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Philosophy, politics, and economics of cryptocurrency I: Money without state

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Abstract

In this article, we describe what cryptocurrency is, how it works, and how it relates to familiar conceptions of and questions about money. We then show how normative questions about monetary policy find new expression in Bitcoin and other cryptocurrencies. These questions can play a role in addressing not just what money is, but what it should be. A guiding theme in our discussion is that progress here requires a mixed approach that integrates philosophical tools with the purely technical results of disciplines like computer science and economics.

1 | INTRODUCTION

A little over a decade ago, the Bitcoin network was launched by its pseudonymous creator(s). It promised a monetary revolution. Here at last, some thought, was an inclusive, privacy-enhancing monetary network whose censorship-resistant rails run outside the purview of both central banks and private corporations.[1]

Bitcoin has spawned thousands of cryptocurrencies, and they command regular coverage in both popular media and research by computer scientists, economists, and lawyers. Their spectacular rise in valuation no doubt explains much of their popularity. Their uses in scams and dark markets explain much of the rest.[2]

Yet there is more going on here than meets the eye. In the hopes of saying what that might be, this article identifies a number of philosophically interesting questions about cryptocurrency. Though we don't aim to answer these questions decisively, we do aim to show both their significance and their connection to important issues not only in philosophy but also in politics and economics. We'll also introduce the vocabulary for approaching these questions. Our goal is not to provide a *complete* primer, but rather to stimulate interest in the hopes that readers may eventually engage the issues themselves.

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One preliminary note. This article focuses on *monetary* uses of cryptographically-secured distributed ledgers – blockchains. But the alleged uses of blockchains far outstrip these monetary applications. Theoretically, any application that involves storing entries in an immutable ledger could operate on a blockchain.[3] This thought has inspired a number of extraordinary claims about the power of "blockchain technology" to revolutionize or transform. Supposed use cases for blockchains include voting, corporate governance, prediction markets, beef supply chain management, tokenized securities, file storage, legal identities, foreign aid, video game collectibles, medical records, and more. The list sounds impressive.

However, there is reason to dampen some of the enthusiasm about these claims.[4] First, blockchains made for crypto*currencies* have a much longer track record of success. They are by now both widely-used and reasonably well-understood. The same cannot be said of non-monetary uses that touch on physical realities external to the blockchain in question – corporate governance, shipping containers, elections, cows, and so on.[5] Second, as we will soon explain, a blockchain's monetary uses contribute to the health of its network. A typical cryptocurrency network incentivizes users to maintain the network with the promise of digital tokens; it is not obvious that a network could incentivize users to maintain it without such a reward. These non-monetary applications need aligned incentives and network security, which in turn assure ledger immutability. A non-monetary application *could* succeed, then, were it (i) built on top of a secure cryptocurrency network with strong settlement assurances, and (ii) incentivized by an asset that ultimately settled on such a network. In short: any success of these applications would be parasitic on the success of the cryptocurrencies and their host networks.

Some applications in decentralized finance (DeFi) do meet conditions (i) and (ii). In DeFi, we find applications for borrowing and lending, derivatives trading, synthetic financial products, generating yield, and so on.[6] While DeFi is both interesting and important, cryptocurrencies play a foundational role. The most successful of these applications occur on and settle to cryptocurrency networks with strong settlement assurances where some cryptocurrency plays a pivotal role. That's one reason we focus on cryptocurrency in this article; one can't understand or evaluate DeFi without first understanding cryptocurrency.

We begin by characterizing what cryptocurrency is, how it works, and how it relates to orthodox conceptions of money. Then, we'll describe four dimensions across which cryptocurrencies vary and describe some tradeoffs involved in their having different combinations of features along those dimensions. A guiding theme in our discussion is that progress on these questions requires a mixed approach that integrates purely technical results – from, say, computer science or economics – with philosophical insight.

2 | THE NATURE AND FUNCTION OF CRYPTOCURRENCY

2.1 | Cryptocurrencies

You might suspect that cryptocurrencies are things like Bitcoin and Ethereum. But these are *networks* that share data between peers in the network and, in addition to their native assets, host "smart contracts" – scripts that perform various functions in the network (e.g., automatically moving value from one address to another given certain conditions) and enable decentralized applications.[7] So, here's a more precise characterization: cryptocurrencies are the native assets (e.g., tokens like BTC and ETH) hosted by the Bitcoin and Ethereum networks and things like them. The distinction between a network and its native token is crucial for any serious metaphysics of cryptocurrency as well as for any serious attempt to evaluate the assets themselves.[8] As we'll show, these native crypto-assets behave like *digital money*. But they're more than just digital money. Unlike traditional forms of digital money, cryptocurrencies deploy cryptography and novel network models to issue and transfer value. As we'll explain shortly, cryptocurrencies make essential use of cryptography to manage and verify the issuance and transfer of bearer instruments on a distributed ledger.[9]

For several reasons, we'll often focus on Bitcoin. Bitcoin is the oldest and most well-understood cryptocurrency. It is also the most valuable and secure.[10] Bitcoin also enjoys significant network effects. The very fact that it is the most valued, secure, and well-understood cryptocurrency makes it an apt object of study. And much that is true of Bitcoin holds for other cryptocurrencies too. But since cryptocurrencies in general serve as our main target, we will often note when and how Bitcoin differs from alternatives.

2.2 | How cryptocurrency works

We'll first describe how Bitcoin works, beginning with the ledger.[11] A ledger is a record of transactions. Your parent's checkbook has one. So does Bitcoin. But instead of recording the movement of dollars across bank accounts, Bitcoin's ledger records the movement of BTC across various addresses. Whereas checkbook ledgers can go astray and differ from official bank records, Bitcoin's ledger cannot go astray, because for an address to have some BTC just is for the ledger to say it does.[12]

Participants in the Bitcoin network fill three main (and non-exclusive) roles:[13]

(1) *Users* broadcast transactions to send BTC to each other.
(2) *Nodes* validate transactions and maintain copies of the ledger.
(3) *Miners* compete with one another to publish updates to the ledger.[14]

With the goal of uncovering some deeper questions, we'll discuss these three roles to find a bird's eye view of the overall network. Once there, we'll also see how Bitcoin secures its ledger without relying on central authorities.

Nodes. Thousands of computers run Bitcoin's ledger-keeping software. These nodes serve as both referees and curators. As referees, nodes ensure that transactions follow certain rules before they're added to the ledger. For example, nodes ensure that no address spends more BTC than it has.[15] *Valid* transactions follow these rules, and nodes forward all valid transactions to the miners (see the next paragraph). As curators, nodes also regularly update their individually stored copies of the ledger and share their copies of the ledger with other nodes, who in turn share theirs with other nodes, and so on. Updates to the ledger propagate quickly across the entire network.

Miners. The ledger updates approximately every 10 minutes. That's when a miner has won a competition to publish the next *block* of transactions to the ledger. To win, a miner digs through mathematical space for the solution to a computationally difficult math problem by trial and error.[16] The miner who first solves the problem then wins the right to update the ledger with the next block, one that includes a transaction that mints new BTC for the winner's address. All BTC that will ever exist has come or will come from these rewards. The winning miner propagates its block to nodes. As long as a node judges that the new block follows the rules, the node adds the block to its copy of the ledger and sends it to other nodes. Each new block contains a tamper-resistant cryptographic fingerprint of its predecessor. The ledger thereby grows block-by-block into an ordered chain – a *blockchain*.

Sometimes, multiple miners produce winning blocks at around the same time. Here, the chain splits, and miners may build on different sides of the chain. But nodes follow a rule to endorse the chain with the most accumulated *proof of work*, the chain whose creation likely required the most processing power. So, miners are always trying to mine on that chain. By following this rule, the network achieves consensus about the content of its ledger without central authorities.

Users. Miners compete to publish blocks of transactions, and nodes verify transactions as valid and store copies of the blockchain. Users are the ones who initiate transactions. With the help of a free software application, anyone can write a transaction that the nodes will judge as valid.

In the simplest case, a valid transaction includes four pieces of information.[17] Suppose you want to send some BTC to Dorian. You specify (i) an amount to send, (ii) a cryptographically-generated address Dorian controls, and (iii) a previous transaction output, yet to be spent, in which one of your addresses received some BTC. Then, with a cryptographic algorithm, your application produces an appropriate (iv) digital signature over the information in (i)-(iii) that will unlock the BTC you'd like to spend. To produce this signature, you need to have the private key, or password, for your address. Your application then sends the transaction to the nodes.[18] The nodes verify the signature and check the ledger to make sure that you're not trying to spend more BTC than you have. The nodes then forward the valid transaction to the miners, who race to publish it in the next block.

The most innovative aspects of Bitcoin's security aren't purely cryptographic or mathematical. When a ledger like Bitcoin's dictates who has which amounts of a valuable commodity, some will inevitably try to alter the ledger in self-serving ways. Bitcoin's ledger strongly resists such an attack by incentivizing honest behavior. It does this by luring participants into competing for scarce rewards in a way that protects the network's integrity and preserves the rewards' scarcity.

To illustrate, suppose Calvin wishes to tamper with the ledger. He might try to add a transaction that sends BTC to himself with an improper signature or from an address with insufficient funds. The nodes would reject these transactions and would not forward them to the miners. Calvin needs a way to cheat the system that isn't transparently invalid. Here's one: Calvin could try to spend his own BTC twice to different addresses. After one valid transaction makes it into a block, he could try to replace that block with a new one containing another transaction that sends his BTC elsewhere. But nodes wouldn't accept his alternative block unless it appeared in a chain with the most accumulated proof of work. And it wouldn't, since the chain containing his original block would have continued to grow.

Calvin could conceivably marshal enough computing power to build a chain that achieves the most accumulated proof of work. With enough power, Calvin can effectively roll the ledger back and add enough blocks, one-by-one, until the nodes recognize his chain as the strongest. This is called a *51% attack* because an attacker with 51% of the network's total computing power is virtually certain to build the strongest branch. But the attack is financially unwise, since Calvin would need to win many blocks in a row – an enormously expensive task in terms of both hardware and energy and by no means guaranteed to succeed.[19]

Even if Calvin succeeds, the cheating itself may undermine the operation's entire purpose. Anyone can look at the publicly visible blockchain and see what happened.[20] Consequently, many might trust Bitcoin less, sell it, and sink the value of Calvin's spoils below the cost of its plunder, or at least below the value of the rewards Calvin could have attained honestly given that he has 51% of the network's computing power. The rest of the network could also coordinate to reject Calvin's blocks, sending the value of Calvin's rewards to zero. With Bitcoin, cheating doesn't pay. But playing by the rules does. Calvin has enough computing power to mine several blocks, so it's in his best interest to behave honestly and enjoy the rewards.

In the absence of central authorities, Bitcoin incentivizes participants to protect the ledger and achieve consensus about it. More generally, provided that a cryptocurrency has some value, it's not hard to see how its network could function as a distinctive kind of payment system – one that stores and transfers value without banks or other legacy financial institutions.

We say more in subsequent sections about how some other cryptocurrencies differ from Bitcoin. For now, we can think of them as variations that change some parameters (e.g., issuance, consensus procedure, privacy) but leave the overall structure (nodes, miners, users) in place.

2.3 | Cryptocurrency characterized

We are now in a position to better explain our characterization of cryptocurrency as *digital money that makes essential use of cryptography to manage and verify issuance and transfer of bearer instruments on a distributed ledger*. Let's take each piece in turn.

Digital: cryptocurrencies are inherently digital and need not involve any concrete material representation of value like a coin or paper bill.

Money: cryptocurrencies, to some extent, enjoy some classical properties of money, like divisibility, portability, and fungibility. (Whether they are apt stores of value, means of exchange, or units of account is more contentious, and something we'll take up in 3.1, below.)

Essential use of cryptography: cryptocurrencies must use cryptography to function properly. They need cryptographic algorithms to generate addresses and signatures, provide a tamper-resistant ordering of blocks, and, in several cases, mint tokens.

Bearer instruments: ownership of a bearer instrument requires nothing beyond possession. Cryptocurrencies, in this respect, resemble bearer instruments. The possession of a token typically amounts to the control of one or more private keys.

Distributed ledger: issuance and transfer of cryptocurrency tokens occurs on a record of transactions or holdings jointly maintained by participants on a network.[21]

3 | CRYPTOCURRENCY AND MONEY

3.1 | Three questions about money

We've called cryptocurrencies "digital money." They certainly seem to have money-like properties. But are they in fact money? Three points will guide further discussion.

First, *money* is a functional kind.[22] Money need not consist of some special material or have a particular origin. Rather, something is money to the extent that it fills a cluster of roles.[23] Standard candidates for those roles include being a unit of account, store of value, and means of exchange. So cryptocurrency is money to the extent that it fills these roles.

Second, each cryptocurrency has distinct technical, economic, and political features, and has achieved varying levels of and kinds of use. It will not be very useful to inquire, then, whether cryptocurrencies in general fill key money roles. We would do better to focus on particular cryptocurrencies and ask about the extent to which each one, in particular, fills key money roles.

Third, when we focus on a particular cryptocurrency, we can still disentangle three questions about its relation to key money roles.

Actual Question. To what extent does the cryptocurrency fill key money roles?

Modal Question. To what extent could the cryptocurrency fill key money roles?[24]

Normative Question. Supposing that the cryptocurrency could fill key money roles, would it be good, all things considered, for it to do so?[25]

The first turns on a cryptocurrency's actual technical properties (e.g., divisibility or portability) and on contingent empirical facts about what people in fact do with their cryptocurrency holdings.[26] There are significant though not necessarily insurmountable obstacles. Cryptocurrencies are notoriously volatile, which is good for speculators but less attractive for those who'd use them as stores of value or units of account. Scaling is another issue. It's no trivial matter for a monetary network to accommodate many transactions per second while maintaining security assurances and decentralization. New users of cryptocurrencies must also adopt unfamiliar security measures to protect private keys. Policy issues have also gained relevance. In June 2021, El Salvador passed legislation to make bitcoin legal tender, a move that will have wide-ranging consequences.[27]

The second question turns on potential use and invites questions about what money must be.[28] One point to consider here is whether credit or commodity theories of money are correct.[29] If something must represent debt in order to count as money (as per the credit theory), most cryptocurrencies couldn't be money by definition. On a more expansive view of money, though – one that countenances representations of synthetic digital commodities as possible monies, for example – then cryptocurrencies would seem to be more apt candidates for key money roles.[30]

The third question, finally, concerns the overall goodness of using a cryptocurrency as money, and raises further questions that inform the rest of the present study: what are the costs and benefits of using cryptocurrencies as money instead of state-issued fiat currencies, precious metals, or something else besides? To whom do those costs and benefits accrue? Should we use a cryptocurrency as money? We address these questions in the following sections. Notably, we address these questions in the context of cryptocurrencies as *supplements* to extant offerings in the monetary landscape – not dominant *replacements*.

3.2 | Varieties of cryptocurrency

We've given a primer on what cryptocurrency is, how a paradigm cryptocurrency works, and how cryptocurrencies bear on some traditional views of money. The technical differences among cryptocurrencies – and the ways in which they diverge from Bitcoin – implicate normative questions. Here are four key dimensions along which cryptocurrencies differ:[31]

Monetary Policy. Cryptocurrencies differ in their inflation rates, total future supplies, the amount and nature of their supplies at their network's genesis, and the introduction and distribution of future supplies.

Privacy. Some privacy-focused cryptocurrencies allow for shielded or private transactions where the sender, the receiving address, or the amount are hidden from view. Others offer privacy through obscurity within a crowd.

Censorship-Resistance. How easy is it to contribute to the network or transact over it? Who, if anyone, gives permission to do so? Can anyone block transactions?

Consensus. Some networks use something other than solving math problems to update the ledger. What do they use, and what are the tradeoffs?

Thinking along these dimensions will blend technical, economic, and normative matters. For example, on the first dimension: what are the tradeoffs of having a particular (inflationary, say) issuance schedule? Who stands to lose or gain? On the second: is financial privacy good? For whom? Against what does it trade off, and what are the costs and benefits of implementing transactions that cannot easily be tracked or monitored? On the third: should people need *permission* before being able to use a financial system? From whom? And finally: who should be in charge of a ledger? Is the use of vast computational resources to cultivate a network worth it? What are the costs and benefits of such a system and how do they stack up against possible alternative models?

In the remainder of this article, we begin our evaluation of cryptocurrency by offering a guide to questions along the first dimension – issuance, inflation, and related matters. In a companion article, we discuss the rest.

4 | MONETARY POLICY

Since cryptocurrencies are or aspire to be money, standard matters of monetary policy arise: (i) when should new amounts be issued? (ii) to whom should they be issued? and (iii) who makes decisions about these first two questions?[32] Different cryptocurrencies implement different answers to these questions.

4.1 | Inflation and money supply

Some cryptocurrencies have no provably strict issuance schedule and thus resemble a state-issued fiat currency with a discretionary supply.[33] Some follow a negative schedule: over time, their total supply declines.[34] Others follow a provably strict positive schedule of issuance: over time, their total supply increases.[35] And algorithmic stablecoins adjust their supplies automatically to keep their prices closer to something like the US dollar.[36]

Bitcoin deserves special interest. Its supply will eventually approach 21 million BTC.[37] What is notable is not that the total supply of BTC increases over time; many currencies do that. Instead, the supply increases at a declining rate and eventually stops. In stark contrast to fiat currencies and commodity monies such as gold or silver, supply of new BTC is inelastic[38] and not a function of demand for BTC.[39]

Before considering arguments over whether the Bitcoin approach is advantageous, we'll introduce a standard analytical framework: the quantity theory of money.[40] This theory relates the supply of money (M), its velocity (V), the price of output goods and services (P), and the amount of output (Y) thus:

$$MV = PY$$

Where V and Y are invariant, any increase in M will result in an increase in P – a general rise in or inflation of prices.[41] This is the condition of most state-issued fiat currencies; they tend to increase in supply and thus engender inflation. Where M and V are invariant, any increase in Y will result in a decrease in P – a general decrease in or deflation of prices. Under conditions of real economic growth, that is (when real outputs – Y – rise), standard economic wisdom predicts deflation of prices under a Bitcoin-style issuance schedule. So we can see that the supply of money is an important factor in inflation or deflation.[42]

Since Bitcoin has such a distinctive approach to money supply, which is in turn so closely connected to inflation and deflation, one naturally wonders which is better, and for whom. This is the proxy question by which we'll investigate whether Bitcoin-style monetary policy improves over state-issued fiat currencies and, accordingly, whether it would be good for Bitcoin (or some other cryptocurrency like it) to be used as money.

4.2 | Stateless money

We've introduced a substantive question about monetary policy: should it tend towards inflation, or deflation, or what? A procedural question also lurks nearby. Who is to oversee all this? Bitcoin's full answer here resists easy classification. But this much is clear: it assigns no essential oversight role to the state.

Money without state is controversial, to put the point mildly. Economists agree more often than do philosophers – but not by much. So it is striking to observe the orthodox status of the view that issuing money is a critical state function.[43] The standard argument for orthodoxy is simple. Powerful market forces engender the creation of too much money. If Schrute Bucks have any value at all, Dwight has an incentive to print more. The incentive remains until the value of a Schrute Buck equals the marginal cost of printing a new Schrute Buck.[44] This result holds even if Stanley is also printing Stanley Nickels; competition between private issuers is no solution. What is needed, says orthodoxy, is a currency issued by an actor that responds to *other* incentives (political forces and elections), which prevents over-issuance.[45]

There is some irony here since state-issued currencies are not obviously immune to over-issuance.[46] Bitcoin, furthermore, is provably free of such over-issuance, by design. Bitcoin's architecture answers a standard objection to privately issued currency.[47]

Another standard argument for state issuance of money stems from the idea that the supply of money must be responsive – someone must be able to adjust supply up or down to, for example, maintain stability of nominal prices in that currency, or ensure optimal employment. And the state is the best institution to respond, the thought goes.[48] Central banks implement this idea through such measures as quantitative easing or adjusting interest rates.[49]

There is no room for such discretionary adjustment within the Bitcoin framework; its supply schedule is inelastic, settled at birth, and ultimately capped. Other projects differ along this dimension, however, and through various mechanisms maintain an elastic money supply. Ampleforth and other "rebasing" cryptocurrencies, for example, contain measures that automatically adjust aggregate supply (and even the nominal amount of tokens held by individual users) in an effort to dampen volatility.[50] Other projects allow token holders to collectively opt for adjustments in supply through a voting mechanism.[51]

The supply of a currency is just one variable at play here. Also important is who gets to adjust the supply and how. Disputes here implicate various schools of macroeconomic thought, the competing convictions they espouse about parallel questions in traditional monetary policy, and related normative issues.[52] There is considerable variety among cryptocurrency projects. In the remainder of this section, we will focus on the merits or demerits of an automated, strict supply schedule like Bitcoin's and connections to inflation and its effects.

4.3 | Standard inflation arguments

What can be said in favor of Bitcoin's approach? Proponents advance a family of arguments:

> Inflation – a general rise in prices as denominated in a target currency – is equivalent to a drop in purchasing power of that currency. This loss in purchasing power is a sort of covert tax imposed on those who hold the currency. And inflation is, or is generally caused by,[53] an increase in the supply of money, typically a state-issued fiat currency. This is a problem. The plain solution is a currency that cannot increase in total supply – or, at least, can only increase along a fixed schedule that is not subject to political machinations or capricious manipulation. Some cryptocurrencies fit that bill and it is therefore good that they be used as money.[54]

How should one react to arguments along these lines? The quantity theory framework, to some degree, vindicates one key assumption. A general rise in M will tend towards inflation of P, which is indeed equivalent to a drop in purchasing power of the currency.[55] But whether such a drop is bad strays into normative and philosophical domains well beyond positive economics.

Proponents of standard inflation arguments have identified five problems with inflation: inflation entails a loss in purchasing power, inflation is a tax, inflation is hidden, inflation is subject to capricious political processes, and inflation penalizes savings or investment over consumption.[56] A full evaluation of these five claims is beyond our present ambitions.[57] But it's instructive to note significant weaknesses in each.

On loss of purchasing power: inflation does indeed involve a loss in *nominal* purchasing power. But it need not involve any loss in *real* purchasing power (to confuse these is to commit "The Inflation Fallacy"). For a rise in price paid by buyers entails a rise in receipts by sellers; nominal incomes, accordingly, tend to rise with nominal prices.[58] Put just a little more simply: inflation means that your dollars are worth less, sure. But it also means you'll be paid more dollars when selling goods or labor. There needn't be any real loss here. But there's a wrinkle: new supplies of money have to appear somewhere, and there's no guarantee that a rise in prices will percolate outwards in a uniform or expeditious way. One result can be a redistribution of buying power towards those who are closest to the supply of new money (e.g., those who sell debt purchased with new money).[59]

On inflation as taxation *per se*: many cryptocurrency proponents explicitly endorse anarchist political theories.[60] Their arguments, if sound, tell against any state at all – including taxation imposed by inflationary monetary policy. In reply, though, we note that these arguments are not available or convincing to the vast majority of political theorists or philosophers, most of whom think that at least some state taxation is justified. A convincing argument here would need to show that there is some special feature of "taxation by inflation" – one not exemplified by all taxation or state action as such – by virtue of which it is wrong or bad.

On inflation as a hidden tax: although many taxes are hidden from those who ultimately pay them, they're not obviously bad or harmful for that reason. And inflation isn't all that hidden: everyone knows that a candy bar used to cost a nickel.

On inflation and politics: cryptocurrencies, too, are subject to politics. One need not look far – miners, developers, users, and advocates of cryptocurrencies routinely “fork” projects over disagreements both substantive and petty. That there are some market pressures here doesn't make the space an obvious improvement over, say, using interest rates or quantitative easing to manipulate public opinion before an election.[61]

On penalizing savings or investment: it may be bad to penalize savings or investment. But it is also bad, and perhaps worse, to penalize consumption, as is the case with a disinflationary or deflationary currency in circumstances of real productivity growth.[62]

We don't say that all five claims decisively fail. But they face serious impediments.[63] Are there better ways to advance a Bitcoin-style monetary policy? We think so. Here are three:

First, the problem with inflation is not that it happens, or even that it is too high. Predictable inflation can be hedged against.[64] The problem is when it is unpredictable. Bitcoin's supply, by contrast, is utterly predictable. Indeed, Bitcoin can be seen as the limit case or fulfillment of the monetarist ambitions of a fixed and modest growth in money supply or of an algorithmically determined supply schedule.[65] And the longer Bitcoin makes good on this promise to a predetermined and inflexible schedule, the more credible is its claim to keeping that promise in the future.

Second, inflation disproportionately rewards those who take on nominal debt. Inflation is a redistribution program.[66] This might be unobjectionable – if it turned out to favor the least well-off, for example. But it doesn't. It favors, instead, those who have significant debt denominated in that currency.[67] And that's a select group within the wealthiest countries – and those wealthy countries themselves.[68] Inflation is a debt-forgiveness program for the global rich.[69]

Third, inflation begets inflation. This is no secret.[70] And it is precisely the risk of inflationary spirals that leads central banks to monitor economic indicators for signs of inflation and then adjust policy in their light. But institutions – and central banks are no exception – tend to do best when subject to competitive checks.[71] Alternative state-issued fiat currencies are one such check. Were the US dollar to collapse under bad management, the world would quickly adopt alternatives.[72] Non-state-issued alternatives like cryptocurrencies provide another competitive check. Their existence incentivizes policy-makers to behave responsibly.[73]

We've surveyed eight arguments purporting to show significant advantages to Bitcoin-style monetary policy. We find the first five unconvincing, but the latter three may yet succeed. And if that's right, then we've made some progress towards a positive answer to our normative question: *yes, it is pro tanto good to use cryptocurrency as money, because doing so promotes sound monetary policy*.[74]

5 | CONCLUSION

Suppose that a cryptocurrency *could* fill key money roles. Would it be all things considered *good* for it to do so? We have argued that cryptocurrencies can be a useful tool to promote sound monetary policy. But further questions remain, especially about the enhanced privacy and censorship-resistance that cryptocurrencies promise, and about their novel governance structures. In the companion article and second half of this two-part series, we will show how design choices around privacy, censorship-resistance, and consensus procedure raise further normative issues and suggest other routes to a positive assessment of cryptocurrency.

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ENDNOTES

[1] Narayanan and Clark (2017) and Brunton (2019).

[2] Chowdhury (2020): Chapter 20 surveys the reception of cryptocurrency.

[3] Bonneau et al. (2015: p. 1).

[4] Carter (2018), Glazier (manuscript).

[5] Schuster (2020).

[6] Schär (2021), Stepanova and Eriņš (2021). On DeFi risks, see Carter and Jeng (2021).

[7] On Ethereum smart contracts, see https://ethereum.org/en/developers/docs/smart-contracts/; on Bitcoin smart contracts, see https://en.bitcoin.it/wiki/Contract. Ethereum and other smart contract platforms have a substantial head start on Bitcoin when it comes to DeFi. But it is clear now that DeFi will also settle to the Bitcoin network through sidechains like RSK and the recent innovation of discreet log contracts. For the latter, see Dryja (2018).

[8] For more, see Warmke (2021) and Warmke (manuscript).

[9] This is not far from the definition given in Ince (2013): "A digital payment system which employs cryptographic techniques to ensure security."

[10] Carter (2019).

[11] The most accurate yet accessible resources for understanding Bitcoin include Antonopoulos (2015) and Rosenbaum (2019). A more technical introduction is Song (2019). Lopp (2020) is the best collection of online resources.

[12] Again see Glazier (manuscript).

[13] For a fuller explanation of these roles, see Warmke (2021).

[14] There are also developers; see Lopp (2018).

[15] For a complete list of the relevant rules, see https://en.bitcoin.it/wiki/Protocol_rules#Transactions.

[16] The resulting solution is called a *proof of work*; see Section 4 of the companion article for discussion.

[17] For a more detailed look at transactions, see Warmke (manuscript).

[18] Bitcoin wallets make this about as easy as sending an email.

[19] We explain why in Section 4 of the companion article.

[20] There has never been a successful double-spend, although in January 2021 there were false rumors of one. See https://www.coindesk.com/bitcoin-double-spend-that-never-happened.

[21] Chowdhury (2020): p. 24 offers a useful taxonomy of distributed ledgers.

[22] When introducing functional kinds in his (1974), Fodor specifically mentions money (pp. 103–104). Mason (2016) treats money as a paradigmatic *social* kind. Haslanger (1995) says that a kind is social when it is "an intended or unintended product of a social practice" (p. 97), so since money is clearly the product of social practice, Mason seems obviously right to classify money this way. Certainly money is multiply realizable – by beads, gold, quarters, dollar bills – which often denotes a functional kind. For philosophical treatment of the ontology of money that connects its functional role with a number of normative issues, see Zelmanovitz (2016).

[23] On this approach to defining theoretical terms known as "Ramsification," see Lewis (1970).

[24] Smit et al. (2016).

[25] So Sidgwick (1879/1998): "What is money?… first, we must observe that when proposed in this form the problem is fundamentally ambiguous; as it blends the two quite distinct questions, (1) What do we call money? and (2) What *ought* we call money?"

[26] On the first two questions, see Ammous (2018a), Baur et al. (2018), Kubát (2015), Yermack (2015), and, especially, Hazlett and Luther (2019). Passinsky (2020) explicitly connects the question of whether Bitcoin is money to mainstream literature in social ontology.

[27] Raskin (2021).

[28] On how a currency's denomination affects its medium of exchange function, see Albrecht et al. (2020).

[29] On credit vs. commodity theories of money and their connections to social metaphysics, see de Bruin et al. (2020), Section 1.1.

[30] On money as credit, see Graeber (2011). On bitcoin as a synthetic commodity, see Selgin (2015).

[31] For a dated but helpful treatment of cryptocurrencies, see Bonneau et al. (2015).

[32] We leave untouched important questions about the proper use or fairness of pre-mining – assigning significant amounts of a new cryptocurrency to its creators upon its launch. The economic questions about Bitcoin and blockchains more generally raised in this section are by no means the only ones worth pursuing. For more, see Berg et al. (2019), Catalini and Gans (2017), and Davidson et al. (2018).

[33] The supply schedule for ETH has changed no fewer than six times from 2016 to 2020, for example. See https://docs.ethhub.io/ethereum-basics/monetary-policy/.

[34] Some cryptocurrencies "burn" transaction fees in the sense that they disappear from the total supply.

[35] Supply might increase by a constant percentage per year or by the same number of coins per year, like Grin's 1 coin per second policy (https://github.com/mimblewimble/docs/wiki/Monetary-Policy).

[36] Ampleforth and Dai involve two fundamentally different strategies for achieving stability in price by altering supply. Whereas Ampleforth uses an oracle to see how far an AMPL is from a dollar and adjusts the supply algorithmically, Dai uses market incentives with collateralized debt to lure participants to bring the price back to a dollar.

[37] This will happen around 2140CE. As Böhme et al. (2015), explain, Bitcoin's issuance schedule has obvious antecedents in Milton Friedman's monetarism: "In a broad sense, the Bitcoin economy implements a variant of Milton Friedman's… '*k*-percent rule' – that is, a proposal to fix the annual growth rate of the money supply to a fixed rate of growth. Indeed, Bitcoin's protocol calls for an end of the minting phase at which point $k = 0$. In fact, k may even be negative in the future, because bitcoins can be irreversibly destroyed when users forget their private key."

[38] See Norland and Putnam (2019: pp. 81–82) on the certainty of supply and perfect inelasticity of Bitcoin and its connection to price volatility. On cryptocurrencies as *bubble* assets, see Chaim and Laurini (2019), and especially Cagli (2019).

[39] Nakamoto (2008: p. 4) notes one dissimilarity – Bitcoin's supply barely responds to demand, whereas gold's significant elasticity in supply is in part a function of its demand; see Cachanosky (2019): p. 371. Dyhrberg (2016) and Klein et al. (2018) locate Bitcoin somewhere *between* the US Dollar and gold.

[40] This framework and the real/nominal variable distinction on which it relies (Y is, e.g., real and so specified in physical units such as *guitars produced*; P, by contrast, is nominal and so specified in arbitrary monetary units such as *dollars*) derive from Hume and other classical economists; see Evans and Thorpe (2013).

[41] On the *ceteris paribus* condition and whether it is historically realistic, see Friedman and Schwartz (1963).

[42] Mankiw (2018): p. 632.

[43] So Klein (1974): p. 423: "Few areas of economic activity can claim as long and unanimous a record of agreement on the appropriateness of governmental intervention as the supply of money… The monetary role of government is agreed to include, at a minimum, the monopolistic supply of a currency, into which all privately supplied demand deposits should be convertible."

[44] See Friedman (1960): pp. 6–8 and Mafi-Kreft (2003): p. 475.

[45] For a counterargument, see Araujo and Camargo (2008).

[46] Federal Reserve Economic Data, for example, reports one measure of monetary base (in millions of USD) as 50,058 in May 1959 and 4,844,940 in April 2020. This vastly outstrips the growth in real USD GDP over the same interval (from 3121.936 to 18,974.702, also in millions of USD). See https://fred.stlouisfed.org/series/BOGMBASE and https://fred.stlouisfed.org/series/GDPC1.

[47] Martin and Schreft (2006) anticipate this advantage of Bitcoin.

[48] Skidelsky (2018), especially Chapter 11.

[49] The precise relationship between central banks and states is often complicated and displays considerable variation. For details about how this works in the American context, see: https://www.frbsf.org/education/publications/doctor-econ/2003/september/private-public-corporation/.

[50] See https://www.ampleforth.org/.

[51] YFI (Yearn Finance), for example: https://yearn.finance/. For discussion of a recent YFI supply adjustment, to be implemented in response to a vote from token holders, see Dale (2021).

[52] For a helpful overview of some of the most important macroeconomic perspectives here and their development over the twentieth century, see De Vroey (2015) and, especially, Eatwell and Milgate (2011).

[53] The Austrian minority of economists insist on the former; more mainstream views characterize inflation as a general rise in nominal prices.

[54] Non-academic or popular defenders of arguments along these lines number in the thousands; it is harder to find serious academic statements of the arguments in view. But one influential source is Ammous (2018b): Chapter 4. See also Malherbe et al. (2019), p. 149.

[55] This drop is only nominal, and need not result in any real loss, as we'll see shortly.

[56] See Maurer et al. (2013): p. 270 and O'Sullivan (2018): pp. 93–94.

[57] These are not the only alleged harms of inflation, to be sure. Others include menu costs (the inconvenience of updating nominal prices), shoeleather costs (the inconvenience of maintaining reduced stores of money than one otherwise would), inefficiencies in tax treatment of interest income. These are all well-understood and accepted by mainstream economists as genuine downsides to inflation. Proponents of standard inflation arguments for cryptocurrency adoption, interestingly, rarely appeal to *these* considerations but instead rely on the first five noted in the main text.

[58] See Burdick and Fisher (2007).

[59] The classic study of this effect is Cantillon (1755/1959). Reflection on this effect supports, we think, a rather *different* argument – inflation isn't bad because it kills purchasing power, but because it redistributes it unjustly.

[60] Golumbia (2016), especially Chapters 1–2. See also Eich (2019) and Huckle and White (2016).

[61] Some of Bitcoin's features are more easily subject to social and political forces than are others. See Dodd (2018), Hayes (2019), and, especially, DuPont (2019): Chapter 8.

[62] Mainstream economic opinion suggests it is at least equally as bad to penalize consumption as savings or consumption. See, for example, discussion of the "paradox of thrift" in Samuelson and Nordhaus (2010): p. 452. For a heterodox alternative that in fact pre-dates Keynes, see Hayek (1931).

[63] All five fall outside professional consensus among economists, for roughly the reasons we've cited in the main text. See Shiller (1997) and discussion in *OpenStax* (2020): Chapter 9.4.

[64] Some US Treasury bonds (Treasury inflation-protected securities, or "TIPS"), for example, are indexed to inflation in consumer prices. On Bitcoin's performance as an inflation hedge, see Blau et al. (2021).

[65] On which see White (1999): Chapter 11 and White (1988).

[66] Brennan and Buchanan (1981).

[67] Fontan et al. (2016).

[68] Doepke and Schneider (2006).

[69] The Cantillon effect is relevant here as well and suggests another way in which inflation redistributes. The global rich don't just hold a lot of debt; they are also "closest to the money spigot," and benefit disproportionately from that proximity; see Bagus et al. (2014).

[70] Black et al. (2012).

[71] Hayek (1976). See also Backhouse (2006), Selgin and White (1994), and Ferris and Galbraith (2006).

[72] Cesarano (1999), Halaburda and Sarvary (2016): pp. 32–46. Endres (2009).

[73] On competitive pressure as a disciplinary force for monetary institutions, see Fernández-Villaverde (2018), Fernández-Villaverde and Sanches (2019), Berentsen (2006), Rahman (2018), Kirkby (2018), and, especially, White (1999): Chapters 12–13.

[74] The widespread availability of alternatives – cryptocurrencies are a fine example – provides an important competitive check against *any* monetary policy. See Salter and Luther (2019) and Mafi-Kreft (2003).

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