

Cryptocurrencies, Evolution of Means of Payments and Validity of Monetary Principles

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Abstract

The paper explores the role, evolution and ruling principles of the concept of “money” in the 21st Century. In this continuously evolving context, cryptocurrencies and Blockchain technology are widely considered the most relevant monetary innovations of the last decades. By means of a macro-founded logical-analytical approach combined with statistical evidence, the paper provides arguments:

1. dismissing the “innovation myth” behind cryptocurrencies because of *de facto* representing a comeback of the private issue of means of payments and, more problematically, seigniorage at its best;
2. confirming that crypto-tokens do not comply with basic, still ruling monetary principles;
3. suggesting that excess liquidity is already invested in crypto-markets (which are themselves “inflationary”, namely not backed by real value (i.e. GDP).

The concrete risk is, once again in economic history, represented by facing a financial bubble.

JEL classifications: E44, E51, E58

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I. Introduction and Methodological Approach to the Essence of Cryptocurrencies

Cryptocurrencies, which we will temporarily (and unsatisfyingly) define as “digital currencies or virtual currencies [being] a form of digital money” (*Central Bank of Ireland* 2021), are perhaps among the most discussed monetary innovations the scientific community has witnessed in the last decade. It is therefore no surprise that economists from different schools of thought (*Belke/Beretta* 2019 and 2020a; *Liu/Tsyvinski* 2020; *Enoksen et al.* 2020; *Siu* 2021) have carefully analyzed risks and potentials of these privately issued financial instruments. For sure, cryptocurrencies are a direct effect of shrinking trust levels in “traditional” banking systems in the aftermath of the global financial crisis (2007–). At the same time, several crypto-tokens among the 8,994 available (*CoinMarketCap* 2021a) – especially, Bitcoin – have benefited from great publicity due to skyrocketing price increases such those occurred from 2020 to 2021, although even huge drops (2018–2019) have been big news (*CoinMarketCap* 2021b). If volatility is a harmful financial phenomenon, it also creates awareness of the concerned financial instruments involved and indirectly promotes them. For sure, fluctuations will be a crucial factor in deciding whether cryptocurrencies will soon become widely used financial investments or remain at a speculative level.

Section II. and Section III. of the paper analyze the fundamental characteristics, which money still has to bear in modern eras of payments. The paper also explores what is happening to Bitcoin in recent times. More specifically, it also claims that part of the liquidity in excess circulating in the banking and financial systems worldwide might have been invested in the crypto-market (*Beretta* 2020), which in turn contributes to increase its nominal price. Among the most significant conclusions, no private nor public economic agent is able to create “wealth” out of nothing. In fact, only “liquidity” can be created by a stroke of a pen, but nothing more. Even if such excess liquidity (as compared to GDP) might stimulate entrepreneurial moves (and, therefore, economic growth), this would be an indirect effect of having already monetized a part of future GDP and of having issued the corresponding money volumes in advance. In this specific regards, For instance, “[c]entral Banks would pay for their purchases with empty money, causing an inflationary increase in the quantity of money. [...] Financed through money creation, the purchase of bonds loses its inflationary character as soon as it is integrated in the set of monetary and financial intermediations carried out by the banking system. What seemed to be an inflationary emission of empty money is reduced to a simple advance of income which does not fundamentally modify the relationship between money and output” (*Cenci-ni* 2002). Nevertheless, it remains that banks cannot issue positive (i.e. real) value (*Werner* 2014a), although they contribute (as any economic agent while re-

munerating labor and compensating the production of goods and services) to GDP. More precisely, banks contribute to economic wealth not because they issue money, but because they pay wages to employees and thereby feed the pool of the goods and services yearly produced and included into GDP. If we add that cryptocurrencies are not even book money issued by banking systems, they contribute at least in the same way to soaring liquidity volumes, inflationary pressures and financial bubbles (*De Souza et al. 2017*).

The economic literature has often analyzed cryptocurrencies from a perspective of costs and benefits (*Boshkov 2009; Committee on Small Business 2014*). It has been also investigated how the underlying technology, namely the Blockchain¹, might contribute to daily banking and financial transactions (*Carson et al. 2018*). Most contributions take, however, the concept of “cryptocurrencies” as granted, as if it would bear no specific need of further investigation. According to *Cambridge Dictionary* (2021), they represent “a digital currency produced by a public network, rather than any government, that uses cryptography to make sure payments are sent and received safely”, which is a quite different statement from “cryptoassets [...] or, as you might know them, cryptocurrencies” (*Bank of England 2021a*). In fact, “currency” and “asset” are even in mainstream economics not synonymous, meaning that it seems for now more appropriate to conclude that “there is no generally accepted definition of the term cryptocurrencies available in the regulatory space” (*Houben/Snyers 2018*). In the same way as already in *Section II.*, the essence of crypto-tokens has to be explored from the angle of view of the three functions (*Carlini 2018*) mainstream economics defines “money” with. After exploring what they (monetarily speaking) represent as compared to currencies, *Section III.* will assess price and volatility trends in crypto-markets and the urgent need of intervention in terms of economic policies.

The paper adopts a logical-analytical macroeconomic approach combined with empirical and/or statistical evidence stripping down the problem to its profound, macroeconomic essence. The relevant message remains that money – no matter how digitized époques might have become – entails essential characteristics, which have not been overcome by technological advances. Cryptocurrencies remain an interesting innovation, but they should comply with still-valid monetary principles.

¹ More precisely, “[a] blockchain is a collaborative, tamper-resistant ledger that maintains transactional records” (*National Institute of Standards and Technology 2021*).

II. The Macroeconomic Essence of Cryptocurrencies and the Risk for Economic Stability

1. Physical Versus Digital Money

“Money” is a cyclically to-be-updated concept, which depends on the historical era it is used in. For instance, monetary history has been regularly characterized by the use of cigarettes in prisons (Mellor 2019) if other means of payments were less available. But, even centuries before, shell fishes have been used as a payment instrument (Wells 1876). From more modern eras onwards, money has been increasingly associated with its physical dimension and, more precisely, its material (Orrell/Chlupatý 2016). The gold standard (1870 – 1914 and 1918 – 1939) before and the gold-exchange standard (1945 – 1971) then are suitable examples of (partially) metallic monetary regimes, which might nowadays belong to the past in terms of payment instruments used (i.e. gold coins and/or bullions and claims on them), but still influence the role of precious metals as epitomes of stores of wealth in post-modern eras. In fact, economic subjects still have a pronounced tendency to associate money with a physical, commodity-like dimension. However, there is no doubt that in 2021 money is issued digitally as a simple book entry in the records of banking systems, since “banks create only ‘nominal money’, which has no purchasing power; only when the ‘baggage checks’ or ‘promises’ are handed out by firms to factors of production do they allow those factors to draw upon the output: only firms create ‘real money’” (Deleplace/Nell 2016).

As explained in Cencini (2008) and depicted in Table 1, the issue of money to the benefit of a Subject A symbolizes a spontaneous acknowledgement of debt. By doing so, a bank becomes indebted towards him/her. The claim of Subject A (which is recorded as a liability in the records of the bank) is also matched by an equal debt entry (which is recorded by the bank as an asset). In fact, Subject A is indebted towards the bank from which he/she borrows the newly created sum x while the bank is also indebted towards him/her by an equal amount. This accounting operation is not null since the credit towards Subject A derives

Table 1
The Issue of Book Money as Asset-Liability

Bank			
Assets		Liabilities	
Subject A	x	x	Subject A

Note: based on Cencini (2008).

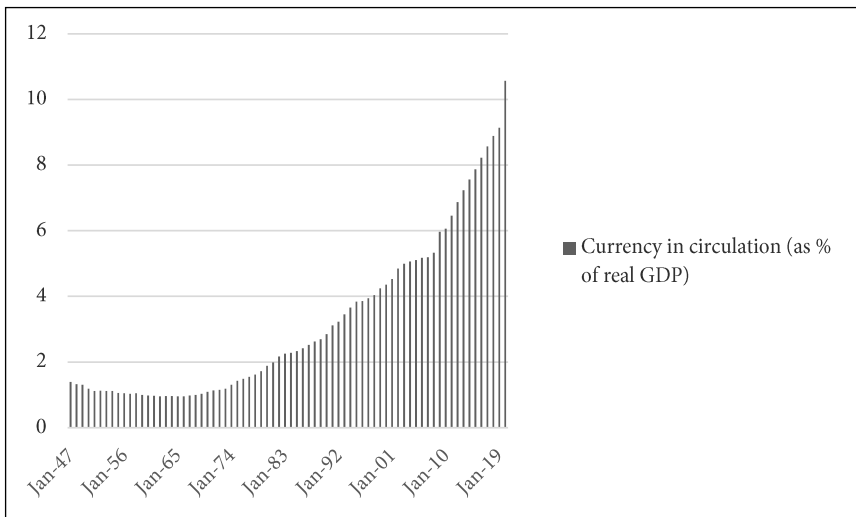


Figure 1: Currency in circulation (as percentage of real GDP), United States of America (1947 – 2020) (based on data Federal Reserve Bank of St. Louis 2021a, 2021b)

from the issue of money by the bank while the debt towards Subject A represents his/her obligation to reimburse the newly created sum x . Clearly, just a part of global liquidity is normally held in its physical form like notes and coins, although cash in circulation is still increasing (Figure 1) (Beretta/Neuberger forthcoming).

However, neither “older” nor “newer” characteristics of money alter its essence, which remains precisely the same as originally. Despite its century-long use, the meaning of money is still underexplored as the mainstream economic definition often proves. In fact, money is commonly defined in three (coexisting) ways, namely as a “unit of account”, “medium of exchange” and “store of value” (Officer 2009). If we would have to play a guessing game, we would suggest that only two functions are coherent while one is not. Let us analyze them separately.

2. Cryptocurrencies as Units of Account?

The function of “unit of account” is for sure coherent, because book money has no intrinsic value and almost no cost when issued by the banking system. For instance, the cost of production of Swiss banknotes “averages around 40 centimes” (Swiss National Bank 2021) despite having the largest-size one a face value of 1,000 CHF (i.e. 2,500 times higher than its cost of issue). Moreover, mon-

ey is a number transforming physical goods and services into their economic form (“[M]oney measures, in numerical terms, all those objects that are dealt with in a monetary production economy. These objects are the result of production” (*Gnos/Rossi* 2020)). For instance, as the term itself states, the Gross Domestic Product (GDP) represents not only goods and services produced within a year in a certain economy (*Bank of England* 2021b), but is moreover the real production as counted by money units. Money confers commensurability to goods and services, which would remain intrinsically not comparable from a physical point of view. Hence, “[w]ithout money, output would simply amount to a heap of physically heterogeneous objects, and would, therefore, remain totally undetermined” (*Cencini* 2010). The fact that book money has no macro-economic value without a real backing (i.e. being associated to goods and services) also proves that it actually is a unit of account, which cannot have an intrinsic value itself, but acts as the denominator of goods and services (“[m]oney serves as a common denominator in terms of which the value of all other commodities is expressed” (*Agarwal* 2010)).

As already mentioned, the very first function of book money is that of “unit of account”, which mostly overlaps with that of “unit of measurement”. In fact, “[t]he accounting system uses money as its basic unit of measurement. [...] This is because money is a useful way of converting accounting data into a common unit” (*Mukherjee/Hanif* 2003). However, cryptocurrencies do not bear any function of unit of account, since in economics the standard of measurement is only represented by money (i.e. the numerical form making goods, services and financial securities measurable).

Money itself as a unit of account is issued by the banking system, which does not necessarily coincide with the financial system (i.e. a broader concept in terms of institutional actors, but a narrower one in terms of functions). In fact, banks are not only intermediaries like other financial institutions or funds borrowing and/or lending existing resources, but they are also money issuers (*Werner* 2014b). Clearly, this double function distinguishes them from any other economic and financial subject. Even if cryptocurrencies should be (wrongly) defined as “units of account”, they should at least not be compared to money, which underlies specific regulations and gives a common numerical measure to all goods, services and financial securities in circulation worldwide.

3. Cryptocurrencies as Media of Exchange?

If we move to its second function, namely that of “medium of exchange”, it can be argued that – since money has no intrinsic value – it cannot be necessarily the object, but just the medium of any exchange. Otherwise stated, “[m]oney is only a simple intermediary, without any intrinsic value and is incapable of de-

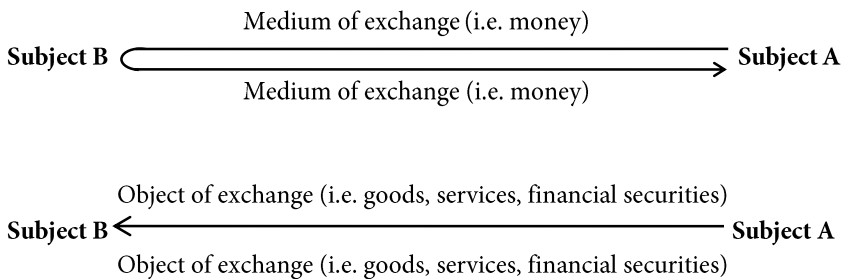


Figure 2: Media of exchange (i.e. flows) and objects of exchange (i.e. stocks)
(based on Beretta 2019)

fining a final payment” (Cencini 1995). Would it make any macroeconomic sense, if the final term of exchange (i.e. the object to transfer), would be void of value like money whenever not in combination with real products? Obviously enough, there would be no utility from giving up real goods for nominal values. Money is, as shown in Figure 2, a medium while the object of exchange is made of goods and services (i.e. current production) or financial securities (i.e. claims on future production). Elsewise formulated, money defines a (circular) flow while goods, services and financial claims are stocks reciprocally exchanged.

This conclusion might be more difficult to understand, because even from a linguistic perspective “money” is used to define several different meanings. Despite that, “much what is called money these days isn’t it. There seems to be a lot of confusion between money and credit, and some of that confusion is built into the M definitions” (Hatch 2005). Banking systems do not issue economic wealth, but just money (i.e. liquidity). GDP alone (to which banking systems evidently contribute as employers remunerating workers for their economic activities generating goods and services) is instead at the origin of economic value and is made of all newly produced goods and services. Paradoxically, “if the ‘vehicle’ issued by banks could have a positive existence in time, then we would have to add it to the amount of income created by the work of man, thus artificially inflating the measure of wealth” (Cencini 2013). The function of medium of exchange is, therefore, coherent with the essence of money.

As pointed out, mainstream economics identifies money with a “means of payments”, which is created without any intrinsic value. Interestingly enough, even before digitization trends in payment methods, it was common knowledge that “[m]oney is a sign, and nothing more, which is used to represent the products, labor and services that men desire to exchange with each other” (Fourier 1876). Therefore, book money is intrinsically worthless without being associated to real current (i.e. goods and services) and/or future (i.e. financial securities) values (i.e. GDP). It is also appropriate to claim that money is a “means of

payments” while the “object of payments” are goods, services and/or financial securities. More precisely, “[n]ow, in order to measure real goods, services and assets in economic terms [...], as well as to homogenize all bank deposits that may exist within a monetary space in any period of time, a ‘numerical counter’ necessarily has to exist. This ‘numerical counter’ [...] is indeed provided by the banking system (including the central bank [...]) every time there is a need for it, that is, every time a payment has to be carried out” (Rossi 2017).

Cryptocurrencies work, however, differently, since they are generated from scratch by so-called “miners” (i.e. non-banks) and are used (where allowed) to settle transactions as if they were commodities embedded with an intrinsic value. At least as conceived nowadays, crypto-tokens originate as an alternative way of paying “based on cryptographic proof instead of trust, allowing any two willing parties to transact directly with each other without the need for a trusted third party” (Nakamoto 2008), but are used – despite measuring no real value – to settle transactions from a “final” point of view (Committee on Payments and Market Infrastructures 2021) as if they would entail a positive value. This way of acting is profoundly inconsistent with the essence of money.

Table 2
Top-10 Cryptocurrencies by Market Capitalization

Rank	Cryptocurrency denomination	Market Cap	Price
1.	Bitcoin	\$1,095.42 bn.	\$58,709.96
2.	Ethereum	\$209.28 bn.	\$1,818.04
3.	Binance Coin	\$41.42 bn.	\$268.01
4.	Cardano	\$40.27 bn.	\$1.26
5.	Tether	\$39.28 bn.	\$1.00
6.	Polkadot	\$33.57 bn.	\$36.43
7.	XRP	\$21.56 bn.	\$0.4749
8.	Uniswap	\$15.78 bn.	\$30.23
9.	Litecoin	\$13.63 bn.	\$204.35
10.	Chainlink	\$12.57 bn.	\$30.43

Note: based on data from CoinMarketCap (2021a) as of March 19, 2021.

Thus, the 18,663,906 Bitcoin (*CoinMarketCap* 2021b) mined as of March 19, 2021, which correspond to a countervalue of \$1,095.42 bn., add up to money volumes issued by commercial and/or central banks (where the monetary aggregate M3, which evidently does not include Bitcoin, stood at €13.744,30 bn. in the fourth quarter of 2020 (*European Central Bank*, 2021b)). If book money created by the banking system in excess to GDP has an inevitable inflationary impact² on the market where excess liquidity is invested, this conclusion must even more apply to cryptocurrencies being created by the stroke of a pen whose collateral is technology alone (but no macroeconomic value). Otherwise stated, “Bitcoin [...] has no intrinsic value; it never did and never will. It is a purely speculative asset – a private fiat currency – whose value is whatever the markets say it is” (*Buiter* 2021).

For sake of completeness, we should also mention a fourth function to be called “payment function” in line with *Jevons’* (1875) concept of “standard of value”, who once stated that “[e]very person making a contract by which he will receive something at a future day, will prefer to secure the receipt of a commodity likely to be as valuable then as now. This commodity will usually be the current money, and it will thus come to perform the function of a standard of value”. At the same time, *Issing* (2014) reminds that „[m]oney also serves as a means of repaying debts” while *Marx* (1890) even considers the means-of-payment functions to be just intertemporal in order to bridge the gap between payments by credits (demanded for investments) as opposed to money as a means for circulation (*Neuberger* 2019). In fact, money existed in the form of debt far before exchange (*Graeber* 2012).

For sure, the credit function is crucial in order to enable productive investments in the real economy. In turn, cryptocurrencies do not originate from credits and cannot be used in a productive way and/or in association with real value. Like several typologies of unproductive credits in the financial sector (e.g. derivatives) cryptocurrencies are likely to be at the origin of financial bubbles. In the contrary, money might also have a (productive) credit function enabling investments in the real economy, since debts and claims are because of double-entry bookkeeping “two sides of the same coin”. In fact, as already highlight-

² As reminded by *Friedman* (1992), “inflation is always and everywhere a monetary phenomenon [...]. Inflation occurs when the quantity of money rises appreciably more rapidly than output, and more rapid the rise in the quantity of money per unit of output, the greater the rate of inflation”. The quantity theory of money (QTM) – where money is mostly considered a medium of exchange – holds especially in the long run when capacities are fully utilized. According to Milton Friedman’s neo-quantity theory of money where money is mostly considered both a medium of exchange and a store of value, the stability of its demand is a necessary condition for a proportional relationship between money and general price level, respectively money growth and inflation. However, financial innovations like cryptocurrencies could make money demand unstable.

ed in *Section I.*, banking systems can monetize income in advance by issuing money (without engaging in inflationary monetary policies).

4. Cryptocurrencies as Stores of Value?

It remains to explore, if the role of store of value attributed by mainstream economics to money also corresponds to reality. The most evident difference between the first two and this third characteristic is that – while the first two confirm that money has no (macroeconomic) purchasing power without being used to monetize goods and services – the third one contradicts this matter of fact. By referring to a “real backing” we are as already pointed out not thinking of some metallic collateral (for instance, gold or silver). In fact, in fiat-money regimes this is (rightly so) not anymore a requirement. Instead, we are referring to the fact that money (in order not to be inflationary and void of macroeconomic purchasing power) necessarily has to be covered by the “real value” provided by GDP. While stores of value like precious metals, assets etc. bear an intrinsic value book money does not. More precisely, only fiat money not backed by GDP (or exceeding GDP) is inflationary. The alleged function of store of value is in any case highly imprecise, since it does not separate “money” (issued by a stroke of a pen without any real (i.e. productive) effort) from what we might call “savings”, namely net saved incomes and the unspent outcome of production of goods and services measured by money, because of deriving from GDP. As pointed out by *Howells/Bain* (2005), “[i]n everyday language [...] we think and talk about income, saving, wealth and so on in money terms. [...] But it is important to be absolutely clear that ‘money’ is merely some token in which we choose to reckon these magnitudes and use to carry out exchanges. [...] Because saving (adding to wealth) is being carried out by holding ‘money’, money is said [...] to be functioning as a store of wealth”. It appears that, even from a terminological point of view, there still is much confusion between “money”, “income” (i.e. production of goods and services measured by money) and “savings” (i.e. net saved incomes) where “[m]ore money cannot generate more real savings or real economic growth” (*Shostak* 2009).

“Stores of value” rather correspond to “savings” (i.e. net saved incomes), which can be also invested in financial securities, precious metals etc. For instance, a saver holding a part of his/her savings in form of notes and coins is not storing and/or exchanging “money” as defined above, but “bearer certificates” (i.e. financial securities) representing *de facto* a claim on his/her “savings”. While money (which has no intrinsic value) cannot be a “store of value” neither today nor in the future – something with no macroeconomic value would namely make even terminologically any sense to consider it a “store of value” – “savings” well are. From a macroeconomic perspective, it is crucial to draw a similar

distinction allowing to understand what has a macroeconomic value because of referring to current and/or future goods and services and what has not.

With specific regards to the third function of “store of value”, there is no doubt that Bitcoin has been a profitable investment if bought at the right time (i.e. at lower prices). But has everything, which subjects spend resources on, bear a real value? Not necessarily. The difficulty consists in understanding that – from a microeconomic (i.e. individual) perspective – owners of cryptocurrencies might have had a significant return on the originally invested capital. However, from a macroeconomic perspective (i.e. as a whole), cryptocurrencies do not increase wealth having no real value.

Claiming that the creation of crypto-tokens would lead to additional economic wealth would be equal to assert that the issue of money enriches the society. On the contrary, macroeconomic analysis shows that “[t]he central bank attempts to stimulate the economy by injecting money (liquidity) into the economy. This new money is created out of thin air – it has nothing to back it up, and therefore has no actual value, but those who get first use of this new money get to use it at face value. [...] The central bank’s money is not “earned”; that is, it has nothing of real value to back it up – no increase in productivity or a commodity such as a precious metal that justifies the existence of the new money” (Kennedy/Kennedy 2010). The above-stated “those who get first use of this new money get to use it at face value” part is particularly significant and confirms our preliminary conclusions:

1. what applies to individuals (i.e. from a microeconomic perspective) is not necessarily true for the economy as a whole (i.e. from a macroeconomic perspective);
2. even if the (over-)issue of means of payments (including for sake of simplicity also cryptocurrencies) might enrich their owners this would be a temporarily effect to be soon absorbed by inflation. *Section III.* also thoroughly deals with this aspect, which is directly related to excess liquidity and financial bubbles. From a microeconomic (i.e. individual) perspective, cryptocurrencies might perhaps act as stores of value (though risky and volatile ones) in the same way as individuals might decide to invest their savings in more or less “safe” investments. This is also true from a macroeconomic (i.e. general) point of view, meaning that savers might decide to invest a part of their income in cryptocurrencies and use these financial instruments as “stores of value”. Such conclusion is not in contradiction to the fact that cryptocurrencies have no intrinsic value at the time of issue, although they might “store” real value from invested income.

At this point, the reader might argue that the economic literature has generally not found the three functions to be inconsistent. For instance, as retrievable

in *Mishkin/Serletsis* (2010) by stating that “[w]hether money is shells or rocks or gold or paper, it has three primary functions in any economy: as a medium of exchange, as a unit of account, and as a store of value”, any academic book intended for students – apparently – confirms the role of money as a store of value. However, it takes only a few lines to specify that “[t]his function of money is useful because most of us do not want to spend our income immediately upon receiving it but rather prefer to wait until we have the time or the desire to shop” (*Mishkin/Serletsis* 2010). The authors are hence clearly referring – as also explicitly mentioned – to “income” and/or “savings” (depending on when they will be spent) like our paper consistently does. No matter how simplified and/or misused the concept of “money” might be in daily use, from a monetary perspective there cannot be any doubt that while writing of “money as a store of value” “income” and/or “savings” are meant. Only the latter (which derive from GDP and remuneration of labor) can in fact store a (macroeconomic) value.

5. *Cryptocurrencies as Conceived today and the Comeback of (Private) Seigniorage*

The object of our analysis should be rather defined as a “financial instrument”, since the term “asset” would be inadequate because of implying a real value. The definition provided by *BaFin – Federal Financial Supervisory Authority* (2020) mostly confirms this conclusion, but also lacks the macroeconomic precision needed from a terminological perspective: “[c]ryptoassets are also financial instruments [...]. They are defined [...] as: a) a digital representation of value which b) has neither been issued nor guaranteed by a central bank or public body; c) it does not have the legal status of currency or money but, d) on the basis of an agreement or actual practice, e) is accepted by natural or legal persons f) as a means of exchange or payment or g) serves investment purposes; h) it can be transferred, stored and traded by electronic means”. The “representation of value [...] neither [...] issued [...] by a central bank” part is, for instance, deceiving, because it does not clarify from which productive activity such “value” would derive. In fact, we have already specified that GDP is the only source of macroeconomic value and cryptocurrencies are not related to it. At the same time, it remains that not even the central bank can create wealth (i.e. income) out of nothing, but just liquidity (i.e. money). If the reader should question even this simple principle deriving from monetary macroeconomics, he/she would have found a zero-cost solution to poverty, namely over-issuing and distributing money. Even more *ad absurdum*, it should be also questioned whether policymakers should continue caring about GDP growth and/or unemployment rates, if economic institutions (or, in the case of cryptocurrencies, private subjects) were actually able to issue macroeconomic wealth.

One of the most relevant concerns about cryptocurrencies is that they are mint on a private (i.e. non-banking) basis. In the light of this, cryptocurrencies do not resemble technological advance, but rather “modern monetary Middle Ages” (*Belke/Beretta* 2020b), because the issue of money is once again becoming decentralized and “the legal value [of medieval money] was almost always higher than the intrinsic value, due to the costs of coining (“brassage”) and also to the fee that the minting authority levied on coins for its own benefit (“seigniorage”)” (*Feliu* 2018). If fiat-money regimes are already characterized by large-size banknotes and low costs of production, meaning that central banks achieve high profits in terms of seigniorage³, this matter of fact does not necessarily imply that such gains are inflationary (i.e. derive from having issued liquidity in excess to GDP). On the contrary, in the case of cryptocurrencies (which are disconnected from GDP), they are. It therefore might be of some interest to calculate how much these “modern seigneurs” – central banks on the one hand and miners of cryptocurrencies on the other – earn from respectively printing paper money and mining cryptocurrencies.

Table 3
**Printing Profit of the Federal Reserve System
Based on Banknotes’ Denomination**

<i>Note denomination</i>	<i>Printing Cost (per Note)</i>	<i>Printing Profit (per Note)⁴</i>	<i>Printing Profit Ratio (Percent)</i>
\$1	\$6.2 c.	\$0.94	94.00
\$2	\$6.2 c.	\$1.94	97.00
\$5	\$10.8 c.	\$4.89	97.80
\$10	\$10.8 c.	\$9.89	98.90
\$20	\$11.2 c.	\$19.89	99.45
\$50	\$11.0 c.	\$49.89	99.78
\$100	\$14.0 c.	\$99.86	99.86

Note: Based on data from Board of Governors of the Federal Reserve System (2021) as of March 2, 2021.

³ History tells that “[i]n bygone days it was the “seigneur” or lord who had the right to mint coins – hence the name. Today in the euro area the national governments mint coins and the central banks issue banknotes” (*European Central Bank* 2017).

⁴ The printing profit (per note) excludes any further costs of distribution, maintenance and/or replacement of banknotes and is a comparable measure to mining costs of cryptocurrencies.

The printing profit ratio (percent) in the United States of America as shown in Table 3 has been calculated in the following way:

$$\frac{\text{printing profit (per note)}}{\text{note denomination}} \times 100$$

and the printing profit (per note) has been derived from:

$$\text{note denomination} - \text{printing cost (per note)}.$$

It is clearly impressive that the printing profit ratio (percent) currently spans from 94.00 to 99.86 percent. In order to draw a comparison, in 2020 the cost to mine one unit of Bitcoin corresponded to \$4,758 in the United States of America (Coin Insider 2021)⁵, meaning that with respect to the Bitcoin price of \$58,709.96 as of March 19, 2021 (Table 2) the mining profit ratio was “just” 91.90 percent. Should we conclude that Bitcoin is less subject to seigniorage revenues than paper money⁶? Not at all, since cryptocurrencies already lack (macroeconomic) purchasing power because of being disconnected from GDP. This matter of fact puts the financial stability at risk, because it revamps the (historically well-known) leverage on money issue in excess to real wealth. Similar inflationary phenomena have occurred for centuries, as paradigmatically highlighted by the occurrences in France at the end of the 18th Century or even during the classical gold standard (1870–1914) with certificates on physical gold being over-issued “so long as the markets were convinced of the authorities’ commitment to defense of gold convertibility” (Eichengreen/Flandreau 1997). With specific regards to the just mentioned French Revolution (1789–1799), it should be noted that “the fear that monetary authorities would systematically overuse their right to issue money has always subsisted. This concern has been aggravated by the introduction of “assignats”, namely inconvertible paper money introduced by the insurgent Government of France in 1790 to finance its expenses – that is, not covered by levying taxes. The volume of circulating assignats has grown so uncontrollably and at the same time lost so much of its value that the Government was not even able to print the night before the assignats needed for the next day” (Ingrao/Ranchetti 1996 [own translation]).

The relevant difference is that cryptocurrencies do not even have a real backing to which they could have been over-issued. More precisely, any single unit of them is over-issued to GDP, which makes each one of them inflationary and reminds us that “[w]ithout any real content, empty money is literally a ‘non-in-

⁵ In Asian countries like China (where in 2020 65.08 percent of Bitcoins have been mined (Statista 2021)) costs were significantly lower.

⁶ Clearly enough, money as issued digitally by commercial and central banks is by far less costly.

come', and since an effective demand can only be exerted by a positive income, it is clear that a non-income defines an additional demand of an inflationary kind" (*Cencini* 2002). The fact that crypto-tokens like Bitcoins are subject to "a hard, asymptotic limit of 21 million coins, expected to be reached by 2040 or so, based on the mining algorithms" (*Putnam et al.* 2019) is also just symbolic, since limiting what has no macroeconomic value does not make it more valuable. Clearly enough, such conclusion does not derive from the private nature of cryptocurrencies. Moreover, it can be also extended to (public) financial instruments like Special Drawing Rights (SDRs) allocated by the International Monetary Fund (IMF) whose potentially inflationary essence has been often object of investigation in economic literature (*Cooper* 2011; *Bordo/James* 2011). In fact, "[m]any US and German politicians oppose SDR creation saying it is "funny money" that will ultimately cause inflation" (*Aiyar* 2009). It is common knowledge that SDRs are "neither a currency nor a claim on the IMF. Rather, [they are] a potential claim on the freely usable currencies of IMF members" (*International Monetary Fund* 2021b)). Nevertheless, they are allocated by a stroke of a pen despite having been also described as "an interest-bearing international reserve asset created by the IMF in 1969 to supplement other reserve assets of member countries" (*International Monetary Fund* 2021a). Once again, we should be already aware that not even international economic institutions can create wealth out of nothing – eventually, liquidity. This task does, however, not even belong to those of the International Monetary Fund, which funnily quotes *Driscoll* (1996) stating that „[John Maynard Keynes] admitted at the inaugural meeting of the International Monetary Fund that he was confused by the names: he thought the Fund should be called a bank, and the Bank should be called a fund. Confusion has reigned ever since". It suffices to say that the International Monetary Fund has actually never been a bank, but neither the World Bank (made of the International Bank for Reconstruction and Development (IBRD) and the International Development Association (IDA)) has ever been Defining money, monetary institutions and phenomena in a coherent way remains an underrated exercise, which is however strategic to make economic forecasts.

The theoretical conclusions on the essence of cryptocurrencies are solid enough to claim that this digital financial instrument might soon nourish a corresponding financial bubble. *Section III.* aims precisely at analyzing the price and volatility trends in crypto-markets and why symptoms of the underlying pathological nature of cryptocurrencies can be already witnessed.

III. Cryptocurrencies: From Being Inflationary to Nourishing a Financial Bubble?

After having explored the essence of cryptocurrencies, it remains to analyze the price trend in crypto-markets, its potential macroeconomic effects and how policymakers should deal with them. Before analyzing the recent empirical evidence, the relevant statement deriving from *Section III*. is that:

1. cryptocurrencies are inflationary (*Nath 2015*), namely blow up monetary volumes with respect to real production. This conclusion relies on the original (i.e. not just consumer-prices based) definition of “inflation”, which is “the process of making an addition to currencies not based on a commensurate increase in the production of goods” (*Federal Reserve Board 1919*).
2. precisely because of their inflationary essence, they contribute – in the same way as legal tender issued in excess to GDP⁷. In fact, “[s]ince the 1990s, we have seen that money and credit instruments worldwide have grown more rapidly than the accumulation of wealth in the economy [...]. From this came the formation of pockets of excessive liquidity and speculative bubbles which later turned into a series of solvency and confidence crises” (*Pontifical Council for Justice and Peace 2011*). Clearly, where price increases will occur would depend on the specific market (e.g. financial, real-estate, foreign-exchange, consumer-goods etc.) the inflationary liquidity is invested in. The causal nexus between excess liquidity, inflation and financial crises has been already explored by the *International Monetary Fund* (2013), which has highlighted that “surplus liquidity has the potential to cause the demand for real and financial assets to increase and thus contribute to asset price inflation. Hence, managing surplus liquidity is of interest not only from a monetary policy perspective (e.g. price stability) but also from a financial stability perspective”.

As already pointed out, cryptocurrencies are not comparable to money, but not even to financial assets – rather, to financial instruments. At the same time, it is a fact that crypto-tokens are already (macroeconomically, wrongly) used as commodities enabling their owners (where accepted) to settle real and financial transactions. If they should however not be used to settle economic transactions and should continue to be exchanged solely at the crypto-market level (i.e. among owners of cryptocurrencies for sake of diversification of financial portfolios), their inflationary effects would be (almost) null.

⁷ In fact, “financing government deficits by printing money is looked upon as the normal way of controlling the economy. In the past issuing an excessive quantity of a means of payment was called inflation” (*Berger 1973*).

Rightly so, financial instruments might be inflationary because of their essence (i.e. not being collateralized by real value), but – if they should lack spendability – they might not (entirely) display their inflationary potential. Such argumentation resembles what is also valid for the previously mentioned SDRs, namely that they “can only be inflationary if [they] cause inflationary increases in one or more national currencies. [They] can only lead to “SDR inflation” if [they] cause excessive increases in one or more of the currencies in the SDR’s valuation basket” (Coats 1990). Nevertheless, this conclusion cannot apply to cryptocurrencies, which are already (and increasingly) spent to finance real transactions and/or can be converted on special platforms charging a spread margin (Coinbase 2021) and providing the countervalue in fiat money. It has also to be expected that this trend will grow over the next years, meaning that the inflationary essence (and effects) of cryptocurrencies could soon become a major concern for financial stability. For sake of simplicity, let us reconnect the inflationary impact we refer to by means of a step-by-step approach.

1. Cryptocurrencies’ Inflationary Essence

As a proof that cryptocurrencies are increasingly used to settle real transactions, empirical evidence shows that – in 2020, in Nigeria, Vietnam and Philippines – respectively 32, 21 and 20 percent of respondents have used or owned cryptocurrencies. Despite being lower in relative (but higher in absolute) terms, Switzerland (11 percent), India (9 percent), China (7 percent), the United States of America (6 percent), Germany (5 percent) and Japan (4 percent) also rank high (Buchholz 2021). Because of being issued in excess to monetary aggregates “compris[ing] monetary liabilities of MFIs and central government (post office, treasury, etc.) vis-à-vis non-MFI euro area residents excluding central government” (European Central Bank 2021a), every time cryptocurrencies are spent, but also converted into fiat money they exert a corresponding demand in terms of goods, services and/or financial securities. For example, as of April 2, 2021, the last 7-day-average of exchange flows from Bitcoin to fiat money has been equal to \$0.96 bn. (Chainalysis 2021), confirming that cryptocurrencies are already converted into legal tender.

Let us also for a moment assume that newly created liquidity (issued by commercial banks and the central bank) in a certain country would be at par with the yearly real production (i.e. GDP). Under such circumstances, there would be no inflationary $\left(\frac{\text{money units}}{\text{product units}} > 1\right)$ or deflationary $\left(\frac{\text{money units}}{\text{product units}} < 1\right)$ pressures deriving from monetary sources (e.g. the over- or under-issue of means of payments). The relationship between newly created liquidity and yearly real production (i.e. GDP) would necessarily be:

$$\frac{\text{money units}}{\text{product units}} = 1.$$

Clearly enough, the general price level might still be subject to upward trends due to entrepreneurial decisions (e.g. the increase of profit margins) or downward trends (e.g. “good deflation” (Brezina 2011) because of technological advance), but not related to monetary dynamics. Newly mined cryptocurrencies, which would be not included into the above-mentioned item “money units” because of not being issued by commercial banks and the central bank, would nevertheless alter the ratio by adding up to liquidity. If we should continue to assume a money-to-product ratio equal to 1, the relationship would turn into a disequilibrium⁸ after the inclusion of cryptocurrencies:

$$\frac{\text{money units} + \text{cryptocurrencies}}{\text{product units}} > 1.$$

Otherwise stated, after the inclusion of cryptocurrencies, the yearly real production (i.e. GDP) would be increasingly “diluted” and spread over a higher amount of newly created liquidity. This scenario would be – by definition – inflationary and would not change, if cryptocurrencies would be converted into fiat money. *Ceteris paribus*, they would be equally responsible for “inflating” liquidity (issued by commercial banks and the central bank) and exchange legal

⁸ According to the quantity theory of money (QTM), this relation holds only if the income velocity of money (V) remains constant ($MV=PY$ which is equivalent to $\frac{M}{Y} = \frac{P}{V}$ or, according to the neo-quantity theory of money, whenever money demand is stable). However, the concept of “velocity of money”, which “is simply the average number of times each dollar is spent during a year (or other time unit). [...] There is an associated velocity concept, of course, for every conceivable payments flow. It is therefore misleading to talk of “the” velocity of money” (Joint Economic Committee 1959), is not particularly helpful in this context. This is due to the fact that in Section II. 4 we have already pointed out that there is a fundamental macroeconomic difference between “money” and “savings” (i.e. net saved incomes). While the first concept is void of any intrinsic value the second one derives from productive (i.e. remunerated) labor at the origin of “income” (i.e. GDP). The term “velocity of money” (wrongly) implies that economic agents would pay with “money” (instead of “income”), namely replicates the misleading definition of the functions of book money. More generally, it is it however right to assert that the inflationary potential of payment instruments (including for sake of simplicity also cryptocurrencies) might be reduced, if inflationarily issued means of payments would not be spent (i.e. invested). But does “hoarding” exist when the concepts of “money” and “cryptocurrencies” are implied? With specific regards to crypto-tokens, Section III. 1 has shown that they are already converted into fiat money, meaning that an inflationary pressure is already exerted. Whenever inflationarily issued money is spent to finance commercial and financial transactions – among others, of goods, services and financial securities – it displays its inflationary essence.

tender (i. e. safeness) for privately created financial instruments (i. e. riskiness). At the end of the day, inflation would still be the outcome.

2. Cryptocurrencies' Price, Monetary Policy and Status Quo

In parallel to the above-formulated step-by-step approach⁹ inspired by *Schmitt* (1978) and highlighting monetary interconnections between cryptocurrencies and inflation, central banks would be less able to manage their monetary policies. In fact, policymakers would suddenly have to deal with additionally circulating payment methods not issued and supervised by them (or commercial banks). Moreover, “[t]hese social objectives can be internalized only by a central issuer, such as government, and surely not by a plethora of ownerless private currencies, even if they operate in ideal competitive markets” (*Benigno* 2019).

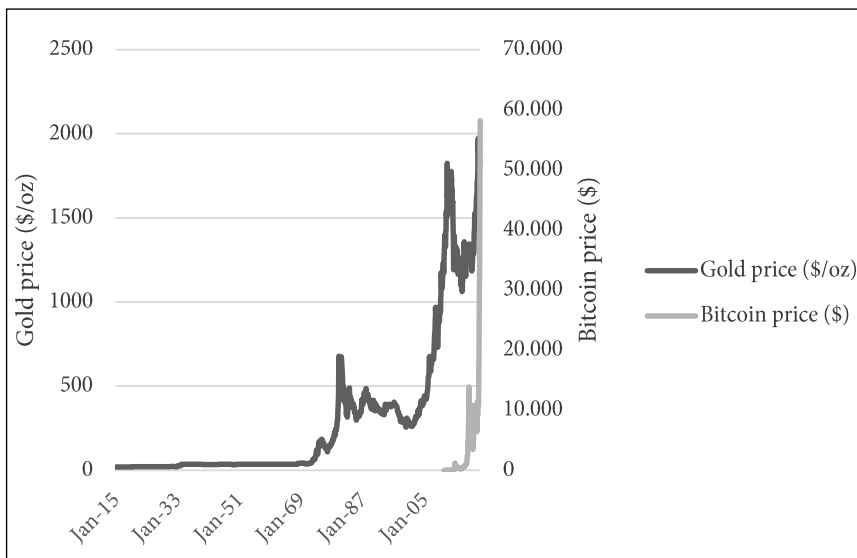


Figure 3: Gold price (\$/oz) compared to Bitcoin price, (1915–2021)
(based on *Investing.com* 2021; *Macrotrends* 2021)

⁹ It has also to be mentioned that *Friedman* (2006) also implicitly adopts the money-to-product ratio while stating that “there is no instance in which a substantial change in the stock of money per unit of output has occurred without a substantial change in the level of prices in the same direction. Conversely, I know of no instance in which there has been a substantial change in the level of prices without a substantial change in the stock of money per unit of output in the same direction”.

For instance, in the case of sustained price increases in crypto-markets, circulating liquidity (i.e. the denominator “money units + cryptocurrencies”) would accordingly increase, meaning that interest rates set by central banks to counter-balance price variations might be inadequately low. If cryptocurrencies would in turn suffer from a sudden price decrease, central banks would have to deal with deflationary pressures not depending of it, but affecting the economy as whole. Under such circumstances, the issue of liquidity would become increasingly exogenous and not allow for significant room of maneuver in the hands of the lender-of-last-resort (i.e. the central bank). More precisely, “digital currencies without the backing of a lender of last resort or central bank can never guarantee being a store of value, as bitcoin gamblers are finding to their cost” (Ure 2019). There are also evident risks deriving from (potentially) millions of individuals investing in financial instruments particularly subject to price volatility. As soon as cryptocurrencies will become more widespread, a sudden price decrease in crypto-markets might cause the default of several economic subjects and lead to a financial crisis. Should cryptocurrencies be, therefore, banned? Not necessarily, but only under certain conditions. If they should be used in the same way as poker like poker chips in casinos (which are bought at the entrance, earned and/or lost after betting), there would be no macroeconomic concern. Whenever used as a “special” currency on certain online platforms to pay services this would be not really an object of novelty. Would they be, in fact, money? Not really, but simply financial securities (or claims) to be bought by spending a part of income denominated in fiat currency. Otherwise formulated, they simply would act like tickets (or claims) to obtain a certain service, but not as money, which does not need to be “purchased” in order to be issued. For instance, Facebook’s to-be-launched Libra payment system cannot be compared to cryptocurrencies, since it would “support single-currency stablecoins (e.g., \approx USD, \approx EUR, \approx GBP, etc.) and a multi-currency coin (\approx LBR) [...]. People need to have confidence that they can use Libra Coins [\approx LBR] and that their value will remain relatively stable over time. To accomplish this, each single-currency stablecoin will be backed 1:1 by the Reserve, which will consist of cash or cash equivalents and very short-term government securities denominated in the relevant currency” (Diem Association 2020). More precisely, Libra Coins would be (despite their name) rather work like a claim collateralized by banking deposits in reserve currencies, meaning that payments would be backed by fiat currencies. Since cryptocurrencies are nor characterized by a real backing (i.e. GDP) neither are linked to banking deposits in reserve currencies despite being used to “finally” settle commercial/financial transactions, they openly contradict still-valid monetary axioms.

Finally yet importantly, Figure 3 compares the historical price trend of one gold ounce (\approx 28.35 grams) with a unit of Bitcoin. Evidently enough, the price differential between “the” epitome of wealth and the most famous crypto-token

is enormous – in February 2021, Bitcoin was 24.77 times more valued than gold – and can only be explained from a speculative perspective. Without addressing this topic in its financial complexity as in *Beretta/Peluso* (2021), Bitcoin and gold (whose market prices have soared in a historically atypical way) are characterized by the same trend, namely the search for economic return (“When new money keeps pumping into the system, it pushes investors to look for assets with higher yields [...]. This is because of the fact that the increase in the money supply devalues the currency and diminishes purchasing power” (*OKEx* 2020)). Otherwise formulated, the “comeback” of Bitcoin after its massive decline in market price throughout 2018 is not due to any reassessment of its utility, but simply to volumes of excess liquidity at the banking and financial level as well as the “shadow banking” level, which are invested wherever economic return might be higher than current interest rates. If in the past decades such excess liquidity has also been channeled in the real-estate market, it seems to be currently less involved than the financial one (including the crypto-market) because of dealing with less “agile” assets than financial instruments. In fact, “[o]ne important feature of housing price cycles tends to be forgotten – their extraordinary length. Many last for more than ten years” (*Gros* 2007). A financial bubble in the crypto-market will be clearly visible to everyone’s eyes as soon as the monetary essence of cryptocurrencies should have been identified. Perhaps, even more precisely, the crypto-market is itself a financial bubble because of trading with financial instruments 1) issued by a stroke of a pen by non-banks 2) with no real backing (i.e. adding up to monetary aggregates without any relation to GDP), but 3) nevertheless used to settle commercial/financial transactions from a “final” point of view as if (macroeconomically speaking) positive purchasing power might be created with no real effort.

IV. Conclusion and Further Policy Implications

The paper deals with the characteristics, which book money still has to bear despite its almost completely digital essence, and investigates cryptocurrencies as “the” financial innovation. We show that crypto-tokens are void of (macro-economic) purchasing power like book money itself – no matter if issued at the central or the commercial bank level. However, cryptocurrencies cannot be compared to money (also) because of not being used as “means”, but rather as “objects of settlement” as if they would bear a positive value creatable by a stroke of a pen. Monetary principles ruling even in eras of digital payments prevent cryptocurrencies from being capable of settling commercial and financial transactions from a “final” perspective (*Committee on Payments and Market Infra-structures* 2020). Because of being also *de facto* used as commodities, they are inflationary and contribute to the expansion of circulating liquidity volumes. The fact that cryptocurrencies’ price has been so far extremely volatile (*Schär/*

Berentsen 2020) is not *per se* problematic, since new financial instruments tend to be less stable due to their shorter-lived price history. Moreover, “the value of crypto assets rests solely on the expectation that others will also value and use them. Since valuation is largely based on beliefs that are not well anchored, price volatility has been high” (*He* 2018).

In times of low interest rates, economic actors like institutional ones search for investments with potentially high returns. It is, therefore, not astonishing that cryptocurrencies’ market price has soared, although this has not occurred because of a change in fundamentals. At the same time, such speculative trend has already reached paradoxical levels, since Bitcoin’s price is significantly higher than an ounce of gold, namely the epitome of wealth, at its historical peak. Clearly enough, it might be argued that times change (and preferences too). The monetary principles we have highlighted so far are nevertheless still in force (even though they might have been neglected). A “non-value” – no matter if book money created by a central bank or privately mint cryptocurrencies – remains such even if its price might be highly positive (*Belke/Beretta* 2020a) because of the interaction of demand and supply (*Friedberg* 2015). In fact, “unlike physical commodities and government-backed currencies, Bitcoin has no intrinsic value. If the market decides it doesn’t want to pay for it, Bitcoin becomes worthless” (*Miller* 2015).

If a contradictory definition of “money” would have no practical impact, we could easily decide to neglect it. *Section II.* and *Section III.* instead show that banking systems issuing excess liquidity on the one hand and financial instruments like cryptocurrencies being mined out of nothing on the other derive precisely from this contradictory approach. It remains that money has never had an intrinsic purchasing power – even in eras of metallic payment methods. More precisely, “the essential problem of distinguishing the means of payment from the physical objects thereby exchanged is crucial [...]. In fact, as pointed out by *Smith* (1776/1976), the means of exchange ought not to be considered as an object itself, but only as a great wheel, that is to say, an instrument, for the circulation of produced goods” (*Rossi* 2007). Although this assertion might be unusual, since metallic coins have been often described as epitomes of precious metals (characterized by an intrinsic value), it should not be forgotten that even then economic exchanges took not place between “goods, services and financial securities” *versus* “gold”, but between “goods, services and financial securities” *versus* “goods, services and financial securities”. Otherwise formulated, even money made of precious metals required the exchange between real values being after all the final terms of each transaction. As reminded by *Cencini* (2008 [own translation]), “in its first function gold is considered to be the denominator of commodities or, more precisely, the best unit of measurement in a world where goods and services have an intrinsically unstable value. However, as a commodity itself, gold has also a value that is unstable and is expressed by means of a

unit of measurement. As a denominator of commodities, gold somehow abandons its physical dimension and acquires the level of stability needed by every unit of measurement". The fact that money made of precious metals had an intrinsic value might be confusing, but does not modify the logical-analytical conclusion according to which payment methods were – even back then – not included into GDP.

This monetary axiom is all the more valid in times where money is just a book entry void of any real value. If banking systems would be able to issue positive purchasing power generating in turn wealth with no need of caring anymore about GDP (i.e. the production of goods and services measured by money), a cheap solution to global poverty would have been found. While from a microeconomic (i.e. individual) perspective getting banknotes issued in excess to real GDP might make their "lucky" owners richer, from a macroeconomic one (i.e. the economic system) no wealth effect would originate, since it would be almost instantaneously compensated by an (inflationary) increase of the general level of prices (Beretta 2020). Cryptocurrencies are – even more than excess liquidity repeatedly created by central banks to boost the economy – in open contradiction to the essence of money. Nevertheless, readers might argue that cryptocurrencies are not suitable to act as money because of (some of) their characteristics, but also that the real-backing argument is not relevant. In fact, other payment instruments like bank deposits are (apparently) not anchored to real values, but used as stores of value and/or in daily transactions.

There is no way around to be – macroeconomically speaking – precise to grasp the difference between cryptocurrencies and other payment instruments and/or stores of value provided by banking systems. As already pointed out, crypto-tokens are not stores of value because of having been created by a stroke of a pen and with no evident relation to GDP. If we push this reasoning further, they do not represent – as bank deposits in turn do – a share of GDP stored at the banking level, but just additional issues adding up to already circulating monetary volumes. Let us also suppose that individuals might still think of cryptocurrencies as potential, though risky stores of value. What could be true at the micro- is not necessarily at the macroeconomic level. For instance, economic subjects might invest a share of their income in (potentially) anything – no matter if characterized by real value (or not). *Ad absurdum*, could garbage be a "store of value"? For some individuals (i.e. at the microeconomic level), maybe (as potentially any object in the world), but not from a macroeconomic perspective, which requires that the good or service involved bears a value. If not, how could it be called a "store of value"? It would be also contradictory to claim that – while banking systems issue money as a "spontaneous acknowledgement of debt" monetizing the production of goods and services – cryptocurrencies are instead mint allegedly bearing a macroeconomic value to be exchanged against goods, services and financial securities. Even if money and its accept-

ance might rely on conventions, it remains that it has a macroeconomic value only in association with goods and services.

The Blockchain technology might be promising, but it remains that cryptocurrencies should not be mint and/or traded in the way they currently are. In fact, the status quo strongly resembles “modern monetary Middle Ages” (*Belke/Beretta 2020b*) where powerful individuals, namely the “seigneurs” (cf. the term “seigniorage”), were allowed to issue their own money. Besides cryptocurrencies, the attempt by social medias like Facebook to create a Diem payment system (i.e. the “new” version of the Libra one), namely “built on blockchain technology to enable the open, instant, and low-cost movement of money [, ...] support[ing] single-currency stablecoins [...] and a multi-currency coin [...] fully backed by a reserve of assets made up of cash or cash equivalents and very short-term government securities” (*Diem Association 2021*), aims at re-establishing the right of powerful (non-bank) subjects to issue their own means of payments. The policymakers’ intervention is, therefore, urgently needed, although central banks are *de facto* tolerating the coexistence of cryptocurrencies and legal tender. Maybe, because they aim themselves at creating central bank digital currencies (CBDC). Even if this is matter of speculation – also if the financial bubble will burst (or not) being in the hand of speculative forces –, the missing compliance of cryptocurrencies with monetary principles is a fact.

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