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Cryptocurrencies, Monetary Policy, and New Forms of Monetary Sovereignty

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Abstract: The article aims to bring to light the limits and contradictions of cryptocurrencies, as well as to investigate possible alternative uses of them. Particularly focusing on Bitcoin, understood as a benchmark for the entire sector, the authors seek to answer the following questions: Should Bitcoin be considered a currency, an investment vehicle, or a speculative asset? On which factors does Bitcoin volatility depend? Do Central Banks effectively have no power to influence/stabilize Bitcoin volatility? Following the empirical strategy proposed by Baek and Elbeck, the article shows that Bitcoin returns merely depend on financial conventions and that the cryptocurrency is acting as a highly speculative asset. Sociotechnical innovations introduced by Bitcoin, the authors argue, have concretely opened the possibility of deeply rethinking money. However, several factors are currently negatively affecting the possibility of the cryptocurrency to function as an effective means of payment. Whether this experience can pave the way for the birth of new and more democratic monetary instruments, as the article discusses, is an issue that calls into question a whole combination of political, technical and social elements.

Keywords money; cryptocurrencies; Bitcoin; monetary policy; alternative financial circuits

JEL Classifications E52; G11; G14; Z13

> Money in its significant attributes is, above all, a subtle device for linking the present to the future. (Keynes [1936] 1973: 294)

The ineffectiveness of monetary policy rapidly to stem crises and revitalize the economy, in terms of growth of GDP and employment, has become increasingly evident, especially after the burst of the recent financial crisis.[1] This is one of the reasons why an incredible number of innovative experiments in the monetary field have emerged in the last few years. Furthermore, information and communications technology (ICT) has opened new unprecedented possibilities for the development of decentralized payment systems, which can work reliably without needing intermediaries or a central authority. Since Nakamoto's famous

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white paper (Nakamoto 2008), cryptocurrencies such as Bitcoin, Litecoin, and Ether have spread swiftly. They are increasingly drawing attention in the public debate, in particular thanks to its innovative underlying technologies, which allow reliable peer-to-peer payments without the need of intermediaries.

Venture capitalists and financial institutions are investing seriously in Distributed Ledger Technology (DLT) projects, seeking to provide new financial services. Central Banks are paying increasing attention to the phenomenon of cryptocurrencies to monitor its potential risks but also to explore the new opportunities it offers (Bech and Garratt 2017). Hileman and Rauchs (2017) presented an empirical overview of the state of both enterprise and public sector use of blockchain and DLT. The analysis gathered data from over 200 enterprise DLT startups, established corporations, Central Banks, and other public sector institutions. One of the most interesting results of the research is that the most widely used case investigated by Central Banks is the opportunity to issue digital currency themselves using a DLT.

This article aims to bring to light the limits and contradictions of cryptocurrencies as well as to investigate possible alternative uses of them. In doing so, we will particularly focus on Bitcoin, understood as a benchmark for the entire sector.

A first issue that arises is whether Bitcoin should be considered a currency or a particular kind of asset. According to the European Central Bank (2015: 259), for instance, cryptocurrencies should not be portrayed as money, since they do not accomplish all the functions that the latter fulfill. This is not to say that cryptocurrencies are not suitable to work as a means of exchange alternative to official money. As we discuss in the first section, however, there are several factors that at present are negatively affecting the possibility of Bitcoin to function as an effective means of payment. This is also consistent with the results of comparative analysis on Bitcoin volatility, which show that the cryptocurrency is acting as a highly speculative asset (Baur and Dimpfl 2018; Baur, Hong, and Lee 2017).

In the second section, following the empirical strategy proposed by Baek and Elbeck (2015), we will attempt to understand whether cryptocurrencies react to Central Banks' monetary policies. In particular, we will verify whether Bitcoin returns have been concretely influenced by the Federal Reserve and the European Central Bank's decisions on interest rates or depend on financial conventions.

Our results suggest that the value of Bitcoin mostly depends on financial conventions and that the cryptocurrency has become part of the traditional financial system. This may be due to a set of reasons that will be analyzed in the third section, with particular attention to the institutional dimension of money, the issue of trust, and other limitations of Bitcoin deriving from its design.

Lastly, we will propose a reflection about the features that a cryptocurrency project aiming at enabling new forms of monetary sovereignty, and at building an alternative to the capitalistic monetary institutions, needs to have.

While we argue that the term "crypto asset" would be more appropriate to define the current nature of Bitcoin, in this article we will keep using the most in vogue "cryptocurrency." The intention is to avoid a possible confusion with the dominant narrative but also to remark the fact that sociotechnical innovations introduced by Bitcoin have concretely opened the possibility of deeply rethinking money. Whether this experience can pave the way for the

birth of new and more democratic monetary instruments is an issue that calls into question a whole combination of political, technical, and social elements.

CRYPTOCURRENCIES AND MONETARY SOVEREIGNTY

Many cryptocurrencies have emerged in the last few years, such as Litecoin, Ether, Monero, etc. Among these, Bitcoin is still by far the most popular, as well as the most important one in terms of market capitalization, representing a benchmark for the entire sector.

In the conclusion to his famous white paper, Satoshi Nakamoto (2008: 8) explains the vision that lies behind Bitcoin as follows:

> We have proposed a system for electronic transactions without relying on trust. We started with the usual framework of coins made from digital signatures, which provides strong control of ownership, but is incomplete without a way to prevent double-spending. To solve this, we proposed a peer-to-peer network using proof-of-work to record a public history of transactions that quickly becomes computationally impractical for an attacker to change if honest nodes control a majority of CPU power. The network is robust in its unstructured simplicity. Nodes work all at once with little coordination. They do not need to be identified, since messages are not routed to any particular place and only need to be delivered on a best effort basis. Nodes can leave and re-join the network at will, accepting the proof-of-work chain as proof of what happened while they were gone. They vote with their CPU power, expressing their acceptance of valid blocks by working on extending them and rejecting invalid blocks by refusing to work on them. Any needed rules and incentives can be enforced with this consensus mechanism.

Bitcoin issuing procedures are based on a complex algorithm designed to decrease gradually the production of new units. Purchasing power is transmitted from one *wallet* to another with the use of a wallet's unique identification code. The exchange happens only when both wallets' codes are recognized.[2] Once the transaction is completed, the network nodes have to validate it by reaching consensus. The validation process is called *mining* and is conducted by the users of the system themselves, who compete to solve a complex mathematical puzzle. The legitimization of the exchange melts with the creation of the new purchasing power, since the miner who first solves the algorithms that underlie the verification process receives a fraction of Bitcoin as a reward. The whole process of creation and exchange of these units of account has also to entertain a certain level of security, which is provided by blocks of information (*blockchains*) that prevent users from taking possession of other user's wallets. It is a sort of public ledger. Besides, the *timestamp server* helps to avoid the same Bitcoin being used in different online commercial operations. As opposed to other online payment systems, like credit cards or Paypal that cannot function without a bank account or some other form of money deposit, Bitcoin does not force its users to deal with intermediaries, whose presence affect the total cost of a commercial operation. Furthermore, due to its construction, in the long term Bitcoin can only be deflationary. It has a fixed maximum supply, and the difficulty of issuing new "coins," i.e., of *mining* new blocks, increase or decrease according to the overall computing capacity deployed by the system.[3] The underlying

protocol ensures that there will be a maximum of 21 million bitcoins in existence (to be reached, according to some estimates, in 2140). This fixed supply, while it is supposed to protect Bitcoin holders from inflation, should not necessarily represent a limit to the usage of Bitcoin as a unit of account.

Deeper criticisms arise with respect to the transactional function of Bitcoin. Indeed, as suggested by its great value volatility, Bitcoin has been mostly perceived and treated as a financial asset. This may also have been one of the reasons for its rapid diffusion but can represent a serious limit to its reach and deployment across different economic sectors and social groups.

There are at least three factors that currently represent a severe obstacle to the usage of Bitcoin as an effective means of payment:

1. Despite the original underlying vision, transaction fees have become considerably high, which make Bitcoin unsuitable for small retail payments.
2. The average confirmation time for a transaction is markedly high compared to other digital payment systems such as credit cards, with some transactions that can remain unverified for a long time.
3. Bitcoin value is extremely volatile (see Figure 1), also due to the lack of a central authority within a rigid system in which there is no space for monetary policy.

It is worth mentioning that the first two issues could be addressed by simply intervening from a technical side—for instance, by increasing the block size limit, as happened in the case of the "hard fork" that led to the birth of Bitcoin Cash in August 2017.[4] On the contrary, the lack of intermediaries, as well as of a central authority, call into question a precise political choice, which is at the core of the entire philosophy that inspired the creation of Bitcoin.

FIGURE 1 Average US$ Bitcoin market price across major Bitcoin exchanges (from March 2017 to date).

These are libertarian theories about the "denationalization of money" (Hayek 1976) that join antistate anarchist ideas along with the hacker ethic, the cyberpunk movement, and crypto-anarchism (Himanen 2001).

As declared by its own creators, Bitcoin was designed to "allow online payments to be sent directly from one party to another without going through a financial institution" (Nakamoto 2008: 1). It has therefore been conceived as a "peer-to-peer electronic cash system" that theoretically does not need to rely on trust, since the accuracy of the transactions is ensured by the reliability of the underlying algorithm (De Collibus and Mauro 2016: 80–81). Most importantly, according to the vision that lies behind Bitcoin, the lack of a central authority with the power of "changing the rules" at its own discretion should itself represent a guarantee of the stability of the system. Contrary to this prediction, however, empirical data show that Bitcoin's volatility is extreme compared to official currencies.[5]

At this point, some crucial questions that arise are: On which factors does Bitcoin volatility depend? Should Bitcoin be considered a currency, an investment vehicle, or a speculative asset? Do Central Banks effectively have no power to influence/stabilize Bitcoin volatility?

THE INFLUENCE OF CENTRAL BANKS' POLICIES ON BITCOIN VOLATILITY

In seeking to answer to these questions, a first insightful piece of work is represented by Baek and Elbeck (2015), who studied Bitcoin's volatility and return by comparing the cryptocurrency market with the American stock market and examined if fundamental economic variables affect the Bitcoin market return. Their first finding is that Bitcoin is 26 times more volatile than the S&P 500 index. Baek and Elbeck's estimation suggests that Bitcoin returns are not influenced by fundamentals (monthly change in consumption price index, monthly change in industrial production, monthly change in real personal consumption expenditures, monthly change in unemployment in the United States) but are internally driven by buyers and sellers. Indeed, the only statistically significant dependent variable they find in their regression is the monthly change in the spread between daily high and low price (estimated coefficient: 0.183). The analysis was conducted on the period from July 2010 to February 2014 by limiting the variables to the United States. Ultimately, these results suggest that Bitcoin is a speculative vehicle driven by the cryptocurrency's exchange participants.[6]

Following Baek and Elbeck's methodology, we conducted a first regression analysis using fundamental economic variables for the USA and EMU (Models 1a, 1b, and 1c) in the period from August 2010 to November 2018. To find out whether the monetary policies carried out by the Fed and ECB have the potential to influence Bitcoin volatility, we subsequently analyzed the monthly variation in the Bitcoin market price. We did this by adding the monthly change in the Federal Fund Rate Target and the Euribor to the variables already taken into account by Baek and Elbeck (Models 2a, 2b, and 2c). In this way, we could verify if the American and European Central Banks' dominant monetary policy instruments[7] influence the Bitcoin price.

The resulting models are the following:

$$R_t = \alpha + \beta_1 \Delta cpi_{t,US} + \beta_2 \Delta ip_{t,US} + \beta_3 \Delta rpce_{t,US} + \beta_4 \Delta S\&P500_t + \beta_5 \Delta TN_t + \beta_6 \Delta \$/€_t + \beta_7 \Delta un_{t,US} + \beta_8 \Delta spread_t + \varepsilon_t \quad (1a)$$

$$R_t = \alpha + \beta_1 \Delta cpi_{t,EU} + \beta_2 \Delta ip_{t,EU} + \beta_3 \Delta rpce_{t,EU} + \beta_4 \Delta Eurostoxx50_t + \beta_5 \Delta Bond_t + \beta_6 \Delta €/\$_t + \beta_7 \Delta un_{t,EU} + \beta_8 \Delta spread_t + \varepsilon_t \quad (1b)$$

$$R_t = \alpha + \beta_1 \Delta cpi_{t,US} + \beta_2 \Delta ip_{t,US} + \beta_3 \Delta rpce_{t,US} + \beta_4 \Delta S\&P500_t + \beta_5 \Delta TN_t + \beta_6 \Delta \$/€_t + \beta_7 \Delta un_{t,US} + \beta_8 \Delta spread_t + \beta_9 \Delta cpi_{t,EU} + \beta_{10} \Delta ip_{t,EU} + \beta_{11} \Delta rpce_{t,EU} + \beta_{12} \Delta Eurostoxx50_t + \beta_{13} \Delta Bond_t + \beta_{14} \Delta un_{t,EU} + \varepsilon_t \quad (1c)$$

$$R_t = \alpha + \beta_1 \Delta cpi_{t,US} + \beta_2 \Delta ip_{t,US} + \beta_3 \Delta rpce_{t,US} + \beta_4 \Delta S\&P500_t + \beta_5 \Delta TN_t + \beta_6 \Delta \$/€_t + \beta_7 \Delta un_{t,US} + \beta_8 \Delta spread_t + \beta_9 \Delta FFT_{t,US} + \varepsilon_t \quad (2a)$$

$$R_t = \alpha + \beta_1 \Delta cpi_{t,EU} + \beta_2 \Delta ip_{t,EU} + \beta_3 \Delta rpce_{t,EU} + \beta_4 \Delta Eurostoxx50_t + \beta_5 \Delta Bond_t + + \beta_6 \Delta €/\$_t + \beta_7 \Delta un_{t,EU} + \beta_8 \Delta spread_t + \beta_9 \Delta Euribor_t + \varepsilon_t \quad (2b)$$

$$R_t = \alpha + \beta_1 \Delta cpi_{t,US} + \beta_2 \Delta ip_{t,US} + \beta_3 \Delta rpce_{t,US} + \beta_4 \Delta S\&P500_t + \beta_5 \Delta TN_t + \beta_6 \Delta €/\$_t + \beta_7 \Delta un_{t,US} + \beta_8 \Delta spread_t + \beta_9 \Delta FFT_{t,US} + \beta_{10} \Delta cpi_{t,EU} + \beta_{11} \Delta ip_{t,EU} + \beta_{12} \Delta rpce_{t,EU} + \beta_{13} \Delta Eurostoxx50_t + \beta_{14} \Delta Bond_t + \beta_{15} \Delta un_{t,EU} + \beta_{16} \Delta Euribor_t + \varepsilon_t \quad (2c)$$

Where R_t is the monthly change in the value of Bitcoin; $\Delta cpi_{t,US}$ is the monthly change in consumption price index in the USA; $\Delta ip_{t,US}$ is the monthly change in industrial production in the USA; $\Delta rpce_{t,US}$ is the monthly change in real personal consumption expenditures in the USA; $\Delta S\&P500_t$ is the monthly change in the Standard & Poors 500 index; ΔTN_t is the monthly change in 10-year U.S. Treasury note; $\Delta €/\$_t$ is the monthly change in euro/dollar exchange rate; $\Delta un_{t,US}$ is the monthly change in unemployment in the USA; $\Delta FFT_{t,US}$ is the monthly change in the Federal Fund Target Rate; $\Delta cpi_{t,EU}$ is the monthly change in consumption price index in the Eurozone; $\Delta ip_{t,EU}$ is the monthly change in industrial production in the Eurozone; $\Delta rpce_{t,EU}$ is the monthly change in real personal consumption expenditures in the Eurozone; $\Delta Eurostoxx50_t$ is the monthly change in the Euro Stoxx 50 index; $\Delta Bond_t$ is the monthly change in 10-year long-term Government Bond yields; $\Delta un_{t,EU}$ is the monthly change in unemployment in the Eurozone; and $\Delta Euribor_t$is the monthly change in the Euribor. We use all these variables as external Bitcoin market factors except for $\Delta spread_t$. $\Delta spread_t$ is the monthly change in the spread between daily high and low Bitcoin prices. The spread between daily high and low prices is used as an internal Bitcoin market factor, as suggested by Baek and Elbeck (2015).

Bitcoin data were downloaded from www.bitcoincharts.com at daily prices (US$) from July 2010 to November 2018. We then computed monthly historical series from the daily Bitcoin data. We also collected monthly data for the United States, included the monthly change in the euro/dollar exchange rate; from the Federal Reserve Bank of St. Louis; for the Eurozone (18 countries) from the Eurostat;[8] and for Federal Fund Target Rate, Euribor, Standard & Poors 550 index, and Euro Stoxx 50 index from www.investing.com.

TABLE 1
Descriptive Data for Bitcoin Prices' Monthly Changes (Rt)

	R_t
Mean	53.631
Median	0.86723
Minimum	−5821.5
Maximum	7053.0
Std. Dev.	1158.6
Skewness	1.2452
Kurtosis	20.739

The descriptive statistics of the dependent variable, i.e., the monthly change in the value of Bitcoin, R_t (calculated as first differences of Bitcoin prices), for the period August 2010–November 2018 are shown in Table 1.

The returns are positively skewed, while the excess kurtosis suggests leptokurtic behavior.

The Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test is used to verify that the Bitcoin values' monthly changes historical series (R_t) is stationary around a deterministic trend.[9]

The KPSS test shows that it refuses the alternative hypothesis of a unit root for the returns for all the variables, except for monthly change in industrial production in the United States (Table 2). Consequently, stationarity is guaranteed for the dependent variable (R_t) and for 15 independent variables that we use as regressors in the following ordinary least squares (OLS) estimations. Tables 3a, 3b, and 3c report the regression results.

The regressions are conducted with the Newey-West's heteroscedasticity and autocorrelation consistent (HAC) covariance estimator. The variance inflation factor (VIF) for each variables is calculated, suggesting multicollinearity between these variables (all VIFs are higher than 1). Nonetheless, there is no serious multicollinearity during the examined time period because the VIFs are less than 4 (Cohen et al. 2003: 423) in all the models we estimated.[10]

In line with Baek and Elbek's (2015) findings, all regressions show that the spread between daily high and low prices as an internal factor of the Bitcoin market is statistically significant. This result suggests that Bitcoin cannot be considered as a proper currency, since its main features are similar to those of a speculative asset.

Model 1c contains an interesting finding, as the S&P500 index is statistically significant and positively correlated with the monthly change in the value of Bitcoin. This suggests that, in certain circumstances, investors consider Bitcoin as an alternative financial asset when the S&P500 index increases.

Most importantly, our results show that both the Federal Fund Rate and the Euribor are not statistically significant. Consequently, the dominant monetary policy instruments seem completely irrelevant in the explanation of Bitcoin volatility.[11]

It does not automatically follow, however, that policy makers can do nothing to influence the variation of cryptocurrencies in market prices. For instance, the banning of exchange platforms or proclamations about upcoming stricter regulations for the sector—as was the case for China and South Korea—could have a clear impact on Bitcoin volatility. However, these

TABLE 2
KPSS unit root test

	KPSS
R_t	0.0374363***
Monthly change in consumption price index EMU	0.131069**
Monthly change in industrial production EMU	0.0230563***
Monthly change in real personal consumption expenditures EMU	0.0583492**
Monthly change in Eurostoxx50 index	0.0723879***
Monthly change in 10-year long-term Government Bond yields	0.131509**
Monthly change in unemployment EMU	0.0347487***
Monthly change in dollar/euro exchange rate	0.086742***
Monthly change in the spread between daily high and low prices	0.0286341***
Monthly change in consumption price index USA	0.0758179***
Monthly change in industrial production USA	0.216097
Monthly change in real personal consumption expenditures USA	0.101999***
Monthly change in S&P500 index	0.0465109***
Monthly change in 10-year Treasury note	0.0426264***
Monthly change in unemployment USA	0.0443179***
Monthly change in FFR	0.180388**
Monthly change in Euribor	0.102437***

***The test-statistics is higher than the critical threshold at 10%.
**The test-statistics is higher than the critical threshold at 5%.

factors alone are not able to explain the extremely high—especially if we consider the last 18 months (see Figure 1)—Bitcoin volatility. To describe the effects of these unorthodox regulatory interventions on Bitcoin volatility, we may build a dummy variable, which is equal to 1 since September 2017–November 2018.[12] The estimation of the Model 3 (see Table 4) does not find a statistically significant correlation between the dummy and the dependent variable.

$$\begin{aligned} R_t = \alpha &+ \beta_1 \Delta cpi_{t,US} + \beta_2 \Delta rpce_{t,US} + \beta_3 \Delta S\&P500_t + \beta_4 \Delta TN_t + \beta_5 \Delta \$/€_t \\ &+ \beta_6 \Delta un_{t,US} + \beta_7 \Delta spread_t + \beta_8 \Delta cpi_{t,EU} + \beta_9 \Delta ip_{t,EU} + \beta_{10} \Delta rpce_{t,EU} \\ &+ \beta_{11} \Delta Eurostoxx50_t + \beta_{12} \Delta Bond_t + \beta_{13} \Delta un_{t,EU} + \beta_{14} dummy\ \varepsilon_t \end{aligned} \tag{3}$$

Consequently, the banning of exchange platforms or the announcements of severe regulations confined in specific countries seems to be much less significant than other factors in explaining Bitcoin volatility. In particular, as confirmed in all the results of the regressions, we refer to the speculative dynamics internal to the Bitcoin market. In this regard, it is also important to underline that a few big players—the so-called whales—still control a relevant portion of all the Bitcoins in circulation, therefore having the power of rapidly increasing or decreasing its value.[13] Hedge Funds and Bitcoin Investment Funds—such as Pantera Capital, Bitcoins Reserve, Binary Financial, Coin Capital Partners, Falcon Global Capital, Fortress, Bitcoin Investment Trust, and Global Advisor Bitcoin Investment Fund—can move the market at will (Khaosan 2018).

TABLE 3A
Regression Results (Models 1a and 2a)

	Estimate coefficient		*p value*		*VIF*	
Variable	*Model 1a*	*Model 2a*	*Model 1a*	*Model 2a*	*Model 1a*	*Model 2a*
Constant	−23.6243	−2.62529	.7359	.9733		
Monthly change in consumption price index USA	16.1305	−3.40369	.8730	.9776	1.174	1.181
Monthly change in real personal consumption expenditures USA	1.30767	1.84603	.4073	.4380	1.037	1.066
Monthly change in S&P500 index	1.01829	0.788456	.4058	.4825	1.085	1.106
Monthly change in 10-year Treasury note	36.9519	109.229	.8570	.7079	1.083	1.102
Monthly change in unemployment USA	−0.140772	−0.127725	.4308	.4336	0.4087	1.026
Monthly change in dollar/euro exchange rate	850.315	1267.73	.4398	.3864	1.120	1.131
Monthly change in the spread between daily high and low prices	5.46687	5.56098	2.33e-17***	4.58e-14***	1.048	1.075
Monthly change in FFR		−1448.30		.5615		1.099
Adjusted R^2	0.59702	0.599786				
Durbin-Watson	2.994440	2.950766				

*Statistical significance at the .05 level.
**Statistical significance at the .01 level.

What is clear is that presently Bitcoin is working as an instrument quite different from the usual definition of "money," such has been stressed also by the European Central Bank in 2015:

> It was considered necessary to amend the definition of virtual currency use in 2012 on several aspects [The definition in ECB report (2012) was: "A virtual currency is a type of unregulated digital money, which is issued and usually controlled by its developers, and used and accepted among the members of a specific virtual community"]. First, it should no longer contain the world "money," since it has become clear that, even today, virtual currencies do not have the nature of a highly liquid asset and have not reached the level of acceptance commonly associated with money. [. . .] For the purpose of this report, and based on the characteristics currently observed, virtual currency can therefore be defined as a digital representation of value, not issued by a Central Bank, credit institution or e-money institution, which, in some circumstances, can be used as an alternative to money.[14]

At the same time, however, it cannot be ignored that money itself, as well as the role of Central Banks, has greatly changed over the last decades. Indeed, over time, the range of assets with money attributes has increased, as stressed by Sheila Dow (2017: 1544) and Fumagalli and Lucarelli (2011: 61), among others. Central Banks have only a very indirect control over a relevant portion of the money supply, which is now provided by private banks and financial investors in the form of loans or speculative activities.

TABLE 3B
Regression Results (Models 1b and 2b)

	Estimate coefficient		*p value*		*VIF*	
Variable	*Model 1b*	*Model 2b*	*Model 1b*	*Model 2b*	*Model 1b*	*Model 2b*
Constant	54.4025	87.7782	.1656	.1607		
Monthly change in consumption price index EMU	−57.8304	−20.4906	.5518	.8532	1.768	2.061
Monthly change in industrial production EMU	1.88299	1.57098	.6422	.7078	1.464	1.471
Monthly change in real personal consumption expenditures EMU	−9.08770e-10	−5.72712e-09	NA	NA	1.791	1.966
Monthly change in Eurostoxx50 index	0.409125	0.363677	.2877	.3615	1.067	1.094
Monthly change in 10-year long-term Government Bond yields	−153.009	−153.334	.5834	.5863	1.057	1.057
Monthly change in unemployment EMU	−0.0431748	−0.00574324	.6563	.9579	1.381	1.570
Monthly change in euro/dollar exchange rate	1493.02	1397.19	.2937	.3451	1.069	1.073
Monthly change in the spread between daily high and low prices	5.70485	5.70315	1.33e-14***	2.47e-14***	1.025	1.025
Monthly change in Euribor		−85.4036		0.2788		1.283
Adjusted R^2	0.620487					
Durbin-Watson	3.151635					

*Statistical significance at the .05 level.
**Statistical significance at the .01 level.

Against this background, the phenomenon of cryptocurrencies seems to be parallel to—and may perhaps represent a further step of—a wider process through which the financial markets are undermining the power of Central Banks, taking control over money creation and management.

Our results suggest that Bitcoin has been subsumed into the logic of the financial markets. Considering this, further questions arise: Can a payment system without a space for implementing monetary policies be "neutral," or are institutions in any case essential, even if only to render the power dynamics behind money more visible and to a certain degree disputable?

DO CRYPTOCURRENCIES REPRESENT A TECHNOPOLITICAL RADICAL INNOVATION?

The most relevant innovation introduced by Bitcoin lies in the possibility to replace technically Central Banks sovereignty. Indeed, in the cryptocurrency system, the multitude of

TABLE 3C
Regression Results (Models 1c and 2c)

	Estimate coefficient		*p value*		*VIF*	
Variable	*Model 1c*	*Model 2c*	*Model 1c*	*Model 2c*	*Model 1c*	*Model 2c*
Constant	−20.1895	5.61989	.7691	.9404		
Monthly change in consumption price index EMU	−327.095	−281.201	.3394	.2888	3.065	3.177
Monthly change in industrial production EMU	4.44833	4.39982	.4803	.4987	1.528	1.531
Monthly change in real personal consumption expenditures EMU	6.20435e-09	9.01781e-09	NA	.2179	1.900	1.931
Monthly change in Eurostoxx50 index	−0.403413	−0.302961	.2859	.3883	2.114	2.144
Monthly change in 10-year long-term Government Bond yields	−267.672	−197.276	.6100	.6376	1.604	1.633
Monthly change in unemployment EMU	−0.0542620	−0.0851051	.6448	.5704	1.415	1.463
Monthly change in euro/dollar exchange rate	836.583	1325.50	.4987	.4606	1.191	1.253
Monthly change in the spread between daily high and low prices	5.64229	5.71197	2.82e-14**	1.35e-12**	1.077	1.100
Monthly change in consumption price index USA	30.0283	−18.3131	.7781	.8284	1.407	1.519
Monthly change in real personal consumption expenditures USA	1.09223	1.11568	.6790	.5321	1.104	1.129
Monthly change in S&P500 index	2.40400	2.16148	.0844*	.1022	1.881	1.963
Monthly change in 10-year Treasury note	159.989	201.682	.7302	.7148	1.676	1.682
Monthly change in unemployment USA	−0.311462	−0.327426	.3488	.2914	1.783	1.889
Monthly change in FFR		−1262.63		0.5771		1.299
Monthly change in Euribor		28.9485		0.9221		1.142
Adjusted R^2	0.619690					
Durbin-Watson	3.132988					

*Statistical significance at the .05 level.
**Statistical significance at the .01 level.

individuals who decide to produce or "extract" the "strings" with their computers in the network substitute for the monetary institutions that are deputy to monetary and financial policy, thanks to the monopoly of emission.

Being potentially able to overcome some contradictions of the contemporary capitalism, the cryptocurrencies communities have opened different perspectives for the construction of an alternative economic system. However, some issues arise that need to be discussed more in depth.

TABLE 4
Regression Results (Models 3)

	Estimate coefficient	*p value*	*VIF*
Constant	−30.6837	.6611	
Monthly change in consumption price index EMU	−325.125	.3472	3.065
Monthly change in industrial production EMU	3.93595	.5507	1.537
Monthly change in real personal consumption expenditures EMU	7.09139e-09	NA	1.903
Monthly change in Eurostoxx50 index	−0.317071	.4585	2.163
Monthly change in 10-year Long term Government Bond yields	−267.263	.6259	1.604
Monthly change in unemployment EMU	−0.0446240	.6929	1.421
Monthly change in dollar/euro exchange rate	929.008	.4512	1.193
Monthly change in the spread between daily high and low prices	5.64938	1.80e-13**	1.078
Monthly change in consumption price index USA	24.0205	.8246	1.409
Monthly change in real personal consumption expenditures USA	0.816782	.7526	1.122
Monthly change in S&P500 index	2.21077	.1040	1.925
Monthly change in 10-year Treasury note	119.359	.8168	1.697
Monthly change in unemployment USA	−0.309354	.3603	1.783
Dummy	154.998	.4232	1.078
Adjusted R^2	0.617339		
Durbin-Watson	3.165392		

*Statistical significance at the .05 level.
**Statistical significance at the .01 level.

Trust, Confidence, and the Problem of Property Rights

Fiat money is guaranteed by the State, which holds the monopoly of emission and imposes that money must be accepted (if not false) as means of payment by all inhabitants of the same State. That implies that the real "owner" of money is the State, not the individual. What happens in the case of cryptocurrency? The dependency of money creation from traditional institutional actors whose decisions are no longer considered able to protect the individual and his freedom has pushed the creators of cryptocurrency and their main proponents to seek such protection in an impartially mechanical action.[15] For many of them, the democratic process could also—indeed, should—be replaced by algorithm decisions performed with impartiality by computers. In this regard, a first critical point is that this vision is based on the—highly questionable—idea that technology is always neutral. Furthermore, as much as a means of payment can be neutral and reliable, this does not automatically imply that people will use it, especially if there are no legal constraints to accept it and its purchasing power is all but stable. It is also worth stressing that, as argued by Aglietta and Orléan (2002), money is not a simple economic phenomenon; neither is it a technical instrument. It rather constitutes an example of what, by using the expression of French anthropologist Marcel Mauss, can be defined as a "total social fact" that involves the entirety of relational, economic, and political dynamics that rule the life of a community. In other words, money is an institution binding individual actors into social relations of interdependence and conflict. The same argument can be applied

to the case of cryptocurrencies, intended as "digital representation of value […] which in some circumstances can be used as an alternative to money" (European Central Bank 2015: 259).

A second critical issue refers to the real proprietor of cryptocurrency. In particular, one should ask whether it is the technological elite who own the codex of the mining algorithm or the community, which organizes the cryptocurrency according to a certain degree of confidence and trust. To be sure, the Bitcoin project is based on a "peer-to-peer" system, anonymous and made secure by nonproperty algorithms, whose code is licensed under open source and uses the principle of a distributed computing network (*clustering or network computing*). These are features that place Bitcoin in the category of major projects of cooperation and collective sociotechnical innovation in the hacker community origin, such as Linux, BitTorrentor p2p file-sharing platforms.[16] At the same time, however, the— financial, technological, relational, and cognitive—resources required to participate in the mining process and to contribute to the development of the cryptocurrency are not easily accessible.[17] Additionally, as has already been observed, a relevant portion of all the Bitcoins in circulation is held by a few big players who can control the market.

Goals and Functions of the Cryptocurrency

In theory, most of the existing cryptocurrencies (Bitcoin, Freecoin, Litecoin, Ether, etc.) are born to facilitate exchange activity. The reason for their existence, as for most "complementary or community currencies," derives from providing more available monetary liquidity, in favor of anonymous and free purchasing activities, especially where there are prohibitionist constraints in some trades. From this point of view, cryptocurrencies could offer new solutions to overcome restrictive monetary policy.

Primarily, a currency should play the role of means of payment and unit of value. As a unit of value, it needs to be connected to the values of the other traditional currencies. In the case of local or complementary currencies, which operate within a specific territory, the exchange rate is fixed—besides the fact that "complementary or community currencies" are usually not convertible.[18] However, for cryptocurrencies, which circulate on a virtual space without any boundaries, the exchange rate is flexible and is set by the different exchange platforms according to market dynamics. It follows that, as confirmed by the empirical literature about Bitcoin's volatility, the value of cryptocurrencies depends on financial conventions.

What happened in the last two years shows in a rather paradigmatic way that Bitcoin has been mainly used as an instrument of accumulation and speculation. Despite the intentions of its creators, it has become part of the traditional financial system. At this point, a crucial question is whether or not—and under what conditions—the innovations introduced by cryptocurrencies may also serve to build alternative monetary systems, able to counteract the increasing power of the financial oligarchies.

SOME PRELIMINARY REFLECTIONS FOR NEW FORMS OF MONETARY SOVEREIGNTY

Many hackers, scholars, and social activists, especially in Europe, are recently working to create currencies based on peer-to-peer mechanisms to redistribute wealth to precarious workers and to different community spaces (such as social centers, self-managed theaters, and alternative economic cooperatives).[19] The discussion on this issue is quite differentiated.

The complexity lies, in particular, in the multidimensional character of the monetary phenomenon, in which a whole set of strictly intertwined technical, symbolic, political, economic, and social elements come into play.[20] The most difficult task is to disclose the dynamics which keep all these elements together, in order to find whether and how they can be concretely recombined for enabling the advance of alternative financial circuits. On this point, sociological theories about the nature of money are insightful but often grounded in two opposite deterministic visions that have in common the tendency to deny the dialectical relationship between money and social behaviors, thereby losing part of their explanatory power.[21]

To recognize the ambivalence that characterizes this relationship is far from being a purely theoretical issue. It allows us to understand that existing structure of power and dominant values are reproduced by money as a technopolitical instrument that, by assuming specific functions and features, ends up acting as a "claim upon society" (Simmel [1907] 1978: 177). At the same time, however, economic activities are part of a wider "relational work"[22] in which money, regardless of its specific technical features, can be charged with different meanings and used to facilitate exchanges that are not necessarily impersonal and profit oriented, since preexisting symbolic, cultural, and relational dynamics keep playing an important role. Whether and how these dynamics can be translated into a coherent political project, which in turn may lead to—and be supported by—an appropriate monetary instrument, is a crucial point.

In fact, complementary currencies could be defined as technopolitical innovations that, by facilitating economic exchanges charged of specific shared meanings, have the potential to enable the pursuit of a set of collectively defined goals that cannot be achieved with the exclusive circulation of official money, this being inexorably linked to certain given features, rules, and institutions. This definition implies the existence of a well-defined community, delimited by clear boundaries, in which preexistent, shared meanings are negotiated and translated into specific goals that in turn may be fixed into particular technical solutions. But it does not apply to many cryptocurrencies in circulation in which, moreover, the political (innovative) dimension of the phenomenon has been overshadowed by discussions about technical problems and solutions.[23]

We argue that the existence of shared meanings, within a well-defined community with precise boundaries, is essential for the construction of alternative financial circuits. In this regard, it has to be recognized that a community of core developers who share goals and meanings through official forums and blogs and try to provide common guidance to the project backs Bitcoin. However, it is also evident that the larger community of its users has no clear boundaries and acts independently of the intentions of the core developers.

This leads us to another important aspect related to the issues of trust and sovereignty. As stated by Geoffrey Ingham (2014: 65) "coercion, as always, preceded any 'trust' in the establishment of a currency."

One should ask whether a monetary system that is not backed by any coercive power can effectively work. The issue is even more complicated if we consider a system such as Bitcoin, which, according to its creators, has been conceived as a tool that does not need to rely on trust.

Indeed, it seems more reasonable to assert that to work as an effective medium of exchange, Bitcoin will paradoxically have to rely completely on trust. In fact, since it is not sustained by the coercive power of the State, which along with trust represents one of the two pillars of money,[24] the element of trust is even more important and not limited to the accuracy of the underlying protocol.

In any case, the element of trust does not exclusively refer to the confidence that a monetary instrument will maintain its purchasing power over time, providing its holders with the right to extinguish a debt or acquiring a credit toward the society. This right is precisely what is ensured by the coercive power of the State, while the social legitimacy of a monetary instrument—and the reasons why it is used—also depends on its ability to effectively fulfill its main function, which consists in fomenting the satisfaction of social needs through the facilitation of exchanges.[25] If money loses this ability, people will most likely cease to use it in their daily exchanges, despite any legal constraints.

At the same time, it cannot be denied that institutions are fundamental in the establishment of a currency and to reinforce trust in it. Central political powers represent a guarantee of the value of money; they are essential to prevent abuses and misconducts and to foster, through monetary policies, the ability of money to fulfill its social function.

It follows that a successful alternative financial circuit should have at least these other two features: to be legitimated by a clear social function, being able to offer tangible benefits to the participants; and transparent preset rules, as well as an institutional infrastructure through which shared goals can be negotiated, codified, and enforced.[26]

In our opinion, these elements, along with the ones aforementioned, are prerequisite for establishing an alternative financial circuit. More specific characteristics could be identified depending on the goals. For instance, autonomist Marxists[27] agree in identifying four main features that a monetary instrument for an alternative financial circuit needs to have by design:

- Not to be cumulative and cannot become the subject of speculation. Consequently, it must lose a part of its value over time. It is therefore a *melting* or *burning money*.[28]
- To be able to mitigate the dependence of workers from the economic constraints of the sale of their labor force and therefore the wage relation, i.e., reducing precariousness.
- To be able to allow, on this basis, to free up time and resources to develop alternative forms of cooperation based on the pooling of knowledge and the results of the production, however, on exchange networks that exclude the logic of profit.
- To be a nonproperty.

These four parameters imply that the way in which *money* enters in the economic process is not through exchange or financial activity (as mean of payment or store of value) but through the financing of production activity.

A cryptocurrency project aimed at enabling new forms of monetary sovereignty should recreate a different monetary circuit in which a new financial institution, able to generate purchasing power under the community supervision in a democratic way, funds alternative production. This new monetary circuit should be irreducible and irreconcilable to the traditional financial hierarchies. In fact, the main political aim is to provide financing for the developing of social services, production of use values,[29] remunerating the social cooperation.

Since 2014, a framework (see Figure 2) in which this alternative monetary circuit is called "money of the common" has been proposed to facilitate the discussion between social activists (Bauwens and Fumagalli 2018).

The framework poses different challenges and presents some clear limits. The first one concerns the definition of economic boundaries. A cryptocurrency, intended as *money of the common*, can be introduced in an economic system as mean of remuneration of labor[30] and investment in favor of social cooperation only if the production cycle is constrained by space boundaries. A local currency could play this role. To preserve the financial stability, it is advisable to start with experiments that deal with economic activities that have well-defined boundaries. Social services, like education and training, transport, health, social security, culture and leisure, real estate, agricultural and artisan activities together with some specific manufacturing production, whose *filières* are localized, could represent good practices.

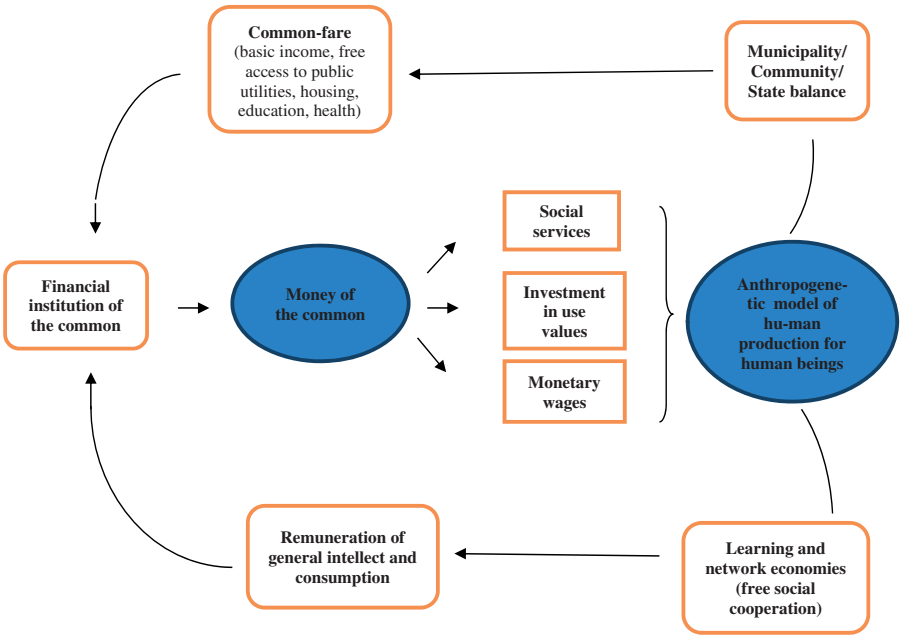

FIGURE 2 Alternative financial-production framework.

The second problem lies in the managing of the alternative financial institutions and of the issuing of the *money of the common*. A solution to this political aspect lies in the existing degree of bottom-up democracy and the decision-making apparatus (Bauwens and Fumagalli 2018).

CONCLUSION

Cryptocurrencies and their underlying technologies seem to have the potential to change radically our way to conceive of money, and it is not without reason that they are increasingly drawing the attention both of the private and the public sector.

As a technopolitical innovation that "makes it possible for money to become a common and no longer a top-down convention imposed by a sovereign and its liturgy of power" (Roio 2013: 8), cryptocurrencies can also play an important role in the implementation of alternative financial circuits able to respond better to the needs of local communities. However, as the case of Bitcoin here analyzed shows, some highly controversial aspects of cryptocurrencies also arise that need to be explored more in depth.

Despite the original intentions of its creators, Bitcoin is currently mostly perceived and used as a speculative tool rather than as a democratic instrument capable of facilitating exchanges and empowering vulnerable people who are excluded from the market. Some of Bitcoin's features could be technically changed to improve it, as new emerging projects are already seeking to do. However, there are other crucial issues—related to democracy, sovereignty, and trust—that cannot be effectively addressed by simply intervening from a technical side.

Of course, political choices and decisions can be translated into technical solutions that in turn can make it easier to reach collectively defined goals. In this sense, we have suggested some features that an alternative financial circuit needs to have by design. At the same time, however, the existence of institutions that are able to exercise a political control over money—to reinforce trust and to censure abuses and misconducts—may be essential to ensure that a monetary system will actually be at the service of an entire community.

In the case of Bitcoin, as we have empirically shown, Central Banks have almost no power of controlling it or influencing its volatility. The total absence of a space for implementing monetary policies, within a market controlled by a few big players, is probably one of the main reasons for Bitcoin having become a highly speculative—and not very democratic—tool. It must be stressed, however, that the weakening of the authority of Central Banks and the increasing power of the financial elite are problems that also concern our official monetary system.

In this scenario, cryptocurrencies may represent a further step toward the imposition of a "fully denationalized financial money" from which only few social groups will benefit with a resulting increase in social inequalities. However, they may also pave the way for bottom-up experiences in which new technologies are used to create financial circuits, enabling a more equitable distribution of the wealth engendered by social cooperation.

We do not exclude that in the long run there is a possibility that Bitcoin will become a more stable, democratic, and effective means of payment. However, we argue that if this will ever happen, it will not be because a cash system, which does not need to rely on trust, has finally been created, as claimed by Bitcoin's inventors. More probably, although still hard to believe, it will happen because people trust each other to the point that a simple unit of account, which does not need to be backed by any material goods nor by a coercive power, is considered sufficient to make exchanges possible.

What is clear is that at the moment, the original definition of Bitcoin as of a "peer-to-peer cash system which does not need to rely on trust" is highly misleading. On the contrary, it seems more reasonable to refer to it as to a highly speculative financial asset that owes its fortune to the fact that it has provided investors with new attractive opportunities to realize capital gains.

NOTES

1. The same cannot be affirmed for the effects of monetary policy on the dynamics of the financial markets. In fact, the quantitative easing policies have guaranteed the liquidity necessary for their recovery after the sharp crash of 2007–2008.
2. In theory, one can send Bitcoins to a not-before-used but valid, in crypto-graphical terms, address. Such funds are "burnt." This is, however, unlikely, as there is a checksum to prevent this situation.
3. When the overall computing capacity decreases, and the average time to solve a problem increases, the difficulty of the algorithm is adjusted downward.
4. See https://www.bitcoincash.org/.
5. See Baur and Dimpfl (2018).
6. Various other contributions argued that Bitcoin shows clear speculative bubble elements (Cheah and Fry 2015; Yermack 2013). Kurihara and Fukushima (2017) did not find anomalies of Bitcoin's prices in a week, and Blau (2017) did not observe, during 2013, a positive relation between speculative trading and Bitcoin's unusual level of volatility.
7. As known, after the monetarist experiences of Thatcher and Volker in the early 1980s, there has been a pragmatic shift from the supply of monetary base to the interest rate as monetary policy instrument. See Caporale Madi (2015) among others.
8. Monthly change in real personal consumption expenditures for EMU, which are not disposable in the Eurostat data set, are the result of our computation based on quarterly Private Final Consumption data and harmonized index of consumption price (2015 = 100 – monthly data) for the Euro Area (18 countries).
9. See the tables. Contrary to most unit roots tests, in the KPSS test the presence of a unit root is not the null hypothesis but the alternative. The test leads to exclude the regressor $\beta 2\Delta ipt,US$ in Models 1a, 1c, 2a, and 2c.
10. The variance inflation factor (VIF) is calculated as $VIF_i = 1/(1–R_i^2)$, where VIF_i is the variance inflation factor of an independent variable X_i and R_i^2 is the multiple R^2 of X_i on the other independent variables.
11. If we add three lags to the regressors "Federal Fund Target" and "Euribor" the results remain the same.
12. In September 2017, Chinese authorities banned Bitcoin trading and initial coin offerings after the People's Bank of China said such activities could pose major financial risks to the real economy.
13. Other factors that could influence the Bitcoin volatility are: the increase or decrease of marketplaces, firms and platforms accepting Bitcoin; the trend in electricity prices for mining; the number of "bad or good news" on Bitcoin. The latter, in our model, could be captured by the monthly change in the spread between daily high and low BTC prices. The trend in electricity prices should be negatively correlated with the monthly change in industrial production both in the EU and the USA. The positive correlation we found between the monthly change in industrial production and BTC monthly returns may be explained by the fact that a decrease in electricity prices sustains BTC returns. However, in our empirical analysis this correlation has not turned out to be statistically significant.

14. European Central Bank 2015: 259.
15. See Roio (2013).
16. On this point see Griziotti (2014), Fumagalli and Giannelli (2013), Roio (2013).
17. It is also worth stressing that Bitcoin protocol is a performative language that, even if codified, is composed of "words or numbers" and by a "grammar." Grammar is the codification and standardization of words and numbers. There is a dialectic dynamic between them, which reflects and reproduces different levels of access (see on this point Austin 1979 [1961] and Marazzi 2008), which implies asymmetry of power and hierarchical structures that should be taken into account.
18. See Longhurst and Seyfang (2011).
19. Various events have been organized to discuss and compare the different projects. Among others: the Workshop hosted by the Digital Culture Unit at the Centre for Cultural Studies at Goldsmiths College in London in January 2014 (Terranova 2014), the D-Cent European Project October 2013–May 2016 (Roio et al. 2015), the Conference organized by MoneyLab in Amsterdam in March 2014 (Roos 2014; Lovink, Tkacz, and de Vries 2015), the Robin Hood Minor Asset Management Cooperative laboratory in Stuttgart (Piironen and Virtanen 2014), the Conference "La moneta del comune" organized by the Effimera network, and Macao, the independent center for art, culture, and research in June 2014 in Milan (Braga and Fumagalli 2015).
20. See Doria and Fantacci (2017).
21. We refer, from one side, to the tradition that can be traced back to authors such as Karl Marx, George Simmel, and Karl Polany, who tend to conceive money as a "radical leveler" that subsumes every aspect of social life to the logics of profit and economic rationality and from the other side, to the idea—shared by authors such as Pierre Bourdieu and Viviana Zelizer—that money is, to simplify, a vehicle of preexistent values, meanings, and symbols.
22. Understood as "the creative effort people make establishing, maintaining, negotiating, transforming, and terminating interpersonal relations" (Zelizer 2012: 6).
23. Of course there are also cryptocurrencies, such as FairCoin (https://fair-coin.org/), that are used by a well-defined community in which technical decisions about the development of the underlying protocol are taken in the light of shared meanings, rules, and goals.
24. See Aglietta and Orléan (2002).
25. See Perna (2014). We are obviously referring to the role that money is supposed to play in a market society. The meaning and the functions of money have greatly changed over time and cannot be reduced to its prevailing contemporary uses.
26. As observed by Evans (2009: 1037–1308) with respect to local currency projects, "market success for money systems may depend on aligning, rather than opposing, social values and economic relationships." In the absence of tangible economic benefits, only the more affluent will be able to participate: "It appears that some minimum level of economic benefit is required to sustain a local currency, along with the legal, regulatory, and administrative infrastructure to support it. Without any economic benefits, systems fail completely, irrespective of social values motivations."
27. See Bauwens and Fumagalli (2018). See also Baronian and Vercellone (2015).
28. In this regard, some helpful indications could be found by looking at Keynes's idea of the Bancor, which was conceived as a supranational currency to be used as a unit of account within a multilateral clearing system. The principle of clearing, in fact, is already at the base of a number of complementary currency projects and mutual credit systems such as Sardex (www.sardex.net). Scholars and activists have also discussed about the proposal, first advanced by Silvio Gesell, of a demurrage-based currency, endowed with a negative interest rate intended to discourage hoarding (see Braga and Fumagalli 2015).
29. The term "use value" derives from Marxian philosophy and economy and refers to the tangible (or intangible) features of a commodity (a tradable object), which can satisfy some human requirement, want, or need or which serves a useful purpose. This idea of value is the opposite of the concept of "exchange value," which takes place in the capitalist activity of exchange and is therefore able to generate, under certain conditions, a plus value. The use value is produced by human activity by means of concrete work, the value of exchange from abstract work (in the different forms in which it is organized).

30. Indeed, the Bitcoin system provides a form of remuneration to those who fruitfully participate in the mining process. Here we refer to the use of the money of the common for the remuneration of different work activities not related to the management of the currency.

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