov: government, F: Firm

In step 1, the central bank makes a loan to the government, creating a deposit; this will allow the government to, say, pay pensions. When it does so, in step 2, the central bank moves reserves from the government deposit to the bank of the pension beneficiary, where she receives her payment. Next, in step 3, the pensioner decides to invest her deposit in bonds issued by a trust fund (which may be a branch of the bank where she has her savings). The purchase entails the transfer of the deposit to the

investment and deposit-loan relationship. […] it is based on the loanable funds notion that 'saving finances investment.' [..] [W]hat finances investment (and any spending in excess of income)? Credit. Where does it come from? Out of thin air. I can just hear our cranks: 'There you go again, that is what we want to eliminate!' Yes, I understand. But crankiness can only take you so far. You've got to have the correct theoretical framework. As Pettifor rightly says in her piece, if we really did limit our finance to saving, then we'd run our economy right into the ground". Along similar lines Fontana and Sawyer (2016, pp. 1339) argue that "It is not clear where the prior savings alluded by … advocates of FRB [Full Reserve Banking] have come from. It is technically impossible for banks as a whole to collect deposits without at the same time granting loans for the same amount. Therefore, at least initially there must have been a process of credit creation in the economy, which was completely unconstrained and unrelated to pre-existing resources". Proponents of the Chicago Plan, Benes and Kumhof (2012, p. 5), note that, paradoxically, while the Chicago Plan intended to restore the intermediation function between savings and investment that many contemporary economists still consider the principle on which banks function, it implicitly acknowledged that banks actually grant loans by creating deposits: "[with the Chicago Plan], banks would become what many erroneously believe them to be today, pure intermediaries that depend on obtaining outside funding before being able to lend".

trust fund account. In step 4, the trust fund makes a loan to a firm: the latter has some funds available in the form of deposits in the bank.

In short: (i) the central bank creates the funds *from outside* of the system (in this case, making a loan to the government); (ii) banks collect that *outside money*; (iii) these deposits can be used to make payments *within* the banking system (e.g. to pay the electricity bill), or kept as a store of value, or invested in financial assets as in the example; (iv) the bank cannot make loans because it cannot create deposits (it is prohibited by law); it is a narrow bank in the sense that it collects an asset - central bank reserves - and then it creates a deposit; (v) loans can be made by non-bank financial institutions providing final finance, transferring an already existing deposit: they cannot create initial finance; (vi) if the loan is not repaid, the loss is ultimately assumed by the owner of the shares issued by the trust fund.

We conclude that in this case banks may lend what they borrow — although at the beginning there has still been an act of money creation by the central bank (which we may regard as an act of endogenous money creation). Ultimately, as in the example, outside money creation by the central bank is transferred to one non-financial private sector agent, which lends it to a second non-financial private sector agent through the intermediation of the financial sector.

(ii) Central bank (direct) channel of reserve provision

The second channel is explained in figure 11. This illustrates a narrow banking system where banks do not create deposits but simply lend CBDC. Under this Full Reserve Banking proposal, the central bank would lend reserves to banks first (Step 1). Then, instead of banks creating deposits when they grant loans, banks would lend the already collected reserves, which the borrower could use as means of payment in the form of an account at the central bank, denominated in CBDCs. In this proposal, the commercial bank would be a narrow bank that can only lend the reserves that it has collected previously: bank deposits are 100% backed by central bank reserves. The power of the bank to create deposits depends on the central bank's willingness to provide it with more reserves. In this regard, Bindseil (2020, p. 7) quotes Joseph Huber, a German economist who renames the proposal 'sovereign money': "Today, there is a mixed money base made up of one kind of money created by the central bank and another kind of money (sight deposits) created by the banks. Sovereign money still implies a two-tier banking system, but it does not mean having a mixed money base any longer, instead, just one kind of money from a single source (…). Simply, banks would be credit brokers and no longer be credit creators."

Figure 11: CBDC as a full reserve banking system.

	Central bank		Bank		Non-financial Priv. Sector	
Step 1	+RO	+Reserves	+Reserves	+RO		
Step 2		- Reserves	-Reserves			
		+CBDC	+Loans		+ CBDC	+Loan

*N.B.*RO: refinancing loans (refinancing operations).

In this channel, the central bank controls both the quantity and the price of reserves.

We find this channel to be problematic. To begin with, despite the awareness of those sympathetic to the FRB as to the endogenous money view, they ultimately rely on a sort of "Say's Law of credit" (Cesaratto 2021, p. 252), and an implicit causality running from reserves to credit, in the sense that all injected central bank reserves will be transformed into loans, using the discredited logic of the monetary multiplier (ibidem, pp. 247-262). In addition, although under this proposal banks cannot destabilize an economic system through granting *too much* credit, now it is assumed that the central bank has a better criterion to decide what is *the* correct volume of credit that an economy needs (Dow *et al.*, 2015, p. 10, 11, 13). This criticism has also been moved to the full reserve provision under a full-disintermediation CBDC regimen or under the analogous flexible (full-accommodating) narrow banking examined in Sections 3.5.2 and 3.5.3. From this point of view, the full-disintermediation CBDC regimen, flexible narrow banking and a proper Chicago Plan (rigid narrow banking) are similar, which makes all them implausible in a practical sense. In the accommodating cases, however, banks do still carry out the preliminary assessment of potential loans, while the central bank accommodates the bank reserve requirements. In a proper Chicago Plan the initiative lies completely in the central bank's hands, both by financing State spending, and by directly providing reserves to banks.

To sum up, in Sections 3.5.2 and 3.5.3 we have underlined the analogy between a full-disintermediation CBDC and flexible narrow banking; in both cases the central bank fully accommodates the reserve needs of banks. In this Appendix we have examined a proper Chicago Plan. The similarity with the first two cases is in the great power assigned to the central bank when it comes to lending decisions. We also examined how an economy can work in which banks cannot create loans "out of thin air" and where banks can lend only after having received deposits (reserves). We found that banks' lending activity can continue through outside money creation (central bank monetization of government spending). The central bank can also control lending by controlling the reserve supply (and its price). However, this view seems to reflect a logic that is similar to that of the monetary (or deposit) multiplier which many proponents of the Chicago Plan reject.

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Footnotes

[1] In some cases specific page numbers for the citations are not indicated because they cannot be identified in the online documents.

[2] Arner, Auer and Frost (2020, p. 4, fn. 5) include among these services "smart contract" and "programmable money" that are defined as follows: "Smart contracts can be formally defined as programmable distributed applications that trigger financial flows or changes of ownership if specific events occur (...). In other words, they are algorithms that automate the execution of contracts". Waller (2021c, p. 6) adds "atomic settlements", which are instantaneous exchanges of assets in which the transfer of one asset is made only if the other transfer is also completed.

[3] Smialek (2022) states that Tether, the largest stablecoin, had invested half of their assets in short-term commercial paper. That debt market melted down in March 2020, "forcing the Fed to step in to fix things". Situations like this one may weaken the credibility of central banks.

[4] The danger of an unregulated payment and credit system would also come from "decentralized finance" (or DeFi), which is still in its infancy but whose "prominent use … at present is the provision of credit. Lending currently represents nearly half of the DeFi market" (Aramonte et al. 2021, p. 8).

[5] Another side effect on the banking system is if the volume of deposits the stablecoin operator holds at a certain bank is notably large. In this case the operator can destabilize this single bank if it withdraws them suddenly. The bank may aim to retain deposits by raising the interest at which it remunerates them, leading to losses. As Cecchetti and Schoenholtz (2019) put it: "the Libra Association could have significant bargaining power in obtaining higher deposit rates (especially from banks dependent on short-term wholesale finance)".

[6] Ferrari and Ferrero (2020, p. 38) argue that even in these countries "the government can always impose the use of its own currency in its purchases of goods and services, in the payment of public salaries, and in the collection of taxes." By contrast, Brunnermeier *et al.* (2019, p. 28) hold that "The most important consequence of a system based on digital platforms may be that agents begin to write contracts in a unit of account specific to a platform rather than the central bank's unit of account […] This would […] destroy the link between the interest rate set by the central bank and the arbitrage that allows monetary policy to have real effects on the provision of credit". In countries with weak fiscal systems, the ability of the fiscal authority to impose the use a particular unit of account seems to be rather limited.

[7] Calvo and Vegh (1992, p. 2) argue that the spread of a parallel currency begins with the store of value function in the context of rising inflation in terms of domestic currency; next, residents start to use the parallel currency as unit of account; and finally, the means of payment function occurs.

[8] Dullien (ibid. p. 19): "from a central bank perspective, the fewer the dollar liabilities (both external and domestic) that exist in an economy, the lower the risk that a fluctuation in the exchange rate will wreak havoc with the balance sheets of the government, the corporate sector or the financial sector, and hence the greater the freedom to accommodate a domestic credit and investment process".

[9] To the extent that stablecoins are well regulated, Waller (2021a) is similarly skeptical of the usefulness of CBDCs as an alternative to stablecoins.

[10] A BIS report (2021a, p. 68) speaks to the exorbitant costs for merchants but ultimately for consumers of current payment systems such as credit or debit cards (costs that can reach up

to 1% of GDP in some regions). Of course, the entry of global players into payment systems might not necessarily guarantee more competition.

[11] Unlike current accounts, the public could obtain CBDC tokens that can be more anonymously spent using an e-wallet. Concerns over the control of illicit activities would suggest a preference for CBDC in the form of deposits (Auer, R., Doerr, S., Frost, J. et al. 2021; BIS 2021a, p. 72; Meaning et al. 2021).

[12] An analysis of the literature on CBDC in recent years reveals a measure of repetitiveness in the arguments. In fact, also operationally, central banks are circling the question of whether to introduce CBDC or not without coming to any conclusion, perhaps waiting for an external event (a Chinese CBDC?) to force them to make a choice.

[13] CBDC allow direct (P2P) payments like banknotes, which are not intermediated by banks; the possibility of withdrawing them as tokens for e-wallets is a further option.

[14] For a critical view, see for instance Waller (2021a).

[15] This disturbance is thus explained: in order to distribute money to citizens, the central bank creates reserves in the current account of the government; the latter will in turn transfer the reserves to the current accounts of banks so that they can credit the funds in the deposits of citizens. This operation creates excess reserves in the monetary market and a decrease in the short-term interest rate below target. The central bank must therefore sterilize the operation by reducing the amount of liquidity supplied through ordinary refinancing operations. No disturbance would occur of course if we were in a floor system where the decoupling between interest rate targeting and liquidity supply is perfect (see Appendix 1).

[16] From a critical standpoint, some authors have argued that, in deep recessions, an expansive fiscal policy is more powerful than a monetary policy of negative interest rates: Cecchetti and Schoenholtz (2021, p. 131), Andolfatto (2021, p. 131), Di Bucchianico, 2020, amongst others. On the contrary, those against the "expropriation of the saver" argument, would oppose this reason for introducing CBDC (Bindseil, 2020, p. 6).

[17] In this regard Meaning et al. (2018, p. 7) point out that "if CBDC only serves as a substitute for central bank notes, then the monetary policy implications are negligible, but once CBDC starts to offer payment services similar to bank deposits, there will be an impact on the quantity and price of bank funding, with interesting implications for monetary policy".

[18] Baker et al. 2022 state that the President's Working Group on Financial Markets had claimed that "stablecoin issuers should be regulated banks if the tokens are to be used as a means of buying and selling things. […] The group of regulators said they feared what might happen if a vast network of a tech company's users suddenly began transacting in a new currency, and that combining a stablecoin issuer with a big corporation 'could lead to an excessive concentration of economic power'."

[19] Appendix 1 provides a summary of the workings of monetary policy in normal (non-crisis) times and, of course, without CBDC. The non-expert reader may wish to read this appendix first.

[20] The transformation of bank deposits into CBDC entails a loss of reserves by the banks, which the central bank will have to compensate through normal monetary policy instruments as it normally does already with variations in the demand for cash (Meaning et al. 2021, p. 16).

[21] An implicit assumption here is that CBDC is not a substitute for reserves. In other words, that is, if CBDC can be convertible into reserves, it is accessible for banks and the outstanding amount is sufficiently large, non-remunerated CBDC would have consequences on the management of monetary policy if the interest rate on reserves is not zero.

[22] Meaning et al. 2021, p. 8) observe that a CBDC might make a negative interest rate policy more arduous. As is well known, storing cash is expensive. For this reason, the rate on deposits (bank or reserves) can be brought into negative territory to the extent that the cost of holding a deposit is lower than that of holding cash. Non-interest bearing CBDC has a zero cost, however, so this would impose an effective zero lower bound on rate policy: "a non-interest-bearing CBDC could actually raise the lower bound for interest rates, because it does not bear the storage costs that currently apply to bank notes. This would worsen the constraint on monetary policy, so any benefits to payments would need to be weighed against this cost" (see also Bank of England 2020, p. 38 and Panetta 2021e). A negative interest rate policy would then imply quantitative limits on the amount of money transferable to non-interest bearing CBDC.

[23] Figures 1 and 2 represent the demand and supply of reserves. In a system with mandatory reserve requirements, the demand for reserves is often plotted as decreasing. This is because during the "maintenance period" a commercial bank does not have to meet the requirement on a day-to-day basis, but only on average over the period (and relatively to the deposits of the previous maintenance period). Given the MRO rate (central bank target rate), if the interbank market rate is lower than the MRO rate, banks tend to demand reserves to take advantage with the target reserve requirement in mind. Conversely, relatively higher market rates tend to discourage such demand. The supply of reserves is drawn as a vertical line. The central bank fixes this supply in such a way as to allow banks to meet their reserve requirements, and is thus not used to change the interest rate (as mainstream textbooks claim), which is instead changed through announcements.

[24] In a blog presentation of their paper, Dyson and Meaning (2018, our italics) add: "A key observation of our paper is that *the rate of interest that the central bank pays on CBDC would act as a floor to all other rates in the economy*. This is because it would both represent the safest store of value and also provide transactional services, so, in our model, no one would lend to someone else, at risk, for less than they could earn by holding risk-free CBDC at the central bank. This would be in contrast to the historic norm, where deposit rates with commercial banks were typically below the policy rate. Other rates in the economy would then be above this CBDC rate, with the spread determined by factors like their relative transactional service, liquidity and risk. By varying the interest rate paid on CBDC, the central bank could move these other rates in the economy, either encouraging or restricting growth". Affected areas would include the rate on deposits and, consequentially, lending rates. The authors also point out that CBDC would make quantitative easing easier as the central bank would buy assets directly from the non-bank private sector (thus also leaving bank liquidity unaffected). On a similar vein, BIS (2021, p. 81): "interest-bearing CBDC would give central banks an additional instrument for steering real activity and inflation. If changes to the policy rate were directly passed through to CBDC remuneration, monetary transmission could be strengthened. There has also been discussion about the use of CBDC to stimulate aggregate demand through direct transfers to the public. Rather than the use of the CBDC per se, the key challenge for such transfers is to identify recipients and their accounts. In any case, as CBDC would coexist with cash, users would have access to either instrument, and it is unlikely that deeply negative interest rates would prevail, or that CBDC would materially change the effective lower bound on monetary policy rates".

[25] "Many commentators also suggest that the substitution of outside for inside money could reduce the volume of credit, with important macroeconomic consequences for investment and growth. According to this argument, the fact that many banks rely on deposits to finance their assets suggests that less deposit funding would reduce the flow of credit extended by these banks. … banks [may] continue to originate loans even when they have no, or less, deposit funding but they sell the loans to the central bank in exchange for reserves or they receive

central bank financing as a substitute for deposits" (Niepelt 2020, p. 229). Bordo (2021a, p. 14) writes approvingly that "disintermediation could be offset by central bank expansionary balance sheet policy". The Bank of England (2020, p. 37) suggests that full funding of lending activities by the central bank may create a shortage of good collateral and tensions in the financial market that may interfere with the bank interest rate target: "A shift from deposits to CBDC could result in banks drawing down on their stock of reserves (which must be paid across to CBDC accounts). Banks may need to replace some of these reserves, for example to meet their own risk appetite or regulatory liquidity requirements. While the stock of reserves is currently ample in the UK as a result of quantitative easing, this may not always be the case. In 2018, the Bank explained that, once it begins to unwind quantitative easing, it intends to meet banks' demand for reserves by lending at Bank Rate against high-quality collateral. However, a large-scale shift into CBDC may mean that banks would not have sufficient amounts of the right quality collateral to obtain the reserves they need. Aside from the financial stability implications of a shortage of liquid assets, this could result in market rates moving out of alignment with the policy rate, or necessitate adjustments to the Bank's monetary policy implementation framework — including to consider supplying reserves against a wider range of collateral. Given this, the design of CBDC would have to consider the effects on how the Bank implements monetary policy".

[26] "In contrast, they argue, non-bank lenders transfer existing purchasing power (either deposits or CBDC) from savers to borrowers, but do not create any new purchasing power in the process" (p. 27). There is great coincidence here with the Post-Keynesian standpoint, where banks have the exclusive role regarding *initial* finance, while non-bank financial intermediaries have a role in *final* finance (Davidson 1986; Cesaratto and Di Bucchianico 2020).

[27] Presently banks do not lend reserves as textbooks sometimes assume, presenting the discredited monetary multiplier model. Indeed reserves circulate among banks' current accounts at the central bank only (the government is the only other agent that holds a current account at the central bank). However, with CBDC ordinary agents can also hold accounts at the central bank; in the event that reserves also consist of CBDC, banks can lend CBDC/reserves to those agents. Doing so, however, would reduce bank reserves, putting in peril the fulfilment of the mandatory reserves target, so banks will prefer to lend by creating deposits (ibid, p. 27).

[28] As Panetta (2021e) points out: "if the digital euro attracted deposits (and the banks did not have the unencumbered reserves to cope with the outflow of funds), it could affect the cost and supply of credit and the transmission of monetary policy through bank balance sheets. The central bank could mitigate or eliminate these effects by increasing refinancing of banks or through asset purchases, thereby expanding its own balance sheet".

[29] A 100% reserve system is called a "narrow banking system" (e.g. Ferrari and Ferrero 2020, p. 20) as opposed to the traditional "fractional" system, in which reserves are a small fraction of the deposits created.

[30] This is particularly the case if commercial banks offer the loans they granted as collateral to the central bank. In this regard Cecchetti and Schoenholtz (2021, p. 60) warn about "the risk of creating a massive state bank (...). As funds shift, sources of private credit will dry up, driving the central bank to become a commercial lender. Over time, this state bank will be tempted to substitute for the discipline of private lenders and markets, inviting political interference in the allocation of capital and slowing economic growth". Similarly, Passacantando (2020, p. 124) notes that by shifting the risks of lending to the central bank, the production of reserves would no longer be functional for monetary policy, as seen so far, but for bank lending.

[31] As noted in footnote 28, according to the Bank of England (2020, pp 37-38), central bank funding would not come without headaches: "In the most extreme scenario, where a CBDC

fully replaced transactional sight deposits at commercial banks, those banks — if they were not to reduce lending — would be reliant entirely on other sources of funding. To the extent that this included an increased reliance on existing central bank facilities, or if shortages of private market funding prompted central banks to adjust the extent to which funding is offered, this would have significant implications for the role of the central bank, including in influencing the cost of credit. Any expansion of the central bank balance sheet to support bank funding would raise the question of what assets would match the additional liabilities, and how they would be supplied. In this scenario there may be a shortage of high-quality assets to back an enlarged central bank balance sheet, and therefore the central bank may have to broaden the range of assets purchased or lent against". In the example, the collateral exhibited by the commercial bank would be the loan granted to the private sector.

[32] Along similar lines, Panetta (2021e) also points out the same trade-off in the event of a positive interest rate for CBDC: *"Conversely, if interest was payable on the digital euro it could strengthen the transmission of monetary policy, but there would be a risk of diverting bank funds."*

[33] All in all, this does not mean that lower bank profits lack other problems: it might be argued that if profits decline, banks will react by adopting a riskier lending strategy; (Bindseil, Domnick and Zeuner (2015, p. 21) call it a "gamble for resurrection".

[34] The recent abandonment of Meta-Diem/Libra (Baker et al. 2022) raises some doubts as to whether the power of regulators (the Fed) is greater than expected (see footnote 28 above), or whether the Fed did not give the green light to Diem because it saw that it was not able to regulate it.