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Digital Value

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Abstract: Digital artifacts — humanly-constructed items that inhabit our computers and networks — suffer an unfortunate reputation as being virtual and therefore unreal, and all too easy to reproduce on the cheap. These features together prompt the question of this article: if digital artifacts can be reproduced for free, and if they are unreal, why do they have economic value at all? Using a focal case study of bitcoin — the most unreal digital artifact of them all, and one that has been copied and pasted a thousand times over — I answer the question. Some digital artifacts can't be copied on the cheap, as it turns out, and they are real enough to be useful.

Keywords: economic value, bitcoin, philosophy of technology, digital artifacts

1. Introduction

1 Our world is increasingly digital. We grip mobile devices and stare at their screens more than ever. And many of the things we care about live and move in the realm of networked digital computers. What are these digital artifacts, or the networks that sustain them? What are they doing to and for us, and who benefits? Is there a price to pay? Who pays it? In what ways can digital items be valuable? These questions are vital, for anyone who hopes to understand an increasingly digital world. And they are, in part, technical, and so overlap computer science. To the extent that they concern prices, markets, or human behavior under scarcity, they also overlap economics. But they are also human questions. They impinge on metaphysics, and inquiry into the nature of reality at a very abstract level. They impinge, too, on ethics and inquiry into what is good or right. These questions about digital computers and what we do with them, in other words, belong in part to philosophy.

2 The present paper is an exercise in digital philosophy. It concerns a cluster of questions about digital items, their value, and how it might arise. What's at stake here is not just a particular

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kind of digital item – bitcoin will be a focal case study – but rather, significantly more abstract questions about economic value and how it might arise in a digital realm.

3 Here is how things will unfold. In Section 2, I will describe two problems concerning copying and reality, and a key question to which it gives rise: if digital artifacts can be reproduced for free, or if they are unreal, why do they have economic value? Section 3 will introduce the focal case study of bitcoin and show how it presents an unusually pressing version of the question of digital value, for it appears to be both eminently copyable and unreal. The copy problem will prove to be the easier of the two to resolve, both for bitcoin and for other cases in view, and Section 4 will present that resolution. The unreality problem is more vexing and will take more work. In Sections 5 and 6, I will show that some initially promising resolutions are misleading. Section 7 develops an improved resolution, which in turn answers the question of digital value: when digital artifacts are valuable, it is on account of their *usefulness*. I will apply the answer to bitcoin, and show its aptness in other cases as well. Section 8, finally, concludes by raising some new questions about digital value, with a few suggestions about how they may be addressed in future research.

4 The upshot? Digital computers are a fixture in our lives. They raise important questions, some of which overlap computer science, economics, metaphysics, and ethics. Philosophy can help.

2. Copying, Virtual Reality, and the Question of Digital Value

5 Have you ever distributed a spicy meme across social media channels? Forwarded an email? Shared an mp3? If so, then you already know one problem that prompts this article: digital artifacts can be reproduced nearly for free. With two keystrokes — copy, paste — one item turns into two, and then into fifty.

6 The pattern here — technology making it trivially easy to copy and paste information — is not new. The printing press reduced the marginal cost of reproducing a book by orders of magnitude. Once you've printed one tome, the next, though not free, is much cheaper. The copy machine did it again. So also for audio and the cassette tape, video and the videotape, and so on.

7 None of this is news. Most information is now stored digitally. Books, audio, images, music, movies, dossiers of personal information: it's all digital. And so most information can be reproduced at very low marginal cost. This is all very exciting for those who think information wants to be free. It's a problem for anyone who believes that digital items could have economic value, construed here and in the sequel as a positive market price: why should anyone *pay* for something that can be copied for free?

8 Digital artifacts — humanly-constructed items that inhabit our computers and networks — are

by now familiar enough. Yet they sometimes prompt a curious reaction: an impression of unreality. It is as though, if something is digital, it is less than fully there, not quite real, a bit ontologically thin. Even the most elaborate constellations of digital artifacts — entire environments, replete with sounds and sights and stimulations for their users — are said to be *virtual*. And when something is virtual, it is very tempting to say that it therefore isn't quite real.[1]

9 Regardless of the details, this impression of unreality poses another problem for anyone who believes that digital items could have economic value: why should anyone *pay* for something that doesn't *really* exist?

10 And so the question of digital value: if digital artifacts can be reproduced for free, or if they are unreal, why do they have economic value?

3. Case Study: Bitcoin

11 In what follows, I will answer the question of digital value. I will use, as a case study, perhaps the most unreal digital artifact of them all, and one that has been copied and pasted a thousand times over – bitcoin.[2] If we can understand why *this* kind of digital artifact has economic value – again, construed as a positive market price – then we can make headway in understanding the broader question of digital value. Bitcoin has, for over a decade, enjoyed a positive market price. The story of that price is a wild ride, but this much is clear: people are consistently willing to pay something for bitcoin. But why?

12 We must distinguish Bitcoin the network from bitcoin the asset or substance (note the difference in case). Bitcoin the network is a constellation of connected nodes all running some software. That network sustains and updates a ledger which tells the story of bitcoin the substance: where it lies in cryptographic space, which private keys may be used to move it about, and in what quantities. But that story is without a real subject. What it is about is either without being altogether, or a mere substance of fiction, akin to butterbeer.[3] Now, quantities of this substance, in my view, actually exist – these are bitcoin's so-called Unspent Transaction Outputs (UTXOs). You think of these as bitcoin containers; they are countable *things* that contain uncountable

1. This impression of unreality may be expressed in two broad ways. It might amount to the conviction that digital artifacts simply do not exist and so are, as with flying pigs, zero in number. Or might amount to the conviction that digital artifacts enjoy existence in a subpar or derivative way – as creatures of fiction, say, or as items that depend on something else for their identity, existence, or sustenance. Both convictions, I think, raise the target problems, and so I'll not try too hard to keep track of these differences in what follows.

2. Bitcoin is a curious thing, and in what follows, I will often presuppose some familiarity for how it works. The canonical technical manual is (Antonopoulos 2017).

3. These are contentious metaphysical claims. I'll not argue for them here, but refer interested readers to (Bailey, Rettler, and Warmke 2024), Chapter 2 and, especially, (Warmke 2021) and (Warmke 2022).

stuff.[4] And it is these containers that are bought and sold for a real price. But stuff they contain is either unreal altogether, or a mere fictional figment of the collective imagination of node operators, suitably extended and abetted by networked digital computers.

13 Thus one way to prompt an impression of unreality for bitcoin; even its proponents concede that it is a fiction.

14 Here is a second: bitcoin represents nothing else, whether within or without its network.[5] Typical bitcoin UTXOs neither contain nor point to external stores of enriched data, such as images or strings of text.[6] Bitcoin UTXOs aren't IOUs, furthermore. And, though bitcoin can be spent, it cannot be redeemed. You can buy things with bitcoin (U.S. dollars, for example), but there is no issuer who owes you something at a fixed rate of exchange should you wish to turn in bitcoin for an underlying asset. There is no underlying asset. Bitcoin's ledger is, in these ways, curiously empty. Though it tells a story, the story is about as thin as can be.[7]

15 Virtual realities are sometimes thought to be unrealities. Bitcoin the substance is unusually susceptible to this charge. It has the virtualness that digital artifacts typically command, and a closer look at the details only seems to vindicate those initial impressions. The question of digital value, as applied to bitcoin, appears pressing indeed. Why should anyone pay for something that isn't real?

16 It gets worse.

17 For there is a sense in which bitcoin can be copied nearly for free. Here's how. Its code is open source. Anyone may read it. Anyone may copy it. And many have done so. Bitcoin clones number in the tens of thousands. And why shouldn't they? Provided that the marginal cost of cloning bitcoin — the cost of pressing a button that says 'fork code' and implementing some tiny change — is lower than the expected benefit resulting (a non-zero chance that the clone will prove useful), people will press the button. And so, like mp3s and spicy memes, Bitcoins 2.0s reproduce like rabbits.

4. On the stuff/thing distinction invoked here, see, *inter alia*(Burge 1972), (Kleinschmidt 2007), and (Markosian 2004).

5. (Glazier, n.d.). This feature — seeing only what happens within the boundaries of a particular system, as it were — holds for other blockchain networks, too, and imposes important limitations on their usefulness; see (Glazier 2021) and (Schuster 2021).

6. 'Inscriptions', which facilitate the storage of arbitrary data on the bitcoin ledger, do not store that data within UTXOs. Their payloads are stashed, rather, inside transactions that forge those UTXOs. This distinction matters; if anything in the overall bitcoin system is owned or possessed in any straightforward way, it is a UTXO; for it is UTXOs that can be spent, not the transactions that created them.

7. A third path to the unreality of bitcoin goes like this: bitcoin is intangible. Its software is abstract. Bitcoin the substance has none of the usual marks of material reality. It is not treated by physics textbooks, nor does it appear to be composed of items so treated. Bitcoin fails more colloquial tests for material reality, too. Bitcoin the substance has no smell. Its software cannot be touched. Nor can you taste UTXOs. Bitcoin seems at war with a stern and by no means universally accepted global materialism, according to which anything that exists is material. Defining 'material object' and 'materialism' is no easy task, of course; for one systematic treatment, see Bailey (Bailey 2020).

4. The Copy Problem Resolved: Networks and Network Goods

18 With all this in mind, it is reasonable, again, to ask: when the software that defines its host network can be cloned nearly for free, why should anyone pay anything for some bitcoin?

19 Let's work through these problems – the copy problem and the unreality problem – backwards.

20 The copy problem is not incorrect, as far as things go.[8] But another distinction reveals that we cannot conclude much from it. For Bitcoin the network is not the same as Bitcoin the software. Bitcoin the software can indeed be cloned at a very low marginal cost. Its network cannot. For its network is sustained by the activity of tens of thousands of node operators. To truly clone Bitcoin the network, each of these node operators would need to be persuaded to run the cloned software. And persuading tens of thousands of people to do anything is a non-trivial operation. You can't do that with the mere push of a button.

21 *World of Warcraft* (WoW) is a popular multiplayer game. Millions log in every month, and interacting with those millions is a main attraction. Imagine that its code and art assets were all leaked. Anyone could now forge their own WoW-style experience and launch their own clone of that game. Would the clones be as popular? Would they actually deliver the same experience to users? It depends. To pull off this feat, they'd have to attract millions of users, for one. Without them, they'd be empty and boring. They might also need to attract developers – to fix bugs, release new content, and so on. Without them, WoW 2.0 might well be unplayable. Networks are hard to reproduce.[9]

22 There is a deeper reason that Bitcoin's network is costly to clone. Bitcoin's node operators evince a preference to run, not Bitcoin 2.0, but Bitcoin, because of Bitcoin's unique history. Histories can't be cloned; nor can their social meaning. That a new country has a letter-for-letter copy of the Constitution of the Republic of Singapore, for example, does not even suggest, much less guarantee, that it will enjoy any of Singapore's successes. It would lack Singapore's founding story, and its founding people. Bitcoin's founding story, and its founding people, are distinctive too. It once had a leader; it no longer does. Though it has early adopters, it has no insiders. No one, not even its pseudonymous creator, can mint new bitcoin for free (a point we'll turn to below). And regardless of how it is cloned or imitated, it remains the first of its kind.[10]

23 Bitcoin the software can be cloned on the cheap. Bitcoin the network cannot. If the substance

8. To confirm, go to https://github.com/bitcoin-core/bitcoincore.org and fork the code yourself.

9. The point extends to traditional monetary networks; see (Luther 2016).

10. (Bailey and Warmke 2023).

hosted by that network is defined by its host — different network, different substance — it follows that bitcoin the substance cannot be cloned on the cheap either.[11]

24 Bitcoin's very design also resolves another manifestation of the copy problem. If quantities of bitcoin could be simply copied and pasted, then bitcoin would be subject to double-spending: sending the same bitcoin twice over. That would not be good. But because of the way bitcoin mining works (the details needn't concern us here), double-spending is prohibitively expensive. There is no economically viable way of spending the same quantity of bitcoin twice, and getting the network to recognize both transactions as valid, and so bitcoin's design blocks that copy problem as well.

25 Here is another way to frame the copy problem, and the proposed resolution to it: why do any digital artifacts enjoy economic value, if they are not scarce? The proposed answer is that, though some digital artifacts within the bitcoin ecosystem can be copied on the cheap, others cannot. Bitcoin the network, bitcoin the substance, and quantities of that substance all fall within that latter category.

26 We may draw a lesson here for our broader question of digital value.

27 Networks cannot be copied for free. Network goods — these are goods that grow in usefulness along with their user base — are similarly resistant to cloning. If you're the first person to launch an Internet 2.0, it won't do you much good – unless you can convince others to join, that is. So also for multiplayer games or other virtual environments where interaction with users is the point. More generally: some digital artifacts, because they are network goods, cannot be reproduced for free. This is, in part, why they have economic value. Robust networks – bitcoin is just one of these – embody one resolution to the copy problem.

28 None of this implies that bitcoin in fact has economic value; nor does it fully explain any economic value bitcoin does have. Scarcity of this kind, by itself, neither guarantees nor explains economic value. The fact that human fingernails cannot be produced for free, for example, doesn't imply that they'll command a positive market price; nor does it, by itself, explain why someone might give up something of value to acquire some fingernails.

5. The Unreality Problem Unresolved: Three Incomplete Answers

29 Turn now to the unreality problem. Bitcoin appears unreal, prompting us to wonder why it has any economic value. More generally, digital artifacts appear unreal, prompting us to wonder why they have any economic value.

11. This resistance to cloning is, in part, why quantities of bitcoin, unlike some other digital artifacts, are private goods – rivalrous in consump

30 So I'll now raise and discuss three candidate replies to the problem, which suggest in turn three answers to the question of digital value. They're all insightful, but not quite right.

31 The first is that bitcoin is in fact without economic value: and so too, any other digital artifacts which are, like it, unreal. To say this is to, as wisdom sometimes requires, dissolve the problem rather than solve it. The problem with this reply is that it is empirically refuted. Bitcoin has enjoyed a positive market price, as noted above, for well over a decade. So too, other digital artifacts. People are willing to give up something of value for these items, and show no signs of changing in that respect. The reply is not responsible to the known facts.[12]

32 But observe the limits of this empirical refutation. It does not show that bitcoin makes the world better — that it enjoys value of the sort discussed in axiology or ethics, say.[13] Nor does it show that those who buy and sell bitcoin benefit from doing so — that it has instrumental value given their aims, say. So, though the reply at hand is empirically refuted, we should be cautious in deriving more substantive theses from that refutation.

33 A second tempting reply goes like this: other monetary instruments are unreal in at least a few senses. The U.S. dollar, for example, exists largely in digital form, and has for decades now. Dollar balances are digital artifacts, sustained by a network of computers. Digital dollars thus inherit any impressions of unreality that stem purely from their digitality. The dollar is a fiat money, furthermore, and neither dollar bills nor digital dollar balances represent any right to an underlying asset, nor can they be redeemed for such. The dollar's ledger tells a story no less thin and empty than bitcoin's — it's numbers moving from one cell in a spreadsheet to another, as it were. And the substance that dollar balances or physical notes are quantities of is a fiction too. Even if balances or notes are quite real, the substance they contain is not; at least, any reasons for thinking this is true in bitcoin's case apply to the dollar as well.[14] Despite all this, the dollar's economic value is unimpeachable.

34 This reply is helpful. It shows that digital artifacts can unquestionably enjoy economic value. And it shows, too, that the dollar's being unreal in some senses does not imply that it has no economic value. But the reply is shallow in two ways. First, though it may show *that* digital artifacts can enjoy economic value, it does not say *why*. Second, there may be too many points of disanalogy between bitcoin and the dollar for direct comparison to prove useful.

35 We have encountered various routes to the unreality of bitcoin. Attention to one of its most interesting features — that bitcoin has a positive marginal cost of production — suggests a third

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tion and excludable.

12. Though this first reply doesn't work in the case of bitcoin, or of all digital artifacts, it does apply to some. For some digital artifacts command no positive market price at all. Memes, email forwards, mp3s, and so on – few people are willing to pay for these, on the margin, and for good reason.

13. For a survey of many of the ethical and value-theoretic questions bitcoin and other cryptocurrencies prompt, see (Bailey, Rettler, and Warmke 2021a; 2021b).

14. (Warmke 2022). See also (Bailey, Rettler, and Warmke 2024): Chapter 2, Sections 10-11.

tempting reply to the unreality problem, and a broader answer to the question of digital value. In outline: bitcoin is real because it is costly to produce, on the margin. And this can explain, in turn, why it is economically valuable. More generally, the idea goes, economic value accrues exactly to and explains the value of those digital goods that are costly to produce, on the margin.

36 Houses, gold, food, and the like all enjoy economic value. They also take work to produce, on the margin. Take a house of a certain type; sure, you can make a new token of that type. But it'll take lumber and piping and concrete and effort to do this. Houses have a non-zero marginal cost of production. The same goes for unearthing new gold, and producing more food.

37 So also for bitcoin.

38 Bitcoin takes work to produce. New bitcoin can be minted in exactly one way: producing cryptographic proofs of work. These are called *proofs* for good reason; when one is produced, there is strong probabilistic evidence that computational work was done — that a number with curious cryptographic properties has been found in a large space. And computational work requires both hardware and electricity.[15] Two observations follow. First, there is a connection between bitcoin and physics. There is no known way to generate proofs of work without expending energy; indeed, this connection between the abstract mathematics of cryptography and actual physics may even be a consequence of our laws of nature. One might, on this basis, insist that for all its appearances of unreality, bitcoin has a sturdy and known connection to physical reality. Second, electricity and hardware — these are the inputs to bitcoin production — are expensive. And so bitcoin, like gold and bread and houses, has a non-zero marginal cost of production. So also, the idea goes, for other digital artifacts.

6. The Unreality Problem Unresolved: Expensive Production is Not Enough

39 To recap: the proposed reply to the unreality problem claims that bitcoin is in fact real in one very important sense: it requires real physical work to make. Bitcoin thus has an interesting economic feature: it is costly to produce, on the margin. That costly marginal production, in turn, explains why bitcoin has economic value. A similar story may be told for other digital artifacts, providing a broad framework for approaching the question of digital value.

40 Tempting though it may be, the reply is fallacious. For it incorrectly reasons from cost to value.[16] To do this is to infer from the premise that something would be costly to make to the conclusion that it is, on that account, valuable. The inference is fallacious twice over.

15. Why bitcoin uses proof of work, costs and benefits for users, and associated externalities are complicated topics. For detailed discussion, see (Bailey, Rettler, and Warmke 2024): Chapters 9-10 and (Cross and Bailey 2023).

16. I borrow this useful phrase — reasoning from cost to value — and its application to bitcoin from (Luther 2022).

41 First, it suffers from clear counterexamples. Your nose is a booger factory. Producing additional boogers at scale would cost you something – you'd need to expose yourself to more dust, ensure additional consumption of the relevant fluids and foods, and so on. This takes work. And yet it doesn't follow from this that your boogers are valuable or will command a positive market price; their price may well be negative, in fact.

42 Second, and more subtly, the target inference gets the direction of explanation backwards. Things that would be expensive to produce, and that are indeed produced, are produced because they are valuable, and not the other way around. No one actually expends great efforts to produce more boogers – unless and if so, because such boogers are valued, that is. So, though costly production can *evince* economic value, it is value that explains someone's actually paying those costs. Observing that something was costly to produce suggests that it was indeed economically valuable; but it presupposes rather than explains such economic value.[17]

43 Bitcoin is costly to produce, and on that account valuable, goes the target inference. It is fallacious. And the correct direction of explanation goes in precisely the opposite direction: it is only because bitcoin is valuable that bitcoin is expensively produced, on the margin. Absent any value, few would clamor to mine new bitcoin, and so anyone could produce new bitcoin themselves at very low marginal cost. The relationship between cryptography and physics ensures that bitcoin's would-be cost of production is positive. Bitcoin's value explains why people actually pay it.[18]

44 The reply at hand – according to which things that are costly to produce, on the margin, are real and thus enjoy economic value – is unconvincing in the case of bitcoin. It fails, too, when it comes to other digital artifacts, and reflection on why this is so bears on the copy problem we've already encountered. Think of Digital Rights Management (DRM) features that content creators may add to their work. Data protected by DRM aren't strictly *impossible* to copy. There are tools to strip an audio file of these limits, and a DRM-protected stream can be recorded using rogue screen capture software, after all. But these tools are a pain to deploy. And so, it would be more accurate to say that DRM-protected data are *expensive* to copy. They have, at least one one margin, a positive cost of reproduction. Freeing information from the chains of DRM is costly the first time. And some people pay that cost. They go through the hassle of stripping data of DRM; this evinces value. But none of this explains why the data is valuable. The correct explanation, in fact, goes in the opposite direction. People value the data, and that is why they are

17. These two points may appear to be in tension. The first gives a case of costly production without economic value, while the second appears to claim that such cases are implausible. There is no tension. For we may distinguish costs of production that are actually paid (as in the second point) from cost of production in theory (as in the first). It would, in theory, be expensive to produce boogers on the margin and at scale. But since few of us actually produce boogers, actual production costs of that kind are, thankfully, nil.

18. There is a sound and useful inference here – from the fact that people pay to produce bitcoin, to the conclusion that it is economically valuable. A parallel explanatory inference is invalid. This is a familiar structure. For it is often the case that sound and useful inferences run opposite the direction of correct explanation. You can correctly infer that it is raining by observing a wet sidewalk, for example, even though the sidewalk is wet because it is raining (and not the other way around).

willing to put in effort at copying it.

45 Thus three replies to the problem of unreality, three corresponding answers to the question of digital value, and some reasons to be unsatisfied.

7. The Unreality Problem Resolved: Real Enough to Use

46 What are we to say, then, about the unreality problem, whether for bitcoin or for other digital artifacts, and the broader question of digital value? As follows: bitcoin has economic value because it is real enough, and because people find it *useful*. So also for other digital artifacts. Let's take these in turn: reality enough, and then usefulness.

47 Bitcoin is real enough, and thrice over.

48 First, I concede that bitcoin is a fictional substance. But the containers of that substance – its UTXOs — are quite real. They are one or more in number. Indeed, at the time of writing, there are exactly 156,222,785 bitcoin UTXOs.[19] From this, it follows that there are bitcoin UTXOs, I say.[20] And if there are some things, then they exist, and they are real.[21] Second, bitcoin is real enough in that its network, whether construed as those people who operate nodes, or the nodes themselves (pieces of computer hardware implementing certain software, networked together), or some combination of these, is quite real. Third, we should resist any quick inferences from digitality to unreality.[22] I'll not argue the point except to say this: I can say from experience that the more time you spend with digital artifacts, the less unreal they seem.

49 Bitcoin is real enough — for what? To be useful. And herein lies its economic value. It will be helpful to distinguish two distinctions, to map them against each other, and to see where some familiar items fall within the resulting matrix.

50 Some things can be consumed and are useful in that way. You can eat them, build houses with them, make jewelry with them — or, in a pinch, burn them for warmth. Some things cannot be consumed in this way, but can nonetheless be exchanged. Their usefulness lies, at least in part, in the fact that they can be traded. There's one distinction. Here's another. Some things generate cash flow, as with dividends or coupon payments for a loan. Others do not; they just sit there, as

19. See https://bitcoin.clarkmoody.com/dashboard/

20. I am not merely saying, note, that according to the bitcoin ledger, there are UTXOs; this claim would permit a fictionalist reading, as with 'according to *The Lord of the Rings*, there are hobbits'. I am saying that there are bitcoin UTXOs. For some useful distinctions and discussion of this style of fictionalism, and what it means for the metaphysics of bitcoin in particular, see (Lipman 2023).

21. In saying all this, I presuppose what is now known as a Quinean metaontology. So be it. For a robust defense of that metaontology, see (van Inwagen 2023).

22. For arguments to this effect, see (Chalmers 2017) and (Chalmers 2022).

it were. And so we arrive at the following matrix:[23]

	Cash flow	No cash flow
Consumption use	houses	Non-Fungible Tokens (NFTs)
Mere exchange use	bonds, dividend-bearing company shares	physical dollars, zero-coupon bonds, bitcoin, digital dollar IOUs

51 Houses are useful indeed. You can consume – live in – them. This is one source of their economic value. Another is the fact that they can be rented out for cash flow. And of course, houses can be exchanged; this is, in part, why people own them, and thus why they have economic value. Thus the upper-left-hand quadrant.

52 You cannot eat or build houses with bonds or dividend-bearing equities. The point in owning them is, rather, to collect a dividend or interest payment. They can also be exchanged, and this is, in part, why people own them. Thus the lower-left-hand quadrant.

53 NFTs typically provide no cash flow to their holders. But they confer status nonetheless; this is one reason some people are eager to tell you about the NFTs they own. Some NFTs even entitle their owners to entry into various social circles: chat servers, conferences, parties, and such. To take part is to consume the NFT. And as with our other examples, NFTs can be exchanged, and this is in part why people own them. Thus the upper-right-hand quadrant.

54 Turn, finally, to the lower-right-hand quadrant. Physical dollars have no cash flow. They bear no interest, and yield no dividends. They just sit there in your fanny pack. They have no consumption use, either. You can't eat them or build houses with them; and they are not terribly useful as fuel for warmth. But physical dollars can nonetheless be exchanged. In fact, this is precisely their source of usefulness. The physical dollar nicely illustrates a simple point: exchange value is economic value enough, provided that enough people want to do the exchanging. Zero-coupon bonds, which bear their owners no interest, are another example of this quadrant; they have economic value, but cannot be consumed and have no cash flow. Digital dollar IOUs are a final and familiar occupant of this quadrant. A PayPal balance typically bears no interest, and cannot be consumed in the target sense. But it can be exchanged, whether for a dollar-denominated balance at a commercial bank (another digital artifact, that is) or for goods and services.

55 For the digital artifacts in this lower-right-hand box, an impressive case may be made for their unreality. They are figments of our collective imaginations, aided by networked computers. And yet none of this has dissuaded us from putting them to use.

56 And it is here that we find bitcoin. As with the physical dollar, it has no cash flow and cannot be

23. Note well: though bonds and shares stem from the much older world of finance, they are nearly all, by now, digital artifacts. The days of physical bearer shares and bonds are over. These items now entirely inhabit the digital ledgers of various exchanges, brokers, clearinghouses. The matrix here bears obvious debt to one drawn in (Selgin 2015).

consumed.[24] But bitcoin can nonetheless be exchanged. In fact, this is precisely the source of its usefulness. As with the dollar and other fiat monies, bitcoin is a *pure* money, free of other uses.[25]

57 It's not just that bitcoin can be exchanged (after all, every item in view in this matrix, digital or otherwise, has that feature). Rather, bitcoin can be exchanged, over a digital network, without the permission of any trusted intermediary. This power sets bitcoin apart from other items in that quadrant. Digital dollar IOUs can be exchanged over digital networks. That is what they do. But they cannot be exchanged without a trusted intermediary; you can't send a PayPal balance without the permission of PayPal and some commercial or central banks.[26] Physical dollars, by contrast, can be exchanged without a trusted intermediary; just hand over the bills directly, and get something in return. But physical dollars cannot be exchanged over a digital network. Bitcoin, again, does *both*. And people find this combination useful. In achieving it, bitcoin has made some progress towards instituting, not digital money, but digital cash.[27]

58 People are willing to pay, furthermore, for things they find useful, when those things can't be cloned for free.[28] Bitcoin enjoys both properties. And so it is ultimately no mystery that bitcoin should enjoy economic value.[29]

59 The points here may be extended to other digital artifacts; if they have economic value, it is because they, too, cannot be cloned for free, and because they, too, are useful.[30] And so we have answered the question of digital value.

24. Some might say that bitcoin is, in this way, without *intrinsic* value. For some useful distinctions and discussion that connects economic or financial uses of that term — sometimes denoting cash flow, sometimes denoting consumption use, sometimes something else — with its use in philosophy, see (Rettler 2021).

25. We offer a systematic account of the ways in which bitcoin is and is not a money in (Bailey, Rettler, and Warmke 2024): Chapter 3. See also (Hazlett and Luther 2019) and (Passinsky 2020).

26. Similar points apply to other dollar-denominated monies that inhabit traditional payment networks. See (Benson, Loftesness, and Jones 2017).

27. The factors that make digital transfer without trusted parties attractive in the first place are many. See (Bailey, Rettler, and Warmke 2024): Chapter 1 for an overview. See also Chapters 6, 7, and 8 for more specific assessment from the perspectives of privacy, censorship-resistance, and financial inclusion. On the limits of bitcoin's ability to achieve censorship-resistance through disintermediation, see (Warmke, n.d.).

28. In particular, people are willing to trade for things that are *more useful* than whatever it is they'd have to give up for them. You'd trade burgers — or dollars — for bitcoins when the latter better serve your purposes than the former.

29. (Andolfatto and Spewak 2019).

30. For accessibility, I have largely steered clear of the vocabulary of contemporary economics. But it is clear, I hope, that the explanation on offer coheres with ordinary price theory. An equilibrium market price for a good lies at the intersection of its demand and supply curves. These curves will intersect at a non-zero quantity and a non-zero price when buyers are willing to give up something of value for that good (demand), and when sellers oblige (supply). Bitcoin and other digital artifacts are no exception.

8. Directions for Future Research

60 There is more to say about bitcoin's usefulness, and the usefulness of other digital artifacts. I'll close with just two points. First, it may be that costly production plays a role in saying why bitcoin or some other digital artifact is useful. Costly production helps to ensure scarcity, for example, and scarcity may figure into an account of something's usefulness. But to concede this would not be, one hopes, to fallaciously reason from cost to value. How to thread that needle is a puzzle for another day. Second, it will be important to develop the explanation at hand — value from usefulness — without objectionable circularity. One must not reason here from economic value, to usefulness, to economic value. I think this can be done. For one, it isn't obvious that the kinds of explanations in view are transitive. More substantively, there are already unobjectionable explanations for the value of other network goods. It is valuable to know a given language because others know that language too, for example; and yet others found it valuable to know that language for that very reason. A convincing and clear story here will appeal to the theory of institutions, the conventions that sustain them, and the game-theoretic problems they solve.[31] It will also draw from, I suspect, actual history — the story of network goods and how they emerged.[32]

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Bibliography

Andolfatto, David, and Andrew Spewak. 2019. "Whither the Price of Bitcoin?" *Economic Synapses* 1. https://research.stlouisfed.org/publications/economic-synopses/2019/01/11/whither-the-price-of-bitcoin.

Antonopoulos, Andreas M. 2017. *Mastering Bitcoin.* 2nd ed. Sebastopol: O'Reilly.

31. I have in mind, of course, (Lewis 1969) and its application and extension in such works as (Guala 2016).

32. See (Brunton 2019) and (Luther 2019), for example. See also (Bailey and Warmke, n.d.), in which we trace details of bitcoin's early history and show how they bear on its institutional metaphysics. Though bitcoin began life as an engineered system, it is now feral – more like a natural language than a formal one.

Bailey, Andrew M. 2020. "Material through and Through." *Philosophical Studies* 199:2431–50.

Bailey, Andrew M., Bradley Rettler, and Craig Warmke. 2021a. "Philosophy, Politics, and Economics of Cryptocurrency I: Money without State." *Philosophy Compass* 16 (11).

———. 2021b. "Philosophy, Politics, and Economics of Cryptocurrency II: The Moral Landscape of Monetary Design." *Philosophy Compass* 16 (11).

———. 2024. *Resistance Money: A Philosophical Case for Bitcoin.* Abingdon: Routledge.

Bailey, Andrew M., and Craig Warmke. 2023. "Bitcoin Is King." In *Cryptocurrency: Concepts, Technology, and Issues*, edited by Jay Liebowitz, 175–97. Boca Raton: CRC Press.

———. n.d. "What Satoshi Did." In *The Satoshi Papers*, edited by Tuur Demeester and Natalie Smolenski.

Benson, Carol Coye, Scott Loftesness, and Russ Jones. 2017. *Payments Systems in the U.S.: A Guide for the Payments Professional.* 3rd ed. Glenbrook Press.

Brunton, Finn. 2019. *Digital Cash: The Unknown History of the Anarchists, Utopians, and Technologists Who Created Cryptocurrency*. Princeton: Princeton University Press.

Burge, Tyler. 1972. "Truth and Mass Terms." *Journal of Philosophy* 69:263–82.

Chalmers, David J. 2017. "The Virtual and the Real." *Disputatio* 9 (46): 309–52.

———. 2022. *Reality+. Virtual Worlds and the Problems of Philosophy*. New York: W. W. Norton & Company.

Cross, Troy, and Andrew M. Bailey. 2023. "Carbon-Neutral Bitcoin Adoption for Nation States." In *Financial Cryptography and Data Security*, edited by Alexander Essex, 55–65. Cham: Springer.

Glazier, Martin. 2021. "Enterprise Blockchain Doesn't Work Because It's about the Real World." https://www.coindesk.com/markets/2021/03/31/enterprise-blockchain-doesnt-work-because-its-about-the-real-world/.

———. n.d. "In Blockchain We Trust?"

Guala, Francesco. 2016. *Understanding Institutions.* Princeton: Princeton University Press.

Hazlett, Peter K., and William J. Luther. 2019. "Is Bitcoin Money? And What That Means." *The Quarterly Review of Economics and Finance* 77:144–49.

Inwagen, Peter van. 2023. *Being: A Study in Ontology*. Oxford: Oxford University Press.

Kleinschmidt, Shieva. 2007. "Some Things about Stuff." *Philosophical Studies* 135:407–23.

Lewis, David. 1969. *Convention: A Philosophical Study*. Malden/MA: Wiley-Blackwell.

Lipman, Martin. 2023. "On Bitcoin: A Study in Applied Metaphysics." *Philosophical Quarterly* 73:783–802.

Luther, William J. 2016. "Cryptocurrencies, Network Effects, and Switching Costs." *Contemporary Economic Policy* 34 (3): 553–71.

———. 2019. "Getting off the Ground: The Case of Bitcoin." *Journal of Institutional Economics* 15 (2): 189–205.

———. 2022. "Bitcoin Is Not a Battery." https://www.aier.org/article/bitcoin-is-not-a-battery/.

Markosian, Ned. 2004. "Simples, Stuff, and Simple People." *The Monist* 87:405–28.

Passinsky, Asya. 2020. "Should Bitcoin Be Classified as Money?" *Journal of Social Ontology* 6 (2): 281–92.

Rettler, Bradley. 2021. "Another Way to Think about Bitcoin's Value." https://bitcoin-magazine.com/culture/bitcoin-intrinsic-value-definition.

Schuster, Edmund. 2021. "Crypto Cloud Land." *Modern Law Review* 84 (5): 974–1004.

Selgin, George. 2015. "Synthetic Commodity Money." *Journal of Financial Stability* 17:92–99.

Warmke, Craig. 2021. "What Is Bitcoin?" *Inquiry* 67:25–67.

———. 2022. "Electronic Coins." *Cryptoeconomic Systems* 2 (1). https://doi.org/https://doi.org/10.21428/58320208.eb69605e.

———. n.d. "Hash Handcuffs."