Is Bitcoin Money? An Economic-Historical Analysis of Money, Its Functions and Its Prerequisites

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ABSTRACT

Bitcoin and other cryptocurrencies' spectacular rise over the past years has attracted considerable public and academic interest. The important question arising in this context is whether cryptocurrencies can legitimately be regarded as money. This paper contributes to the current discourse by evaluating cryptocurrencies' monetary merits based on the two dominating schools on the origin and nature of money, (1) the orthodox, or Metallist, school of money and (2) the heterodox, or Chartalist, approach. The theoretical as well as empirical findings advanced in this paper serve to illustrate that cryptocurrencies cannot legitimately be regarded as money owing to their lack of essential characteristics universally shared by other monetary systems. By cryptocurrencies' lack of intrinsic value as well as government support, virtual currencies fail according to the orthodox as well as the heterodox school of money, respectively. In addition, the inelasticity of the bitcoin stock due to the fixed maximum amount of 21 million units stands in sharp contrast to that of other monetary systems – including gold and other depletable resources –, further reducing bitcoin's suitability as a medium of exchange, and thus as money.

In an attempt to explain the apparent discrepancy between the current value the market attaches to cryptocurrencies and their monetary deficiencies, we advance that market participants are misled by what we term the input fallacy of value (IFV). Similar to the labour theory of value, which posits that value is a function of the labour required to produce a good or service, market participants appear to be misled into believing that the value of cryptocurrencies is the product of the input costs required in the "mining" process. In this context, it is overlooked that value, far from merely being a function of labour and capital deployed, is solely determined by the resultant utility. Since, however – as detailed in this paper –, bitcoin lacks the essential characteristics associated with money, cryptocurrencies' utility, and hence price, should tend towards zero over time.

JEL classification: N10, N20, B12, B13, B15, B25, B59, E31, E41, E42, E51, E58

Keywords: bitcoin, cryptocurrencies, economic bubbles, nature of money, origin of money, theories of money, money, evolution of money, medium of exchange, orthodox school of money, heterodox school of money, Chartalist school, Metallist school, labour theory of value, input fallacy of value, stone currency of Yap

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1. INTRODUCTION

At least since 2017, the "*Year of Bitcoin*", according to the *The Washington Post* (Shaban 2017), bitcoin and other cryptocurrencies have evolved from a fringe phenomenon to a mainstream topic frequently encountered in newspapers and other media. Cryptocurrencies' subsequent spectacular rise has attracted considerable public and academic interest. Notwithstanding the steep price appreciation of bitcoin since its emergence, acceptance of cryptocurrencies remains negligible, however. The discrepancy between cryptocurrencies' market valuation and their limited use as a medium of exchange raises the question whether cryptocurrencies can legitimately be regarded as money, or must rather be viewed as a speculative hype based on greater-fool thinking – thus that rapidly rising prices and the prospect of reselling at a higher price, as opposed to their use-value, provide the main reason for buying cryptocurrencies.

A handful of papers have commented on cryptocurrencies' lack of monetary functions and other shortcomings. Ali, Barrdear, Clews and Southgate (2014) show that bitcoin is rarely used as a medium of exchange. Yermack (2013) stresses that bitcoin is not being used as a unit of account for standard consumer finance credit, auto loans or mortgages and that no credit or debit card are denominated in bitcoin. According to Yermack (p. 7), the usefulness of bitcoin as a unit of account and store of value is further undermined by its volatility, which is "an order of magnitude higher than the volatilities of widely used currencies". Further points of critique include an impracticably long waiting time upon transaction confirmation (Velde 2013) as well as the system-inherent deflationary setup due to the incentive to hoard (Krugman 2011).

One serious – and, in my opinion, fatal – flaw has not drawn commensurate scrutiny, however, namely the failure of cryptocurrencies to comply with the two dominating theories of money pertaining to the origin and nature of money. This paper contributes to the current discourse by evaluating cryptocurrencies' monetary merits based on (1) the orthodox, or Metallist, school of money and (2) the heterodox, or Chartalist, approach. The theoretical as well as empirical findings advanced in this paper serve to illustrate that cryptocurrencies cannot legitimately be regarded as money owing to their lack of essential characteristics universally shared by other monetary systems. By cryptocurrencies' lack of intrinsic value as well as

government support, virtual currencies fail according to the orthodox as well as the heterodox school of money, respectively.

In an attempt to explain the apparent discrepancy between the current value the market attaches to cryptocurrencies and their monetary deficiencies, we advance that market participants are misled by what we term the input fallacy of value (IFV). Similar to the labour theory of value, which posits that value is a function of the labour required to produce a good or service, market participants appear to be misled into believing that the value of cryptocurrencies is the product of the input costs required in the "mining" process. In this context, it is overlooked that value, far from merely being a function of the amount of labour and capital deployed, is solely determined by the resultant utility. Since, however – as detailed in this paper –, cryptocurrencies lack the essential characteristics associated with money, cryptocurrencies' utility, and hence price, should tend towards zero over time.

The remainder of this paper is structured as follows: Part II provides a brief explanation on the functioning of cryptocurrencies as exemplified by bitcoin. Part III discusses the two dominant schools on the nature and origin of money – the orthodox and heterodox school of money – along with a cursory view of money throughout history and geographies. Part IV answers the question whether cryptocurrencies can legitimately be viewed as money before the backdrop of the orthodox and heterodox school of money. In addition, a framework is proposed within which bitcoin and other cryptocurrencies appear to be valued. The article closes by providing a short summary of the article's main arguments and a conclusion.

2. AN OVERVIEW OF CRYPTOCURRENCIES

The starting point of cryptocurrencies is marked by a paper titled "*Bitcoin: A Peer-to-Peer Electronic Cash System*" published in 2008 by pseudonymous Satoshi Nakamoto, outlining the details and mechanism of an electronic cryptocurrency termed bitcoin and a peer-to-peer solution for online transfers by bypassing the need for a trusted third party.[1]

The revolutionary property of bitcoin consists in the fact that it solves what in computer science is known as the double-spending problem, whereby the possibility is described that digital cash tokens may be spent more than once owing to the fact that the underlying digital file may be duplicated. Bitcoin solves the double-spending problem by a decentralised ledger which is distributed among users through a peer-to-peer network referred to as blockchain. Transactions are recorded consecutively in the blockchain which simultaneously serves to verify that the same token has not already been spent (Brito and Castillo 2016, pp. 5-6).[2] The decentralised nature of bitcoin permits the transfer of bitcoins without a designated (central) third party (i.e. financial intermediaries, such as banks or other payments system providers like PayPal, Western Union, etc), which play an indispensable role in preventing double-

[1] For the purpose of the analysis conducted on the following pages, this paper will concern itself with bitcoin as the best-known and most established virtual currency as a proxy for cryptocurrencies in general.
[2] For an in-depth review of the distributed ledger technology, see Bank for International Settlements (2017).

spending by the provision of clearing services. In other words, financial intermediaries serve as guarantors that money is not spent more than once in traditional transactional setups.

Like modern fiat currencies, such as the U.S. dollar, the euro or the Japanese yen, bitcoin is not redeemable into specie, i.e. it cannot be converted into a pre-determined amount of metal or other commodity. Unlike modern fiat currencies, however, bitcoin is not backed by the full faith and credit of a central government or other official institutions.

According to the proposal outlined by Nakamoto (2008), new bitcoins are "mined" based on solving predefined cryptographic problems (hence the "crypto" prefix), which renders bitcoin's supply insusceptible to government or central bank intervention. However, contrary to the oft-cited parallels of bitcoin's algorithmic growth rate with Milton Friedman's monetary orthodoxy, the bitcoin system does not seem to be concerned with considerations of an optimal monetary growth rate, instead providing for the rate of growth to decrease asymptotically to zero by the year 2114, when the maximum total supply of 21 million units will be reached (Yermack 2013, p. 4). A decreasing growth rate also stands in sharp contrast to that of gold – a commodity which bitcoin seems to attempt to mimic, not least by the shared terminology (e.c. "mining"), since the supply of gold was not constrained by an absolute amount and neither was gold's growth rate decreasing. Instead, the growth of the gold supply would accommodate economic growth as long as technological advancement in mining would, on average, co-develop with output growth.

3. THEORIES OF MONEY

Since bitcoin's primary purpose is to eliminate financial intermediaries and to replace incumbent money,[3] an understanding of money in general and its nature as well as functions in particular are indispensable – an overview of which will be provided on the following pages. In one of the seminal works on money, Jevons (1896, p. 19) notes that "[l]iving in civilized communities, and accustomed to the use of coined metallic money, we learn to identify money with gold and silver; hence spring hurtful and insidious fallacies." Indeed, technically, anything can serve as money, and historically, many things have. Although money developed in numerous civilisations independently, it is remarkable that, while the specific forms in which money came into existence inevitably differed owing to a variety of factors, certain characteristics of money appear to have been universal in their occurrence across peoples, geographies and times. In pre-modern times, intrinsic value, or use-value, appears to have played an indispensable role in transforming something from a commodity or good into money. Contemporary money, on the other hand, is unexceptionally devoid of intrinsic value, and instead is dependent on continuous government support in the form of declaring it acceptable for the purpose of paying taxes.

Not surprisingly, therefore, Goodhart (1998) distinguishes two schools concerned with the origins and the nature of money: (I) The orthodox, or Metallist, school views money as a

[3] Cf. Nakamoto (2008).

natural consequence of economising man confronted with the adverse concomitants of barter. Although the orthodox school finds little support in the historical record, it has not prevented the theory from gaining wide-spread acceptance. (II) The heterodox, or Chartalist, approach, on the other hand, views money as a creature of the state, stressing the importance of authorities in the origins and evolution of money.

3.1. THE ORTHODOX SCHOOL OF MONEY

As a hypothetical starting point for the orthodox school serves a suppositional state of barter,[4] in which transactions required simultaneous wants of both transactional parties – the so-called double-coincidence of want.[5] Such burdensome must have been this state of barter that from ancient Greek thinkers over moral philosophers to modern economists that primordial state of direct commodity exchange has frequently been identified as the natural starting point from which money must have developed in order to facilitate trade and increase efficiency.[6] Standard economic theory therefore holds that the emergence of money is the

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[4] In contrast to this explanation preferred by economists for the emergence of money from and in response to a state of barter, anthropologist Graeber (2011) argues that money developed from credit, not from a medium for exchange, producing considerable empirical evidence for the anthropologist/historian view of the emergence of money. Graeber demonstrates that money as a medium of exchange was mainly confined to exceptional circumstances, such as inter-societal trade or trade between strangers or even enemies, while intra-societal trade, was largely characterised by debt. In what Graeber (2011) describes as the "definitive anthropological work on barter", Humphrey (1985, p. 48) comes to the arresting conclusion that "[t]he mainstream economists' view that barter should be seen as a 'natural' phenomenon of human nature and as the origin of money is rejected" by observing: "No example of a barter economy, pure and simple, has ever been described, let alone the emergence from it of money; all available ethnography suggests that there never has been such a thing."

Graeber (2011, p. 394-395, n. 14) points out that the notion of a historical sequence from barter to money to credit first appeared in a lecture by an Italian banker named Bernardo Davanzati (1529-1606). It was subsequently developed as an explicit theory by economic historian Bruno Hildebrand (1864), who stipulated a prehistoric stage of barter, an ancient stage of coinage and ultimately – after a relapse to barter in mediaeval times – the modern economic stage of credit, before taking canonical form in his student Karl Bücher (1907), thenceforth becoming universally-accepted common knowledge, advocated, for instance, by Marx and Simmel.

The notion that credit may have preceded physical money in the form of media of exchange is not confined to modern research, however. Classical economist Senior (1928: II, p. 40, quoted by Priddat 2012, p. 3), for instance, notes:

> *The use of credit is the simplest mode of effecting an exchange between those whose wants and supplies do not precisely* [sic!] *correspondent. To a certain extent it must exist in the rudest stages of society. We may be sure that a savage hunter or fisher often purchases arrows or nets by a promise to pay for them out of the produce of his labor.*

Since the use of credit requires a considerable degree of trust, it can be aligned well with the observation that money was confined to inter-societal and war-time trade, as described in Graeber (2011). That trust is an indispensable cornerstone of credit is further evidenced by the fact that the word "credit" itself is derived from the Latin verb "credere", meaning "to believe".

[5] The term double coincidence of want was termed by Jevons (1896, p. 5) in his seminal work "*Money and the Mechanism of Exchange*":

> *The first difficulty in barter is to find two persons whose disposable possessions mutually suit each other's wants. There may be many people wanting, and many possessing those things wanted; but to allow of an act of barter, there must be a double coincidence, which will rarely happen.*

[6] It is noteworthy that the primary function characterising money in the context above is as a medium of exchange. In contemporary accounts, money is frequently defined by three additional functionalities besides (1) "medium of exchange": (2) a unit of measure, (3) a store of value, and (4) a standard of deferred payment (cf. Allen 2009, p. xiii).

logical result of the inconveniences associated with barter systems, to wit, the double coincidence of want problem (Jevons 1896; Menger 1892), lack of divisibility (Menger 1892; Jevons 1896, Smith 1976 [1776]) and information asymmetries (Brunner and Meltzer 1971; Alchian 1977; see also Menger 2007 [1871], p. 260) [7].

Menger (1892, p. 242) colourfully describes the suppositional state of barter in "*Origins of Money*":

> *Consider how seldom it is the case, that a commodity owned by somebody is of less value in use than another commodity owned by somebody else! And for the latter just the opposite relation is the case. But how much more seldom does it happen that these two bodies meet! Think, indeed, of the peculiar difficulties obstructing the immediate barter of goods in those cases, where supply and demand do not quantitatively coincide; where, e.g., an indivisible commodity is to be exchanged for a variety of goods in the possession of different persons, or indeed for such commodities as are only in demand at different times and can be supplied only by different persons!*

However, in "*Principles of Economics*", Menger (2007 [1871], p. 279-280) stresses that the monetary functions complementary to the medium of exchange characteristic are either accidental or, in fact, erroneous:

> *But the notion that attributes to money as such the function of also transferring "values" from the present into the future must be designated as erroneous. Although metallic money, because of its durability and low cost of preservation, is doubtless suitable for this purpose also, it is nevertheless clear that other commodities are still better suited for it. Indeed, experience teaches that wherever less easily preserved goods rather than the precious metals have attained money-character, they ordinarily serve for purposes of circulation, but not for the preservation of "values. […] [And] it appears to me to be just as certain that the functions of being a "measure of value" and a "store of value" must not be attributed to money as such, since these functions are of a merely accidental nature and are not an essential part of the concept of money.*

Mises (1953 [1912], p. 34) follows Menger in "*The Theory of Money and Credit*" by observing:

> *The simple statement, that money is a commodity whose economic function is to facilitate the interchange of goods and services, does not satisfy those writers who are interested rather in the accumulation of material than in the increase of knowledge. Many investigators imagine that insufficient attention is devoted to the remarkable part played by money in economic life if it is merely credited with the function of being a medium of exchange; they do not think that due regard has been paid to the significance of money until they have enumerated half a dozen further "functions" – as if, in an economic order founded on the exchange of goods, there could be a more important function than that of the common medium of exchange.*

Ultimately, as Rothbard (2010, p. 11) correctly points out, the sole property which money ought to possess, in order to be classified as such, is its function as a medium of exchange: "Many textbooks say that money has several functions: a medium of exchange, unit of account, or 'measure of values,' a 'store of value,' etc. But it should be clear that all of these functions are simply corollaries of the one great function: the medium of exchange."

[7] Menger (2007 [1871], p. 260) recognises the difficulties arising as a result of informational inefficiencies accompanying the use of precious metals:

> *The chief defects involved in the use of the precious metals for monetary purposes are: (1) the difficulty of determining their genuineness and degree of fineness, and (2) the necessity of dividing the hard material into pieces appropriate to each particular transaction. These difficulties cannot be removed easily without loss of time and other economic sacrifices.*
>
> *The testing of the genuineness of precious metals and their degree of fineness requires the use of chemicals and specific labor services, since it can be undertaken only by experts. The division of the hard metals into pieces of the weights needed for particular transactions is an operation which, because of the exactness necessary, not only requires labor, loss of time, and precision instruments, but is also accompanied by a not inconsiderable loss of the precious metal itself (because of the loss of chips and as the result of repeated smelting).*

Equivalently, as Graeber (2011, p. 23) points out, virtually all modern economics textbooks prompt readers to "imagine" the problems associated with a barter-based economy, instead of pointing to historical, ethnographical, sociological or other evidence in favour of such a state.[8]

The classical-orthodox approach views money as a logical, evolutionary process from the inefficient nature of barter towards a more functional setup for the conduct of transactions.[9] The notion that the emergence of money addressed the inefficiencies of economies based on barter is as old as the field of economics itself. In "*An Inquiry into the Nature and Causes of the Wealth of Nations*", Smith (1976 [1776], p. 126-127) asserts that the double coincidence of wants problem must have inspired the invention of money in the form of a commodity "few people would be likely to refuse":

> *But when the division of labour first began to take place, this power of exchanging must frequently have been very much clogged and embarrassed in its operations. One man, we shall suppose, has more of a certain commodity than he himself has occasion for, while another has less. The former consequently would be glad to dispose of, and the latter to purchase, a part of this superfluity. But if this latter should chance to have nothing that the former stands in need of, no exchange can be made between them. The butcher has more meat in his shop than he himself can consume, and the brewer and the baker would each of them be willing to purchase a part of it. But they have nothing to offer in exchange, except the different productions of their respective trades, and the butcher is already provided with all the bread and beer which he has immediate occasion for. No exchange can, in this case, be made between them. He cannot be their merchant, nor they his customers; and they are all of them thus mutually less serviceable to one another. In order to avoid the inconveniency of such situations, every prudent man in every period of society, after the first establishment of the division of labour, must naturally have endeavoured to manage his affairs in such a manner, as to have at all times by him, besides the peculiar produce of his own industry, a certain quantity of some one commodity or other, such as he imagined few people would be likely to refuse in exchange for the produce of their industry.*

In *"Principles of Economics"*, originally published in 1871, Menger (2007 [1871], pp. 258-259) follows Smith, describing the difficulties of barter as "insurmountable" and the purported evolutionary development of money as "inevitable":

> *This difficulty* [of barter] *would have been insurmountable, and would have seriously impeded progress in the division of labor, and above all in the production of goods for future sale, if there had not been, in the very nature of things, a way out. But there were elements in their situation that everywhere led men inevitably, without the need for a*

[8] Maunder, Myers, Wall and Miller (1991) prompt readers to "[i]magine the difficulty you would have today, if you had to exchange your labor directly for the fruits of someone else's labor," Begg, Fischer and Dornbuch (2005) write "[t]o see that society benefits from a medium of exchange, imagine a barter economy," and Parkin and King (1995) ask to "[i]magine you have roosters, but you want roses." Jevons (1896, p. 4) hypothesises that [t]he earliest form of exchange must have consisted in giving what was not wanted directly for that which was wanted", and Menger (1892, p. 242) laments: "It is clear then, that in these circumstances [barter system] the number of bargains actually concluded must lie within very narrow limits."

[9] See fn. 3.

> *special agreement or even government compulsion, to a state of affairs in which this difficulty was completely overcome.*

In a widely-cited paragraph of the same book, Menger (2007 [1871], p. 260) reiterates that the concept of money is an emergent market phenomenon[10], an inevitable outcome naturally arising in non-subsistence economies:

> *As each economizing individual becomes increasingly more aware of his economic interest, he is led by this* interest, without any agreement, without legislative compulsion, and even without regard to the public interest [emphasis as in the original text]*, to give his commodities in exchange for other, more saleable, commodities, even if he does not need them for any immediate consumption purpose. With economic progress, therefore, we can everywhere observe the phenomenon of a certain number of goods, especially those that are most easily saleable at a given time and place, becoming, under the powerful influence of custom, acceptable to everyone in trade, and thus capable of being given in exchange for any other commodity. These goods were called "Geld" by our ancestors, a term derived from "gelten" which means to compensate or pay. Hence the term "Geld" in our language designates the means of payment as such.*

The classical-orthodox view may still be discovered in contemporary accounts on money. Samuelson (1973, p. 274), for instance, writes, acknowledging the important role of hypotheses and logic: "If we were to construct history along hypothetical, logical lines, we should naturally follow the age of barter by the age of commodity money." Samuelson's characterisation, historically incorrect as it might be, can be found in this or similar form in virtually all economics textbooks and more specialised books on money.

According to the orthodox school, the media of exchange resultant from the attempt to overcome the inefficiencies of barter possessed intrinsic value. Much like other aspects of the Metallist school, this assumption is based on the logic of armchair-theorising: In the early phase of human history, the use of money cannot have been regulated by law, the reasoning goes. It thus follows that a material's utility for non-monetary purposes, and thus intrinsic value, must have been the precondition for its employment as money.

Jevons (1897, p. 32-33) logically deduces the need for intrinsic value to have been an indispensable requirement for the development of money based on the absence of a sufficiently powerful ruler to enforce its use:

> *Certainly, in the early stages of society, the use of money was not based on legal regulations, so that the utility of the substance for other purposes must have been the prior condition of its employment as money.*

In "*Human Action*", Mises (1998 [1949], p. 407) argues along the same line:

> *[N]o good can be employed for the function of a medium of exchange which at the very beginning of its use for this purpose did not have exchange value on account of other employments.*

[10] "Emergence" is a philosophical term used to describe the crystallisation (emergence) of new properties or structures due to the interplay of a system's individual elements.

Until 1912, however, when Mises's *"The Theory of Money and Credit"* was first published, economists had been unable to apply the marginal utility theory to the concept of money and thus to theoretically establish the value of money. The problem theorists faced was one of circularity: Goods have marginal utility which is reflected in their demand and supply in terms of money. If money possessed marginal utility, its demand could only be explained in terms of all other goods. Since, however, goods were valued in terms of money and money in terms of goods, the result would have been a circular argument (Helfferich 1903).
Mises's (1953 [1912]) succeeds in circumventing the circularity problem by introducing the element of time. Underlying Mises's "regression theorem" is that any instrument used as a medium of exchange must, at some point in the past, have been valued for its intrinsic utility – consumption, ornamental or religious purposes, etc. – prior to its employment as money, its initial non-monetary use being the prerequisite of it becoming a medium of exchange. Thus, today's subjective use-value of money, which equals its subjective exchange-value, Mises argues, is based on its past exchange value:

> *Once an exchange-ratio between money and commodities has been established in the market, it continues to exercise an influence beyond the period during which it is maintained; it provides the basis for the further valuation of money. Thus the past objective exchange-value of money has a certain significance for its present and future valuation. The money-prices of to-day are linked with those of yesterday and before, and with those of to-morrow and after.* (Mises 1953 [1912], p. 109)

Mises's accomplishment lies in the fact that the regression theorem first demonstrated that the demand for money can be explained in the context of marginal utility just like other commodities – without having to resort to a circular argument: Today's subjective value of money derives, at least in part, from its objective price, or use-value, at some point in the past. Thus, money, according to Mises, developed based on its intrinsic value or usefulness, a contention lying at the heart of the orthodox, or Metallist, approach to money.

Just as Mises's regression theorem demonstrates that money must at some point in the past have possessed intrinsic value, or use-value, Menger's saleability hypothesis (1892) rests on the assumption of intrinsic value in explaining the emergence of money, and, in fact, presupposes it. According to Menger, money emerged spontaneously in a process of interaction among economising individuals in the pursuit of their own self-interest. Again, a state of barter provides the starting point, in which, as Menger asserts, goods would have different degrees of saleability. The more saleable a good, the higher the probability that it can be exchanged for an objective equivalent in other goods, its economic price, in a reasonable amount of time. Saleability of a given good, therefore, is characterised by the proximity to its economic price one may obtain in exchange for it and the interval of time the disposal requires. Menger (1892, p. 245) defines "saleability" as follows:

> *A commodity is more or less saleable according as we are able, with more or less prospect of success, to dispose of it at prices corresponding to the general economic situation, at economic prices.*
> *The interval of time, moreover, within which the disposal of a commodity at the*

> *economic price may be reckoned on, is of great significance in an inquiry into its degree of saleableness.*

If a commodity or good exists with high saleability, instead of insisting on finding a transaction partner for direct barter, rational individuals will accept it as a medium of exchange, even if no immediate need for the medium's use-value exists, because it will facilitate the possessor's next transaction. As a direct corollary, more saleable goods or commodities become even more saleable owing to the extra demand as a medium of exchange, the most saleable becoming money in the process. Although less elegant than Mises's regression theorem, Menger's saleability hypothesis likewise demonstrates that use-value is a necessary prerequisite for a good to emerge as a commonly accepted medium of exchange, and subsequently money.

Consequently, the first step in the history of money according to the orthodox theory constituted commodity money, which may be consumed or otherwise used, and thus serves as a commercial commodity, while at the same time acting as a commonly accepted medium of exchange. In the early days of economic development, when man found himself in the transition from nomadic life to agriculture, cattle[11] constituted the primary item of wealth and as a consequence appears to have been the most universal commodity in use. Indeed, so commonplace was the use of cattle as a medium of exchange in the early phase of civilisation that the word for "money" in several languages is identical to or derived from some kind of cattle or cattle in general. The Latin word for money ("*pecunia*"), for instance, is derived from *pecus*, meaning cattle.[12] In the ancient German codes of law, fines and penalties were often defined with reference to livestock (Jevons 1896, p. 22) and were still imposed in terms of cattle under Otto the Great (Menger 2007 [1871], p. 264). In the Arab world, as well, the cattle standard survived until the time of Mohammed (Menger 2007 [1871], p. 264), and among the Kirghiz of the Russian steppes, horses acted as the main monetary unit until well into the twentieth century, while sheep- and lambskins were used as complementary monetary units (Davis 2010, p. 43).

As civilisation progressed along the path of increasing division of labour and the formation of cities, the marketability of cattle decreased, and metals emerged as the preferred medium of exchange. Of such importance was the growing degree of specialisation premised upon the division of labour and the formation of cities, that Mises (1953 [1912], p. 29) goes so far as to assert that the division of labour is a necessary prerequisite for money to emerge:

> *The phenomenon of money presupposes an economic order in which production is based on division of labour and in which private property consists not only in goods of the first order (consumption goods), but also in goods of higher orders (production goods).*

[11] The vague term "cattle" generally refers to cows, buffalos, goats, sheep and camels, but usually excludes horses (Davis 2002, p. 42).

[12] Cf. Jevons (1896, p. 21-23) for further historical and etymological evidence for the importance of cattle as "the most valuable and negotiable kind of property" in human history. For further reading, Jevons (1896, p. 23) refers to "*The Early History of Institutions*", written by H.S. Maine, for a full account on the importance of livestock in primitive states of economic development.

> *[…] What is to be produced, and how it is to be produced, is decided in the first place by the owners of the means of production, who produce however, not only for their own needs, but also for the needs of others, and in their valuations take into account not only the use-value that the themselves attach to their products, but also the use-value that these possess in the estimation of the other members of the community. […] The function of money is to facilitate the business of the market by acting as a common medium of exchange.*

The increasing use of metal in commerce did not, however, preclude the continuous use of non-metallic commodity money. Instead, metallic money appears to have complemented non-metallic money in many instances. In ancient Rome, for example, where the use of copper was wide-spread, soldiers, officers and civil administrators were paid an allowance of salt. The use of salt was so commonplace that the Latin word "salarium", meaning "salt money", was used for military pay and from which the English word "salary" is derived.[13]According to Marco Polo, salt was also used as money in Kain-Du, where cakes of salt were imprinted with the grand khan's stamp. In Ethiopia, salt as a means of money survived until the 20th century and acted as money as late as during the inflationary period after the October Revolution in Russia (Allen 2009, pp. 353-354). The use of salt as money was so widespread that Allen (2009, p. 354) concludes that "[i]n virtually every quarter of the globe examples can be found of salt circulating as money at some point in history. It is one of those commodities universally in demand."[14] A similarly universal commodity money was rice. In Japan, gold, silver and copper circulated alongside rice after the 16th century, but prices were expressed, debts were contracted and workers were paid in rice, while taxes were collected in rice as well as metallic money. In remote Japanese villages, rice as a currency even survived up to the eve of the Second World War (Allen 2009, pp. 344-345).

In what must appear as a logical next step in the evolutionary process of the division of labour, the harnessing of comparative advantages led to intensifying inter-regional trade patterns. As long-distance trade grew in importance, so did the use of money. It was with the establishment and formation of (long-distance) trade-links, when the preferred medium of exchange increasingly took the form of precious metals, with gold and silver dominating in advanced and commercially active nations.

On the use of precious metals due to the growing importance of (long-distance) trade, Aristotle (350 B.C., book 1, chapter IX) notes:

> *When the inhabitants of one country became more dependent on those of another, and they imported what they needed, and exported what they had too much of, money necessarily came into use. For the various necessaries of life are not easily carried about, and hence men agreed to employ in their dealings with each other something which was*

[13] Salt came into military use in the French language, as well, where the Latin word "sal" became "solder", meaning "pay", which is the origin of the word "soldier" (Kurlansky 2003, p. 63). Equivalently, "Sold" in German denotes military pay.
[14] For an extensive account on salt in global history, see Kurlansky (2003).

> *intrinsically useful and easily applicable to the purposes of life, for example, iron, silver, and the like.*

In addition to facilitating transportation due to the high ratio of value to weight and size, precious metals were uniquely qualified as a medium of exchange along the indispensable qualities of money as per Jevons (1897, pp. 32-40): (a) utility and value, (b) portability, (c) indestructibility, (d) homogeneity, (e) divisibility, (f) stability of value and (g) cognizability.[15]

According to the orthodox view, the development of fiat money happened via the detour of so-called goldsmith-bankers and the successive repression of commodity money in favour of commodity-backed money. In seventeenth-century London, commodity money was frequently deposited with goldsmiths for the purpose of safekeeping against the receipt of depository notes. It was soon discovered that the underlying money need not necessarily be directly involved in transactions. Instead of redeeming the goldsmith notes for the underlying commodity, exchanging the commodity and subsequently re-depositing the commodity in exchange for goldsmith notes, the notes could be exchanged instead of the underlying commodity. Before long, convertible paper money displaced commodity money as the dominant medium of exchange. However, the quantity as well as the value of issued notes were still governed by the quantity and value of the underlying commodity by virtue of the issuers' promise to redeem paper money into specie upon request. The goldsmiths, in turn, soon figured out that a certain number of notes will never be redeemed, as long as solvency and reputation of the note issuer were kept intact, permitting goldsmiths to economise on the reserves held in their vaults through the issuance of additional notes. By the second half of the seventeenth century, London's goldsmith-bankers had formed a system of banks through mutual acceptance of bank-issued notes based on interbank clearing, further promoting the use of bank notes. The wide-spread acceptance of bank notes created positive externalities for member banks, further promoting the use of bank-issued notes (Quinn 1997).

The orthodox approach is so widespread and commonly-accepted, that arguments in favour of the theory are rarely needed. After all, the hypotheses offered by the Metallists compose a logical and coherent framework. Little regard is paid to historical facts, as emphasis is put on the logical and hypothetical. However, it is indeed remarkable that although the specific forms in which money came into existence inevitably differed owing to a variety of factors,

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[15] Reference to the characteristics rendering precious metals particularly suitable for the use as a medium of exchange can be found in nearly all accounts on money. Mises (1953 [1912], p. 99), for instance, mentions "[t]he relative scarcity of the precious metals […] along with such of their other characteristics as their practically unlimited divisibility, their malleability, and their powers of resistance to destructive external influences" as the characteristics "decisive in causing them to be recognized as the most marketable goods and consequently to be employed as money."
Smith (1976 [1776], p. 127) remarks on the wide-spread use of metals as a medium of exchange:

> *In all countries, however, men seem at last to have been determined by irresistible reasons to give the preference, for this employment, to metals above every other commodity. Metals can not only be kept with as little loss as any other commodity, scarce anything being less perishable than they are, but they can likewise, without any loss, be divided into any number of parts, as by fusion those parts can easily be reunited again; a quality which no other equally durable commodities possess, and which more than any other quality renders them fit to be the instruments of commerce and circulation.*

certain characteristics of money appear to have been universal in their occurrence across peoples, geographies and times. Almost unexceptionally, pre-contemporary money possessed intrinsic value, which is most readily apparent with commodity money due to its dual-use as a medium of exchange as well as a commodity.

3.2. THE HETERODOX SCHOOL OF MONEY

Although the orthodox school has attempted to incorporate modern, or fiat, money into traditional models, the Metallist theory is at a loss explaining convincingly the modern monetary arrangement. Mises once quipped: "Government is the only institution that can take a valuable commodity like paper, and make it worthless by applying ink." Looking at contemporary money, however, it appears that the opposite appears to be true. The twentieth century has seen the successful emergence of fiat money in virtually all nations, as traditional commodity and commodity-backed money disappeared with the fall of the Bretton Woods system. Indeed, if anything, the period since the early-1970s has demonstrated that, for money to function as money, it need not necessarily consist of material with intrinsic exchange value, for modern, or fiat, money is in so far distinctive from historic variants as it is exclusively state money and as such possesses neither intrinsic value – i.e. serves neither consumptive, nor ornamental or religious use – nor is it redeemable in specie.

Opposing the orthodox school of money, the heterodox, or Chartalist, approach provides valuable input for understanding why seemingly worth- as well as useless materials might circulate as money, while other materials possessing apparent use-value do not.

According to the Chartalist view, money has a social dimension (Foley 1987; Ingham 1996) and therefore cannot be understood without consideration of the institutions within which it is embedded (Bell 2001). More precisely, the heterodox school of money maintains that money cannot be studied in isolation from the power of authorities. As such, the Chartalist school is fundamentally opposed to the orthodox notion of spontaneously emerging money as an attempt to minimise transaction costs. Instead, the Chartalists stress the importance of authorities, regarding money as a "creature of law" (Knapp 1924, p. 1) and thus provide a non-market-based explanation for the emergence of money.

Chartalism was coined and first advanced by Georg Friedrich Knapp, a follower of the Germany Historical School. Knapp's formative work "*Staatliche Theorie des Geldes*", originally published in German in 1905 was translated into English ("*The State Theory of Money*") in 1924. According to Knapp, money emerges when the government specifies a given object as a unit of account and institutes acceptance for it by the state:

> *Then all means by which a payment can be made to the State form part of the monetary system. On this basis it is not the issue, but the acceptation, as we call it, which is decisive. State acceptation delimits the monetary system. By the expression "State-acceptation" is to be understood only the acceptance at State pay offices where the State is the recipient.* (Knapp 1924, p. 95)

Following Knapp's argumentation, Ingham (2004a, p. 179) defines money as a promise supported by the government's taxing prerogative. Ingham (2004, p. 25) concretises that "a state issues money, as payment for goods and services, in the form of a 'promise' to accept it in payment of taxes." Lacking intrinsic value, fiat money thus derives its value from what Ingham (2004a, p. 29) terms "the promise of last resort", the coercive power of the sovereign state manifested in the government levying taxes and accepting money for extinguishing the resulting debt to the state. Sgambati (2015) stresses the central role of the state promise in the construction of money's value. In addition to conferring credibility as well as political legitimacy, the state promise comprises a public tax upon the private economy. By virtue of its fiscal prerogative, not only is the state in the position to impose the money of account and to endow it with legal tender status within its sovereignty, but it can ultimately also stipulate its purchasing power "by influencing what must be done in an economy to earn the income to pay the tax" (Ingham 2004a, p. 84). The central role of the state in general and its taxing prerogative in particular is summarised by Knapp (1924, p. vii) by stating that "the money of a State is not what is of compulsory general acceptance, but what is accepted at the public pay offices". The pivotal role of the government and its fiscal prerogative of levying and collecting taxes has given rise to the characterisation of fiat money as "tax-driven money", which perhaps best captures the "value-creation process" in modern monetary systems.

Although the list of theorists in the orthodox tradition is far more illustrious,[16] acknowledgement for the Chartalist approach can be found in numerous writings of classical and neo-classical economists. The earliest acknowledgement for the role of taxation in the emergence of money, to my knowledge, dates back to Adam Smith's (1976 [1776], p. 328) "*Wealth of Nations*":

> *A prince who should enact that a certain proportion of his taxes should be paid in a paper money of a certain kind might thereby give a certain value to this paper money, even though the term of its final discharge and redemption should depend altogether upon the will of the prince.*

An extensive paragraph on the formative power of taxation can be found in Wicksteed's (1933 [1910], p. 620) "*The Common Sense of Political Economy"*, originally published in 1910:

> *The Government has, however, a further resource. It has the means of maintaining a perpetual recurrence of persons thus desiring money at its face value, for the Government itself has more or less defined powers of taking the possessions of its subjects for public purposes, that is to say, enforcing them to contribute thereto by paying taxes. […] The Government, then, levying taxes upon the community, may say: "I shall take from you, in proportion to your resources, as a tribute to public expenses, the value of so much gold. You may pay it to me in actual metallic gold or you may pay it to me in anything which I choose to accept in lieu of the gold. If you do not give it me I shall take it from you, in gold or any other such articles as I can find, and which would serve my purpose, to the value of the gold. But if you can give me a piece of paper,*

[16] For an excellent overview, see Goodhart (1998).

> *of my own issue, to the face value of the gold that I am entitled to claim of you, I will accept that in payment.*

In "*Money and the Mechanism of Exchange*", Jevons (1896, p. 219) also touches upon taxation and public receivability, but beyond that adjudicates the government's prerogative of taxation a value-stabilising function: "Inconvertible paper money may be freely issued, but an attempt may be made to keep up its value by receiving it in place of coin in the payment of taxes."

So, in contrast to the Metallist theory, which regards intrinsic value as a prerequisite for the emergence of money (Menger 1892, Mises 1953 [1912]), Chartalism identifies taxation as the decisive factor in the formation of money, a notion shared by orthodox economists from Smith to Jevons and Wicksteed.
In an article published in *Econometrica*, Starr (1974) confirms theoretically the importance of taxation in an investigation of the possibility of a zero equilibrium price of money:

> *How can we eliminate the possibility of the price of money being zero in equilibrium? In order to do this we must arrange that there be a positive excess demand for money when the price of money is zero. One way to achieve this is to guarantee that money can always be used in payment of taxes; […] Taxes can be used to create a demand for money independent of its usefulness as a medium of exchange, thereby ensuring that its price will not fall to zero. (p. 46)*

While early-Chartalists, such as Knapp (1924), maintain that new money be linked to the money to be replaced,[17] modern scholars view the incurrence of obligations through the state prerogative of taxation per se as sufficient for the formation and continuous use of money.

For instance, Tobin and Golub (1998, p. 27):

> *In advanced societies the central government is in a strong position to make certain assets generally acceptable media. By its willingness to accept a designated asset in settlement of taxes and other obligations, the government makes that asset acceptable to any who have such obligations, and in turn to others who have obligations to them, and so on.*

Lerner (1947, p. 313) agrees, observing:

> *The modern state can make anything it chooses generally acceptable as money and thus establish its value quite apart from any connection, even the most formal kind, with gold or with backing of any kind. It is true that a simple declaration that such and such is money will not do, even if backed by the most convincing constitutional evidence of the state's absolute sovereignty. But if the state is willing to accept the proposed money in payment of taxes and other obligations to itself the trick is done. Everyone who has obligations to the state will be willing to accept the pieces of paper with which he can settle the obligations, and all other people will be willing to accept these pieces of paper because they know that the taxpayers, etc., will accept them in turn. […] What this*

[17] Even Knapp (1924, p. 21) acknowledges that the government will be exposed to historical path dependency in the introduction of new fiat money: "The unit of value which is to come into use is defined by its relation to the previous unit. It is therefore historically defined."

means is that whatever may have been the history of gold, at the present time, in a normally well-working economy, money is a creature of the state. Its general acceptability, which is its all-important attribute, stands or falls by its acceptability by the state.

4. CRYPTOCURRENCIES, THE STONE CURRENCY OF YAP AND THE INPUT FALLACY OF VALUE

Summarising the two dominating schools on the nature of money, money ought to have intrinsic value according to the orthodox school, while the heterodox approach stresses institutional support in the form of taxation and receivability ("accepted at the public pay offices"). So, how does bitcoin and other cryptocurrencies fit into the picture?

As an intangible asset, bitcoin does not possess intrinsic value in the traditional, or orthodox, sense. It is, however, frequently argued that the "mining" process requires a certain input of energy and computing power, a sufficient condition, it is claimed, so as to create – and justify – value. In that context, bitcoin is frequently compared to gold and other precious metals, a comparison which appears to be actively encouraged by both the terminology used as well as the fixed maximum amount of units which can be mined in most cryptocurrencies. Not least, Nakamoto (2008, p. 4) claims that "[t]he steady addition of a constant of amount [sic!] of new coins is analogous to gold miners expending resources to add gold to circulation. In our case, it is CPU time and electricity that is expended." Bitcoin wiki, as well, makes reference to gold with regard to the mining process, claiming that "the algorithm was chosen because it approximates the rate at which commodities like gold are mined."[18]

The derivation of value from the input required to mine bitcoins is closely related to the classical concept called labour theory of value (LTV), according to which value is a function of the labour input required in the production process.

On that, Adam Smith (1976, p. 51) in "*The Wealth of Nations*" notes:

> *Labour alone, therefore, never varying in its own value, is alone the ultimate and real standard by which the value of all commodities can at all times and places be estimated and compared. It is their real price; money is their nominal price only.*

A few pages later, Smith (p. 54) reiterates: "Labour [...] is the only universal, as well as the only accurate measure of value, or the only standard by which we can compare the values of different commodities at all times and places."

Similarly, Ricardo (1821, chapter 30) holds that "[i]t is the cost of production which must ultimately regulate the price of commodities, and not, as has been often said, the proportion between the supply and demand".

We shall refrain from attempting to assess the theory's accurateness, as for the purpose at hand, it shall suffice to note that the labour theory of value has empirical validity in the

[18] https://en.bitcoin.it/wiki/Controlled_supply

aggregate, since it is a matter of simple logic that prices and input costs in an economy tend to be highly correlated: If the price of a product were to exceed its production cost, competition amongst established producers and/or new entrants would lead to higher output and/or a pushing-up of production prices. Analogously, if the price of a given product were to be below its cost of production, output would decrease either by producers dropping out of the market and/or decreasing production volume of producers, establishing higher prices and/or lower input costs.

What may be true in the aggregate need not necessarily – and does not, in our view, with respect to bitcoin – hold for each individual part, however. Contrary to the oft-cited parallels between gold and bitcoin, there exists a material difference between the quarrying of gold and the "mining" of bitcoin. The extraction of gold involves input costs, such as buying suitable land, obtaining licences, buying equipment, paying labour, etc. for a certain output of gold. People are willing to undergo the toil and cost of quarrying gold, as gold has many industrial and decorative uses making it valuable. While the price of gold may fluctuate, it can never fall to zero, since there will always be someone willing to accept gold because of its inherent properties, its use-value. The same cannot be said of bitcoin. "Mining" bitcoin, while involving costs in the form of electricity and computing power, is fundamentally different to mining gold as the cost involved is arbitrarily set and nothing of value is created in the process. While the mining of gold requires an objective quantity of labour and resources, set by technology and nature, which must be expended, the "mining" of bitcoin is based on a subjective assessment on what should be expended. The logical fallacy underlying the notion that the mining of gold and bitcoin might be comparable must become immediately clear if one asked whether the justified price or value of one bitcoin should or would be ten times the current price if Nakamoto (2008) had proposed an algorithm requiring the monetary equivalent of ten times the computing power and energy which it actually does.

Over the course of history, only one monetary system existed with which bitcoin can be alleged to share important – and even defining – characteristics: the stone currency of Yap. The economy of the Pacific island called Yap relied on an historically unique medium of exchange, the so-called *fei* – stone wheels ranging in size from one foot to twelve feet with a hole in their centre, wherein a pole could be inserted for the purpose of transportation. The limestone, of which the stone currency was composed, was not to be found on the island of Yap, but had to be quarried and shaped on islands several hundred miles south of Yap and transported thence in canoes and rafts by venturesome expeditions over an ocean "by no means as pacific as its name implies", as Furness (1910, p. 93) quips.

In 1882, British naturalist Jan. S. Kubary reported that 400 Yapese men worked in the production process on the island of Palau, the primary island where stones were quarried. Based on the total population on Yap, Kubary's observation implies that more than 10 percent of Yap's adult male population were involved in the money-cutting business (Bryan 2004, p. 1).

Intriguingly, the stone currency's value did not derive from the respective coin's size. Instead, it appears that *fei* values varied according to the cost for and difficulty in obtaining them and transporting them back to Yap (Bryan 2004). Confirmation for that can be abducted from the case of the Irish-American David O'Keefe, who shipwrecked on Yap in the late nineteenth century and upon returning to Yap, imported large quantities of *fei* to the island. Owing to the more advanced tools and superior means of maritime transportation, the arrival of O'Keefe and other Western traders was followed by a dramatic increase in the number as well as the size of *fei*. However, since the newly arriving stones had required significantly less effort for quarrying and transporting them, they traded at a discount to the older stones which had commanded a substantially greater cost of obtaining (Bryan 2004, p. 3). Closing the circle to the labour theory of value mentioned above, Furness (1910, pp. 92-93) observes:

> *Here then the simple-hearted natives of Uap* [sic!]*, who never heard of Adam Smith nor of Ricardo, or even if they should hear of them would care no more for them than for an English song from the phonograph, have solved the ultimate problem of Political Economy, and found that labour is the true medium of exchange and the true standard of value.*

As must have become clear upon reading about the stone currency of Yap, *fei* share some striking similarities with cryptocurrencies, the most important of which is the deliberate expenditure of economic resources required for quarrying the stones. So "why did the Yapese expend such great resources to carve them out of the mountains of Palau and carry them all the way back to their island?", Bryan (2004, p. 3) asks, while less resource-intensive tokens could have been used instead. Bryan suggests that the Yap chiefs might have lacked sufficient credibility to simply decree a random object's value. In order to assure the Yapese that the tokens could not easily be replicated by the issuer for his own benefit, the Yap chiefs resorted to a stone only to be found on islands several hundred miles away, commanding a significant amount of labour for fetching and fashioning the new currency.

Thus, the stone currency of Yap is based on the same foundation in determining its value as bitcoin and other cryptocurrencies, namely the labour, or cost, theory of money. Similar to the labour theory of value, which posits that value is a function of the labour required to produce a good or service, market participants appear to be misled into believing that the value of cryptocurrencies is the product of the input costs required in the "mining" process, a fundamental misunderstanding, in our view, which we term the input fallacy of value (IFV). The impossibility of instituting money devoid of use-value (and without government support) by the imposition of costs in an attempt to emulate money proper is evidenced by the fact that the stone currency of Yap has long ceased to function as money and now acts as a curiosity in the history of money in works like Friedman's "*Money Mischief: Episodes in Monetary History*". Value, far from merely being a function of labour and/or capital deployed, is solely determined by the resulting utility. Utility with regard to cryptocurrencies, however, is difficult to attest on the basis of either of the two dominant theories on money analysed in this paper:

According to the Metallist approach, money must emerge spontaneously from a state of barter. For a commodity or other good to emerge in response to barter, it must command widespread

acceptance, which presupposes prior use-value, since nobody would exchange commodities, goods or services in exchange for objects without non-monetary use (Mises 1953 [1912), Menger 1892). With the possible exception of Yap's stone currency, all pre-modern monies possessed a certain degree of use-, or intrinsic value, prior to their employment as money. Here arises the principal problem with regard to cryptocurrencies, which did not emerge spontaneously in a state of barter, but instead were invented with the explicit aim of replacing incumbent money (Nakamoto 2008). Notwithstanding a number of self-evoked analogies with gold, bitcoin and other cryptocurrencies have never possessed non-monetary use-value, and therefore disqualify according to Mises's regression theorem (Mises 1953 [1912]) and as a consequence according to the orthodox theory of money.

Cryptocurrencies also fail according to the heterodox view by virtue of their extra-national nature, since cryptocurrencies, by their very design, are independent from national authorities. As a direct corollary, cryptocurrencies fail to be employed in the context of what Knapp (1924, pp. 96-97) classifies as epicentric ("accepted at the public pay offices") and apocentric (transaction in which the state is the payer) transactions. Bitcoin and other cryptocurrencies hence are what Knapp terms accessory money – facultative in acceptance and unable to settle tax obligations. In fact, many countries in recent years have contemplated measures to ban or restrict the use of cryptocurrencies. However, while cryptocurrencies' initial lack of use-value – and as a result failure to conform to the orthodox theory of money – cannot be remedied, cryptocurrencies could, hypothetically, be accepted for the purpose of extinguishing liabilities vis-à-vis the state. Since the issuance of money with which taxes may be paid constitutes the primary means of obtaining purchasing power for the government (Lerner 1947), making cryptocurrencies acceptable at pay offices would be diametrically opposed to the state's self-interest and may therefore viewed as distinctly improbable. Thus, in addition to disqualifying according to the orthodox approach of money by failing to comply with Mises's regression theorem, cryptocurrencies also lack the institutional support required for qualifying as money according to the Chartalist school of money.

In addition to the two primary objections based on the Metallist and Chartalist school described above, the criticism of cryptocurrencies can easily be extended to the four functions of money frequently encountered in the literature: (a) Bitcoins appear to be hoarded and used as a speculative asset, rather than as a medium of exchange (Ali, Barrdear, Clews and Southgate 2014) owing to the deflationary setup as a result of the maximum amount of bitcoins which can be mined (Krugman 2011) as well as the impracticably long waiting time upon transaction confirmation (Velde 2013);[19] (b) Neither has bitcoin evolved into a unit of account due to its high exchange rate volatility (Yermack 2013); (c) Bitcoin also fails as a standard of deferred payment in longer-term contracts, since bitcoin's volatility would arbitrarily redistribute wealth between creditors and debtors; (d) Likewise, bitcoin's high volatility prevents it from functioning as a store of value (Yermack 2013). The sole utility contemporary economic agents assign to bitcoin appears to derive from the continuous price

[19] As noted above, the inelasticity of the bitcoin stock stands in sharp contrast to that of gold, since the supply of gold was not constrained by an absolute amount. Instead, the growth of the gold supply accommodated economic growth as long as technological advancement in mining co-developed with output growth.

appreciation, and not its use, or prospective use, as money, further undermining its usability as a medium of exchange, fulfilling all necessary characteristics for a speculative bubble.[20]

While cryptocurrencies, in our view, fail as a serious alternative to incumbent money for the simple reason that they lack the essential properties associated with money, the underlying blockchain technology appears promising due to its versatile potential application, reaching far beyond its intended use as an alternative to centralised financial transactions clearing. The blockchain-enabled "distributed consensus in the digital online world" (Crosby et al. 2015) might well represent "a shift from trusting people to trusting math", as Antonopoulos (2014) envisages, and the "the disintermediation and decentralization of all transactions of any type between all parties on a global basis" (Swan 2015, p. x), including self-executing, automatized arrangements between parties (smart contracts)[21] and the digital bookkeeping of ownership of tangible as well as intangible assets (smart property)[22]. Given the underlying technology's manifold potential use, Hanley (2013, p. 1) summarises the bitcoin phenomenon quite aptly by observing that "[b]itcoin's developers combine technical implementation proficiency with ignorance of currency and banking fundamentals."

Summarising, cryptocurrencies do not look like money, they do not behave like money and, importantly, they are not being used as money – even by their most ardent supporters. Instead, cryptocurrencies resemble an increasingly speculative investment on a greater fool basis. Hence, cryptocurrencies' future as a promising alternative to incumbent money will, in all likelihood, be short-lived.

5. CONCLUSION

This article provided an evaluation of bitcoin and other cryptocurrencies' monetary merits in view of the two dominant schools on the origin and nature of money. The analysis finds that cryptocurrencies fail according to both schools. According to the orthodox view (Metallist approach), money arises spontaneously in response to the deficiencies of barter (Menger 1892, Mises 1912), invariably possessing intrinsic value. Cryptocurrencies are neither the result of spontaneous action from economising man, nor do they have intrinsic value according to Mises's regression theorem, and thus do not comply with the orthodox school of money. According to the heterodox school (Chartalism), money need not possess intrinsic value. However, money according to the Chartalist school is a creature of the state and derives its legitimacy as well as value from its acceptance as a means to extinguish the debt levied upon the citizenry in the form of taxes. Thus, by virtue of their decentralised and extra-national nature, cryptocurrencies lack and will continue to lack the governmental support necessary

[20] Cf. Baur, Hong and Lee (2017).

In addition to its use as a speculative investment, bitcoin and other cryptocurrencies appear to be frequently used for illicit purposes. Foley, Karlsen and Putniņš (2018) show that approximately one-quarter of bitcoin users and one-half of bitcoin transactions are associated with illegal activities – around $72 billion per year.

[21] Cf. Swan (2015, pp. 13-16)

[22] Cf. Swan (2015, pp. 16-18)

for qualifying as money by the Chartalist school. Therefore, cryptocurrencies' origin, nature as well as characteristics stand in sharp contrast to the defining contours of money throughout history and across cultures, which, in our view, explains cryptocurrencies' failure to perform monetary functions. Owing to the absence of essential characteristics universally shared by monetary systems, and, as a direct corollary, the failure to perform monetary functions, cryptocurrencies' utility – and, by logical extension – price, should tend towards zero over time.

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