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Is Programmable Central Bank Digital Currency (PCBDC) Money? Some Remarks from the Ontology of Money Perspective

Abstract

The goal of this paper is to investigate whether programmable central bank digital currency (PCBDC) qualifies as money under different ontological theories of money. This study shows that according to the state theory, it qualifies as money, under the institutional theory, it has the potential to be money, and from the perspective of the credit theory, it is money but with important caveats. This paper refers to current debates regarding CBDCs, and by using the perspective offered by various ontological theories of money it sheds a new light on these issues.

Keywords: Programmable central bank digital currency (PCBDC), digital money and finance, ontology and philosophy of money

JEL codes: E42, E51, B52

Introduction

What is money? Does money have intrinsic value? What is the essence of money? Where does money come from? What makes money persist while in use? Does money simply exist because people believe it does? Is it necessary for something to be backed by state authority to be qualified as money? These questions concern the ontology of money.

The above questions are definitely not new, they have been asked by philosophers and economists for centuries. In particular, it was Aristotle who proposed the so-called commodity theory of money which treats money as a commodity serving as a medium of exchange, a unit of account, and a store of value. In order to perform

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these functions, a commodity qualified as money should be easy to store and transport as well as to be measured and divided to facilitate calculations. Also, it should be difficult to destroy.

A different theory of money is the one seeing money as a social construction, namely a credit relation (see, e.g., Ingham 2004). Here money represents a claim on goods or services. In other words, every unit of money is a record of a debt. For a credit relation to serve as money, it should be sufficiently credible and the credit should be transferable, namely acceptable by others as payment for trade. There is a general agreement that the most creditworthy issuer of credit money is the state¹.

In recent years, due to technical progress, new forms of money have emerged, e.g., electronic money, cryptocurrencies, and central bank digital currencies (CBDCs). This has attracted the attention of economists, who question whether these can be classified as money (e.g., Passinsky 2020). A special case is programmable CBDC (PCBDC), which incorporates built-in rules (code) that govern its use, for instance, limiting spending to certain goods, imposing expiration dates, or adjusting interest automatically. The goal of this paper is to investigate whether PCBDC qualifies as money under different ontological theories of money. Such a question is not only theoretically worth asking, but also has important practical consequences. In this context, reference can be made to various legal disputes regarding whether Bitcoin is money and correspondingly to different positions in court rulings (see, e.g., *SEC v. Shavers* 2013, or *United States v. Ulbricht* 2014). It is easily imaginable that the very same issue can be raised in hypothetical legal and court proceedings regarding PCBDC.

The question we are asking here is very up-to-date. Various central banks around the globe are preparing their CBDCs. For instance, the European Commission states in the following way the reasons for introducing the digital euro:

“In the euro area, the establishment of a retail CBDC – the digital euro – is necessary to supplement cash and adapt the official forms of the currency to technological developments, so that the euro can be used as a single currency, in a uniform and effective manner across the euro area” (COM(2023) 369 final).

However, in the very same document there is a clear statement that CBDC to be issued by the European Central Bank under no circumstances will take the form of a programmable CBDC, i.e., “The digital euro would not be programmable money and could therefore not be used to limit its spending or direct it at specific goods or services: as a digital form of the single currency, it should be fully fungible” (ibid.). Very recently, various representatives of the ECB have called for a swift introduction of the digital euro, also due to rising risks of geopolitical fragmentation and a need for the European Union to maintain control over its monetary and financial system – a diplomatically framed argument for reducing reliance on US-based payment providers (Lane 2025).

¹ For more insights regarding general ontological theories of money, see, e.g., de Bruin et al. (2023).

A more open approach towards programmability of their CBDC is presented by the Chinese authorities. Although digital yuan (e-CNY) is not par excellence programmable, it has specific functions easing its use in programmable payments, namely smart-contract and conditional-payment features. Moreover, in 2023, the People's Bank of China conducted a pilot study in Chengdu, distributing e-CNYs that were programmed to allow payments for public transport only. Some representatives of the Chinese financial authorities are openly suggesting adding a programmable dimension to the e-CNY in the future². The situation is quite the opposite in the United States, where President Donald Trump, in his Executive Order of January 23, 2025, prohibited any actions aimed at creating a digital dollar.

This paper proceeds as follows. Section 2 presents various theories referring to the ontologies of money. Next, Section 3, discusses in detail characteristics of PCBDC. Then, in Section 4, it is answered which ontological views on money allow PCBDC to be qualified as money. Conclusions follow.

1. Disentangling different ontological theories of money

In the above introductory remarks, we referred to two important traditions in the ontology of money. Since the commodity theory of money is of little use nowadays, as most money is fiat money, we should primarily refer to various theories treating money as a specific institution. An insightful instantiation of such a view is a perspective offered by J. Searle in *The Construction of Social Reality* (1995) where money is an institutional fact or, in other words, a kind of a commonly shared belief:

“in order that the concept ‘money’ apply to the stuff in my pocket, it has to be the sort of thing that people think is money. If everybody stops believing it is money, it ceases to function as money, and eventually ceases to be money” (32).

And next he adds: “Most money is now in the form of magnetic traces on computer disks. It does not matter what the form is as long as it can function as money” (34–35). So, here we have a definition of money in terms of its function (what money does) rather than of its structure (what money is made of). Such definitions are typical of institutions, and the primary task of institutions is to facilitate exchange. So, here we have money-as-an-institution ideal, as Guala (2020) nicely explains: “To say ‘X is money’ is a shorthand for a complex list of possible actions for the proper use of object X, which is regulated by money-as-an-institution. Actions such as purchasing, borrowing, saving, betting, inheriting, and so forth” (275). On a more metaphysically rich understanding, money consists of “deontic power to buy, pay, and close debts” (Searle 2017, 1463), granting individuals “the ability to buy and sell and the ability

² See, e.g., a 2023 statement by Mr. Lu Lei, deputy administrator of the State Administration of Foreign Exchange, as reported by Reuters (<https://www.reuters.com/markets/currencies/china-fx-regulator-says-cbdc-features-could-improve-monetary-policy-2023-10-13/>).

to incur and pay debts” (Searle 2017, 1466)³. Everyday statements such as “the purchasing power of money” can be framed in this way.

Stating that money is an important institution easing market exchange means that it reduces transaction costs what should motivate individuals to use money. However, once it ceases to perform this function, it is no longer money. For instance, if a given currency is subject to hyperinflation, people are more willing to use different currencies, and thus the malfunctioning currency starts to lose its status as money. In this context, Hindriks (2024, 20) states that “bills and coins are artifacts that can but need not be money. What ultimately matters for being money is not whether an entity is accepted as such, but whether it performs its functions”. One reservation is in order here: something can be partially money, meaning it does not fulfill all the functions that money should have⁴. Or, in other words, it has the potential to become a widely used form of money, but it has not yet fully achieved this status due to volatility, limited acceptance, and regulatory concerns. Some cryptocurrencies (probably) have such a status, at least for now.

Let us come back to the just disregarded commodity theory of money, and let us have a closer look at what *commodity* can mean. Historically, as we have mentioned earlier, it was a particular commodity, for instance, a cow, a barrel of oil, or a golden coin. In modern monetary systems such a theory is generally claimed to be untenable, however, what if we introduce the idea of a universal commodity, namely an abstract commodity which is exchangeable for all others? For instance, in Walras’ moneyless economic model, the numeraire represents the pre-existing value of a randomly selected commodity, serving as the reference standard of value against which the exchange rates between commodities are calculated. But this randomly selected commodity can be a kind of an abstract commodity being introduced *artificially* to serve as money. There is a long tradition in economics to treat this commodity as a kind of lubricate that facilitates market exchange as Hume once famously said: “Money is not, properly speaking, one of the objects of commerce, but only an instrument. It is none of the wheels of trade: it is the oil which renders the motion of the wheels smooth and easy” (Hume 1792). In modern interpretation, “As opposed to the *commodity* cigarette, the *monetary* cigarette in any cigarette *standard* would be an *abstract* cigarette” (Ingham 2004, 25). We will use these terms later in describing PCBDCs. For now, let us just describe such a view on what money is as the abstract-commodity theory of money.

What is common to all the above-discussed theories of money is that money, whether treated as a commodity or as an institution, emerges spontaneously from human interactions. It is only after evolutionarily emerged that it is backed by state authority, though state intervention cannot be considered a condition *sine qua non* for the persistence of money in market exchange. In such a perspective, “Money is

³ For more insights regarding Searl’s views on money, see, e.g., Hindriks (2024).

⁴ Some authors debating these issues introduce a distinction between the nominal essence of money and its real essence, however, referring to such debates is beyond the scope of this paper (more philosophically oriented readers are advised to look into, for instance, Mäki (2020)).

not a medium that emerges from exchange. It is rather a means for accounting for and settling debts, the most important of which are tax debts" (ibid., 47). So, here we have the state theory of money with its central claim that it is impossible to understand money "without the idea of the state" (Knapp 1973, vii–viii). Here, the state is not primarily issuing money rather it is accepting what can be qualified as money, namely a means to pay taxes.

An interesting *example* of this theory *in practice* was the proposal of the former Italian government in 2018 to allow Italian citizens to pay their taxes with Italian government bonds. If this were to happen, then according to this theory, these bonds would become a form of money. This proposal was met with clear criticism from M. Draghi, the then-governor of the ECB, saying: "They are either money, and then they are illegal, or they are debt, and then that stock goes up [...]. It is either money or debt, and I do not think there is a third possibility" (2019). In this sense, if a given government were to accept, for instance, Bitcoin as payment for taxes, then Bitcoin would be considered money⁵.

Let us return to our considerations on the ontology of money. The state theory of money described above can be understood as a view in which money is exogenously created, namely through the state's act of accepting something as a means of paying taxes. On the other hand, however, we have endogenous money theories where "first, loans make deposits, second, deposits make reserves, and third, money demand induces money supply" (Wray 1990, 73–74). Proponents of exogenous money theory recognize that the banking system generates credit money, but maintain that the central bank retains control over this process through its ability to issue high-powered base money as reserves for the system. Nevertheless, in all these theories money is a kind of credit relation.

Now, on a more sociological front, money is seen as a symbolic medium of communication and interaction. Also, especially in the Weberian tradition, money is not a neutral veil but "a weapon in this struggle [for economic existence], and prices are expressions of this struggle; they are instruments in this struggle only as estimated quantifications of relative chances in this struggle" (Weber 1978, 108). However, money *qua* weapon is not a very useful concept to be employed in answering the central question of our paper. But still, it underlines the very fact that what is accepted as money has important redistributive consequences. Being in the field of sociology, it is worth turning to Simmel's *The Philosophy of Money*, which is however more focused on what money does to society rather than on what money is. Nevertheless, he criticised the commodity theory of money and states that "money

⁵ For instance, in an official statement from 2014 the US Internal Revenue Service (IRS) announced that it would treat virtual currencies not as currency for federal tax purposes: "The IRS is aware that 'virtual currency' may be used to pay for goods or services, or held for investment. Virtual currency is a digital representation of value that functions as a medium of exchange, a unit of account, and/or a store of value. In some environments, it operates like 'real' currency [...] is customarily used and accepted as a medium of exchange in the country of issuance – but it does not have legal tender status in any jurisdiction" (IRS Notice 2014-21). It was confirmed more recently in IRS Notice 2023-34.

is only a claim upon society” (1978, 177). So, for him, the very existence of money results from individuals’ beliefs that something is money, and such a belief system is a kind of a “social-psychological quasi-religious faith” (ibid., 178). In other words, money is a cultural fact. Once money *exists* in individuals’ minds as a shared mental model, it can then be represented symbolically. It is insightfully, and metaphorically, described in Y. Harari’s *Sapiens*:

“[...] money is also the apogee of human tolerance. Money is more open-minded than language, state laws, cultural codes, religious beliefs and social habits. Money is the only trust system created by humans that can bridge almost any cultural gap, and that does not discriminate on the basis of religion, gender, race, age or sexual orientation. Thanks to money, even people who don’t know each other and don’t trust each other can nevertheless cooperate effectively” (2015, 177).

So, money is here conceptualised as a trust system. It is similar to view money as an institution enabling human cooperation.

What we have done above legitimizes us to claim that the dominant ontological theories of money locate money in collective agreement, credit relationships, and state law, rather than in innate properties of objects. Most functionalists traditions, on the other hand, define money, including its existence, by its roles and functions. What needs to be added here, however, is that the intrinsic properties (functions) of money, such as its power to enable the purchase of goods, can be offset by external conditions, such as a legal system that prohibits the use of a given form of money. A necessary condition for money’s proprieties (functions) to be actualised is that money must be used. Also, what should be now clear is that a given *X* can be money under, say, functionalist ontological theory of money, but at the same time not according to state theory if *X* is not legally backed by the state. Although studying this is definitely beyond the scope of this paper, it is unlikely that *X*, accepted as money by a given state authority, can persist in the long term if it is stripped of the typical functions of money, namely a medium of exchange, a unit of account, and a store of value.

In what follows, we will discuss the key characteristics of CBDCs, especially those with programmable features. Next, we will return to various ontological theories of money to examine under which theories a PCBDC qualifies as money.

2. Central bank digital currencies with programmable features

We now have examples of central banks that have introduced their own digital currencies, albeit with caution and various limitations, e.g., the digital yuan issued by the People’s Bank of China. Several other major central banks, including the ECB, are now on the verge of doing the same. Although the idea of expanding access to digital central bank liabilities dates back at least to Tobin (1985), recent developments in the area were stimulated by advancements in financial-sector technologies, new competitors entering payment and intermediation markets, a noticeable drop in

cash usage in some countries, and growing focus on privately issued digital tokens (BIS 2018, 3).

There is still an ongoing debate concerning how to best define central bank digital currencies, especially on how to distinguish CBDCs from other forms of electronic money, including reserves. Here are some definitions:

“[...] a CBDC is a digital form of central bank money that is different from balances in traditional reserve or settlement accounts” (ibid., 4).

“digital euro denotes a liability of the Eurosystem recorded in digital form as a complement to cash and central bank deposits” (ECB 2020, 6).

“digital euro means the digital form of the single currency available to natural and legal persons” (COM(2023) 369 final).

“Central Bank Digital Currencies (CBDCs) are digital representations of sovereign currency that is issued by a jurisdiction’s monetary authority and appears on the liability side of the monetary authority’s balance sheet” (OECD 2023, 5).

All of these definitions share the idea that CBDC is a form of central bank money that is digital, universally accessible, issued by the central bank, and implemented either as tokens or through accounts. However, CBDCs can vary based on who is permitted to use them and their underlying technology. The main distinction lies between retail and wholesale CBDCs. A retail CBDC functions like cash or a bank deposit and is open to households and businesses for daily transactions. In contrast, a wholesale CBDC is limited to financial institutions and is designed for high-value interbank payments and settlements. While both types represent liabilities of the central bank, wholesale CBDCs simply convert existing central bank reserves into digital form, whereas retail CBDCs broaden access to central bank money to the general public.

Another important classification is account-based vs. token-based (a bearer instrument). A token-based CBDC resembles digital cash: transfers are peer-to-peer and verifying a payment involves checking the token’s authenticity. A general-purpose token CBDC would be accessible to anyone (a retail digital currency), whereas a wholesale token CBDC would be restricted for interbank settlements. By contrast, an account-based CBDC would require users to have digital accounts with the central bank. In this model, the central bank opens accounts for individuals or businesses and records balances and transactions, with identity verification on each account holder. Account-based CBDCs function like today’s electronic bank deposits, but held at the central bank.

A bearer-form CBDC would operate beyond the immediate oversight of the central bank and its regulated intermediaries, which means that things like caps on how much one can hold, limits on the size of cross-border transfers, and restrictions on who can use it would have to be built into and enforced by the payment device itself (ECB 2020).

Now, let us focus on programmable CBDCs. Here again we have various definitions, for instance, ECB (2024) defines it as “a digital form of money used for a predefined purpose, like a voucher, with limitations on where, when or with whom people

can use it". Similarly, Lee (2021) in a FED Note of June 23, 2021, states that "Two natural components of the definition [of the programmable CBDC] are a digital form of money and a mechanism for specifying the automated behavior of that money through a computer program (this mechanism is termed 'programmability')". In other words, programmability requires an inseparable link between the currency's ledger and executable logic. Importantly, some analysts distinguish programmable payments (where the payment system can enforce logic) from programmable money (where the currency itself has embedded restrictions) (IMF 2023). In either case, programmability relies on technologies like smart contracts or APIs to trigger actions when conditions are met. Meanwhile, some central banks emphasize that adding programmable features should not compromise money's fundamental qualities. In fact, institutions like the ECB and the Bank of England have made it clear they are not to introduce fully programmable CBDCs.

Nevertheless, as a recent survey by BIS confirms, 62% of central banks in advanced economies and 39% in the emerging ones consider introducing wholesale CBDCs that allow for programmable payments (BIS 2024). Interestingly, however, less than 15% central banks in advanced economies study the possibility of introducing programmable money in the form of PCBDC (app. 25% in emerging countries). Here, programmable CBDC is understood as "a coherent product that encapsulates both the storage of digital value and programmability of that value" (ibid.). Debating technical complexities of doing it is beyond the scope of this paper.

For the sake of simplicity in what follows, we are to understand PCBDC as a digital form of money with an inseparable programmable dimension allowing for imposing such restrictions as paying only for certain goods, imposing expiration dates, or adjusting interest automatically.

3. Programmable CBDCs as seen from various ontological theories of money perspective

Let us start from the functionalist ontological view on money. Here, a programmable CBDC can be qualified as money only if it performs crucial functions of money, namely a medium of exchange, a unit of account, and a store of value. The programmable nature of PCBDCs may make performing these functions difficult, if not impossible. For instance, if currency units are encoded with spending restrictions or expiration, their fungibility is constrained, potentially undermining their general acceptability, and thus making PCBDCs special-purpose tokens. Also, programmability could hinder the store of value role if one adds an expiration date to PCBDC. Lastly, PCBDC can perform the role of a unit of account if prices and contracts refer to that currency. Therefore, under the functionalist view PCBDC can hardly be treated as money.

On the other hand, if we treat money as an institution (a shared belief) facilitating exchange then PCBDC can potentially qualify as money. This is so, when people think a given PCBDS is money. Its moneyhood rests on collective recognition. To program

a CBDC is to layer additional institutional rules onto what is already an institutional construct. However, once programmability takes the extreme form of an algorithm whose logic of action is largely hidden from the possessor of money, such a PCBDC may lose its status as money, since it ceases to be collectively recognized. In general, the programmability of CBDC can be seen as a factor undermining trust, so once a given central bank decides to issue such a CBDC, it should be very careful in communicating its programmable functions to the public.

In the state theory of money, it is the state that grants the status of money to a given instrument. So, once the state declares that PCBDC is money then it is so. In particular, when the state allows individuals to pay taxes using PCBDC, such acceptance gives PCBDC the status of money. Synonymous name of the here-referred-to theory is chartalism, a term originally coined by Knapp based on the Latin word *charta* which “bears the sense of ticket or token” (1924, 32), and next, “Chartality rests on a certain relation to the laws” (34). So, for instance, the future moneyhood of digital euro in the chartalism sense would be derived from the now proposed regulation of the European Parliament and of the Council on the establishment of the digital euro (COM(2023) 369 final). However, its Article 24 prohibiting the introduction of programmable euro immediately strips it of the status of money under the state theory of money

Last but not least, let us look at the PCBDC from the perspective offered by the credit theory of money. Here, PCBDC is a digital ledger of central bank liabilities: each electronic unit is a claim on the central bank (or government). Once such a claim is allowed, then its representation, a PCBDC, is money in the credit theory sense. It should be added however that the majority of credit theories are preoccupied mostly with interpersonal debts (I owe you something) rather than with only impersonal *state* debt claims (a state owes you something). And here we have a challenge since, say, a PCBDC allowing only for paying public transport tickets can hardly be considered someone’s debt. Not to mention a programmable PCBDC with an expiration date which would be highly unusual for a credit relation. The credit theorist might say that PCBDC *functions* like money but is not literally credit in the same way a bank ledger is. So, the PCBDC is more aligned with the state’s credit than with personalized debt-credit, and hence it only partially satisfies credit-theory criteria.

In sum, the PCBDC can be money at least under some ontological theories of money, for instance, the state one. In other cases, programmability introduces significant uncertainty about whether a given PCBDC qualifies as money. It should also be emphasized that, in practical terms, the answer to this central question must be determined on a case-by-case basis, as it depends on the specific type of programmability involved.

Conclusions

Whether a programmable central bank digital currency qualifies as money depends on the ontological theory of money applied. Under the state theory it is money, however, under the institutional theory it only could be money, and in the credit theory sense it is money but with caveats. This presents a different situation from that of a standard CBDC, which – at least from an ontological perspective – leaves no illusions about its monetary status⁶. Therefore, it is legitimate that the vast majority of central banks considering the introduction of CBDCs have made it clear that they do not intend to introduce programmable CBDCs.

But still, many questions remain. For instance, especially in legal documents regarding CBDCs there is a clear distinction between programmable payments using CBDCs and programmable CBDCs as such. Whether such a distinction is possible to be applied in practice is rather unclear given fast developments in blockchain technology (see, e.g., Lee 2021). Also, many important issues emerge while debating whether it would be easier to add a programmable dimension to token-based or account-based CBDC. We leave those questions for further studies, since this paper should be treated mostly as an invitation for interdisciplinary studies regarding the status of programmable central bank digital currencies.

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⁶ We set aside questions related to the impact of CBDC introduction on the monetary transmission mechanism and cross-border payments, as these issues are not central from the perspective of the ontology of money.

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