Cryptocurrency Economics and the Taxation of Block Rewards, Part 2

by Abraham Sutherland

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Part 1 of this report provided an overview of cryptocurrency economics and explained the consequences of treating proof-of-stake block rewards as gross income, as suggested by Notice 2014-21, 2014-16 IRB 938. To help in understanding those consequences, the report introduced the metaphor of a cryptocurrency kitty.

Those who hold a cryptocurrency’s tokens pay for the maintenance of that cryptocurrency network. Token holders do this by taking a handful of their tokens (five, let’s say) and putting them in the kitty. Those who maintain the network (validators) are allowed to take tokens from the kitty and keep them. For example, a validator might take back her five tokens, plus two on top of that. Those extra two tokens come from token holders who pay for, but don’t help with, the network maintenance. Notice 2014-21 would tax that validator on seven tokens, ignoring the five contributed to the kitty.

This part of the report explores ways to account for the validator’s contribution to the kitty. If the validator puts in five tokens and takes out seven, how might the law tax her only on the resulting gain of two?


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IV. Option 2: Tax Accretion to Wealth Annually

Under a popular view of ideal tax policy, income should include “the change in the value of the store of property rights between the beginning and end of the period in question.” Under that approach, taxation of cryptocurrency block rewards would be based on taxpayers’ accretion to wealth as a result of participation in validation. Conceptually, this approach is straightforward, and among adherents of the Haig-Simons definition of income it would also be regarded as equitable. In practice, however, it raises significant administrability issues and would be plagued by the same concerns that meet proposals to annually tax other assets, such as equities. And as shown by Haig-Simons Coin, a faithful implementation of the Haig-Simons approach would also require an annual tax reckoning for those who experience a reduction in stake.

A. Pure Haig-Simons Taxation: Mark-to-Market

We have modeled validators’ new wealth as a function of reward token creation and participation in validation. This clarifies the basic economics of cryptocurrency incentives, but it might obscure the complexity of real-world cryptocurrency transactions and their effect on calculating gains and losses. The models presented in Part 1, Section III, are unlikely to help taxpayers if they are asked to tally and report their true gains from participating in cryptocurrency validation.

But when markets allow easy valuation of assets, there is a simpler way to establish validators’ true gains: Establish the actual change in the value of validators’ token holdings over the course of a tax period. This could be done by marking to market, so that gains from block rewards are properly offset by the effect of dilution on all the taxpayer’s tokens.

This approach, however, would reach not just the new wealth represented by block rewards but also the change in wealth represented by all the taxpayer’s tokens. This report has explained validator gain in terms of the change in the token holder’s stake, which is distinct from that stake’s dollar value. When, for purposes of illustration, it has assigned a dollar value to a network, that network value has been held constant for simplicity. These approaches factor out the change in value of cryptocurrencies over time for reasons other than dilution. But in fact these values rise and fall in relation to the dollar, and if cryptocurrency’s short history is any indication, cryptocurrency values are indeed quite volatile.

Cryptocurrency owners — whether holding tokens as an investment, as a means of making payments, or for any other reason — would resist this attempt to tax all gains (and losses) annually for the same reason proposals to annually tax other types of “paper gains” remain unpopular. Note also that in the hands of many taxpayers, under current rules tokens will be capital assets subject to long-term capital gain treatment. Cryptocurrency owners would not like to see token holdings singled out for an annual tax reckoning, with the kicker of losing the potential advantages of long-term gain treatment.

We also should not lose sight of the fact that block rewards are just a tool for funding the maintenance of a cryptocurrency network; they are not the purpose of any cryptocurrency. The mark-to-market option is presented as a way for validators to ensure that the annual tax burden is based on true gains and not solely on a cryptocurrency’s token creation rate. Presumably, however, a legislated mark-to-market requirement would also apply to those who hold and use cryptocurrency without participating in validation. By definition, non-validators will not

67. Part 1, at Section III.G.

68. This discussion leaves aside whether mark-to-market taxation of cryptocurrency is constitutional under the 16th Amendment. See Henry Ordower, “The Expatriation Tax, Deferrals, Mark to Market, the Macomber Conundrum and Doubtful Constitutionality,” 15 Pitt. Tax Rev. 1, 37-47 (2017) (noting that the few tax code provisions that use a mark-to-market mechanism to include unrealized gains in gross income have not been subject to Supreme Court review).
show any gains resulting from validation. This report has emphasized that any gains from validation amount to a redistribution of network stake, and therefore network value, away from those who don’t participate in validation. Accordingly, it has highlighted the consequences of failing to participate in validation, and its example of choice, Tezos, is indeed designed to encourage broad participation to promote network security and ensure that the costs and benefits of network maintenance are broadly distributed among token holders.

But participating in the maintenance of a cryptocurrency network is a choice. Arguably — and contrary to the philosophy embedded in Tezos — the ideal incentive structure is one that allows a small minority to maintain the network,70 allowing the majority to simply use the network at the understood cost of a small “tax” on their stakes as a result of dilution. Mark-to-market, in other words, would invite non-validators into an annual reporting process that is inconsistent with the aims and uses of cryptocurrency for most cryptocurrency users.

B. Proof-of-Stake Tokens as Depreciating Assets

The key problem with treating reward tokens as gross income when received is that the tokens’ dilution effect takes the form of losses that may not be realized in the same tax period. This assumes, following basic property and taxation principles affirmed by the 2014 and 2019 IRS guidance, that once acquired, tokens are property that generate gains or losses only upon their sale or exchange.

In a proof-of-stake cryptocurrency, tokens are the basis for obtaining validation rights and the associated rewards. These tokens could be viewed as a capital investment required for the production of reward tokens. As with other types of assets used in productive activity, the tax code could allow tokens’ value to be written down over time, following established accounting and taxation principles of depreciation, amortization, and depletion.

Under that approach, block rewards can remain gross income under the principles of Notice 2014-21, subject to deductions that result in an equitable statement of taxable income. In theory, like marking to market, this approach to rationalizing reward taxation is coherent. With proof of stake, tokens are the key determinant of validators’ reward income. Dilution from new tokens reduces the stake in the network that each token represents, and the change in tokens’ value resulting from this dilution could be set against the fair market value of new tokens received as rewards.

Using the Tezos figures developed in Part 1,71 a validator will end the year with 7.34 percent more tokens. Under Notice 2014-21, this results in gross income of 7.156 percent of the validator’s initial stake. Accounting for the dilution of all tokens over the course of the year at the rate of 4.952 percent, the validator will reach an adjusted income of 2.02 percent of her stake.

For a commercial validation business operating at scale, this approach could have its merits. Once again, however, remember that cryptocurrencies are not a means to create tokens; token creation is a means of maintaining a cryptocurrency. Token depreciation is a way to rationalize the taxation of block rewards, but at considerable cost to the allure of cryptocurrency as a store of value, medium of exchange, and the unit of account for the various other transactions and operations conducted on the cryptocurrency’s network.

All token holders — or at least all token holders who wish to participate in validation without being taxed annually on an exaggerated gross income figure — would lose the ability to hold tokens without triggering annual tax consequences. And while the effect of dilution is easily modeled, this approach would be complicated administratively, especially for token holders who use the cryptocurrency network, and for whom delegation is a means to avoid dilution and ensure the integrity of the network.

In sum, trying to achieve the Haig-Simons ideal of annually taxing taxpayers’ accretion to wealth — whether through annual marking to

70 Contingent, however, on this minority being sufficiently decentralized to ensure the network’s integrity.

71 Part I, at Section III.E.
market or by authorizing the writing down of tokens’ value to account for the dilution effect — would mark a departure from the tax treatment of other capital assets and invite considerable administrative complications that would undermine cryptocurrency’s allure as a financial innovation.

V. Option 3: Deferring Taxation

The third alternative is to defer taxation of reward tokens until they are sold or exchanged. The deficiencies of the alternatives should by now be clear. Taxing block rewards at the time of their sale or exchange is equitable, efficient, and elegantly simple. Reward tokens convey wealth to their recipients, and that wealth — along with any gain or loss from changes in the cryptocurrency’s value as the result of other factors — will be accurately assessed and taxed when the tokens are sold. At the same time, validators’ new wealth from reward tokens has been a zero-sum redistribution from those whose stake has been diluted. The effects of dilution borne by those who do not participate in validation are given equal status: They are accounted for at the time of the diluted tokens’ sale.

Like many taxation issues, the treatment of reward tokens is helpfully framed as a question of when taxation should occur. Block rewards are a zero-sum game: Because gains from reward tokens are necessarily equal to the losses caused by dilution and redistribution, Treasury does not have a strong argument to expedite the taxation of validators’ gains. Any delay in its receipt of tax revenue is a small price to pay to avoid the economic and administrative costs of immediate taxation that were demonstrated in Part 1, Section III of this report.\(^\text{72}\)

A. On the Analogy of Corporate Distributions

It is important to distinguish the example of taxable stock dividends.\(^\text{73}\) The analogy is useful, but it does not support the treatment of proof-of-stake block rewards as income. At first glance, proof-of-stake block rewards do look a lot like stock dividends that would be taxed as income under current law, but in fact the comparison shows why these block rewards should not be income when received. This point is especially important because the history of stock dividend taxation plays a prominent role in the story of Congress’s increasing latitude to define and then tax income. Generally speaking, Congress prefers to impose tax sooner rather than later, and its approach to the taxation of corporate earnings and profits distributed through stock dividends lends superficial support to treating block rewards as income at the time received.

In short, the analogy fails because block rewards are not really like property distributions made to shareholders, and they’re especially unlike taxable stock dividends. Arguably, validators could be deemed a class of token holders akin to shareholders who own a particular class of distribution-eligible shares. The analogy is still awkward because even among validators, stake does not actually determine block rewards, only the eligibility to perform validation. Blocks and block rewards are not created until and unless validators successfully do their job.

Block rewards are especially unlike dividends because they do not distribute E&P; a cryptocurrency doesn’t have E&P. All it has is a potentially unending supply of new pieces of itself that can be created under the rules of the cryptocurrency’s governing computer code. So if block rewards were taxed like “a distribution of property . . . made by a corporation to a shareholder with respect to its stock,”\(^\text{74}\) the amount of the distribution would not be included in gross income. Instead, the distribution would

\(^{72}\)The character of gain from the eventual sale of reward tokens is a separate issue, although it is argued later that reward tokens should be capital assets that qualify for favorable capital gains tax rates. See infra Section V.C.2.

\(^{73}\)This section of the report focuses on proof-of-stake cryptocurrencies such as Tezos. In Bitcoin and proof of work, the analogy to corporate distributions proceeds quite differently. The analogy of proof-of-work block rewards to corporate distributions is discussed in Section VI.A.

\(^{74}\)Section 301(a).
be taxed only to the extent that the reward tokens improved their recipients’ financial position. And this gain, if it exists, would be treated as a capital gain, not ordinary income.  

First, a brief history of a long succession of court cases and amendments to the tax code: In its landmark Macomber decision in 1920, the Supreme Court held that unlike cash dividends, stock dividends were not income and therefore could not be taxed as such under the 16th Amendment. In dissent, Justice Louis D. Brandeis emphasized the role that stock dividends play in avoiding the taxation of corporations’ accrued E&P, and he argued that stock dividends are equivalent to cash dividends accompanied by a right to reinvest the cash on preferential terms.

In 1936 the Court in Koshland clarified the rule from Macomber, narrowing the exclusion of stock dividends from taxable income. Macomber itself concerned a pro rata stock dividend, and the Koshland decision held that stock dividends that were not pro rata were income that could be taxed: “Where a stock dividend gives the stockholder an interest different from that which his former stock holding represented he receives income.” Since 1936 Congress has taxed as income most stock dividends that are not pro rata. And in this sense proof-of-stake block rewards do not fit the Macomber fact pattern, because no real cryptocurrency will involve reward tokens distributed pro rata among token holders. Instead, block rewards will alter the stake in the network held by validators and non-validators.

Accordingly, block rewards are not insulated from treatment as income by virtue of any constitutional rule traceable to the Macomber decision. Moreover, history since 1936 shows that Congress generally does intend to tax stock dividends as income, except in a narrow range of cases similar to the fact pattern in Macomber and now codified in section 305. For this reason, proof-of-stake block rewards can appear to be taxable income.

For purposes of this report, we can assume that Congress could tax these block rewards as income. The point here is just to establish why the analogy to stock dividends doesn’t counsel such a decision, much less mandate that tax treatment under existing law.

When stock distributions to shareholders are gross income, it is because — and then only to the extent to which — they distribute corporate E&P. Taxing these earnings sooner (while still technically held by the corporation) rather than later (when the earnings are firmly in the hands of the taxpayer — for example, after a sale of shares) is a reasonable policy decision because Congress is concerned with corporations deferring the distribution (and resulting taxation) of the E&P indefinitely.

Block rewards, on the other hand, never distribute earnings because cryptocurrencies have no earnings. Block rewards merely redistribute stake and thus are zero-sum in terms of the net income Treasury seeks to tax. And as we’ve seen from the examples of Hardship Coin and Tezos, the effect of immediate taxation is to vastly overstate proof-of-stake validators’ gains, undermining any interest of Treasury in expediting its collection of tax.

The tax treatment of stock distributions to shareholders illustrates this point nicely. A non-pro-rata stock distribution that is not excluded from income under section 305(a) is, under

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75 See infra note 85 and accompanying text, explaining the implications of sections 301(c) and 316(a).
77 Id. at 198. The dissent gives an example of an untaxed 2,900 percent stock dividend that insulated $29 million of surplus from (taxable) distribution to shareholders.
78 Koshland v. Helvering, 298 U.S. 441, 446 (1936).
80 See Ordower, “Revisiting Realization: Accretion Taxation, the Constitution, Macomber, and Mark to Market,” 13 Vt. Tax Rev. 1, 8 (1993) (explaining the majority view that “(1) there is no continuing vitality to Macomber’s constitutional realization requirement, and (2) to the extent the tax law continues to include a realization requirement at all, it is solely a function of administrative convenience,” but arguing that Macomber remains constitutional law); and Ordower, “The Expatriation Tax,” supra note 68, at 39-40 (noting that despite requests by the government, the Supreme Court has not overruled Macomber on its holding that unrealized gains may not be taxed).
section 305(b), treated as “a distribution of property . . . made by a corporation to a shareholder with respect to its stock” under section 301(a). The taxation of that distribution is determined by section 301(c). First, “that portion of the distribution which is a dividend . . . shall be included in gross income.”

Dividend is defined as “any distribution of property made by a corporation to its shareholders out of its earnings and profits.” If there is no E&P, it is not a dividend, and none of the distribution is included in gross income. The distribution is then treated under subsections 301(c)(2) and (3). Those rules provide that distributions exceeding earnings are a nontaxable return of the recipient’s capital, in the amount of their FMV when received. This nontaxable return of capital reduces the recipient’s adjusted basis in the stock, and if that basis is depleted, any excess distribution is treated as a gain from the sale of property.

This “return of capital” doctrine is not well suited for the treatment of cryptocurrency block rewards, but it illustrates that taxation of distributions is aimed not at distributions as such, but rather at the gains those distributions typically represent. Similarly, this report is arguing for an approach to taxation that acknowledges distributions are not equivalent to gains, because the FMV of proof-of-stake reward tokens overstates validators’ gains. The best way to avoid the overstatement of validators’ gains is to tax reward tokens at their sale, but the example of section 301(c) is still illuminating.

Section 301(c) suggests a possible “return of stake” doctrine that would prevent the overtaxation of proof-of-stake block rewards. Reward tokens would be deemed a nontaxable return of the validator’s stake to the extent that they preserve the validator’s stake in the network. To the extent that reward tokens increase the validator’s stake, they would be a taxable gain. Applied to a Tezos validator who receives “distributions” of about 7 percent, the distributions would consist of a nontaxable return of stake of about 5 percent, leaving a taxable gain of about 2 percent. And to the extent that the analogy to section 301(c) taxation is compelling, it also illustrates that reward tokens that increase the validator’s stake should be “treated as gain from the sale or exchange of property” — that is, not as ordinary income, but as capital gain.

This approach bears a resemblance to the mark-to-market and token depreciation proposals sketched earlier in Section IV: It is a method of adjusting a taxpayer’s nominal gains to account for the effect of dilution. But a return-of-stake approach would suffer from the same defects in terms of administrability. Corporations exist to earn money for their owners, whether distributed through dividends, the eventual sale of shares, or otherwise. Cryptocurrencies, on the other hand, do not exist to distribute new tokens to token holders; new tokens get created so that secure cryptocurrencies can exist.

### B. Are Reward Tokens Barter Income?

We have just established that block rewards differ from taxable stock dividends because cryptocurrencies do not distribute earnings or profits. We have also seen that the logic supporting the taxation of stock dividends does not translate to proof-of-stake block rewards: Block rewards are a zero-sum redistribution of stake, and cryptocurrencies cannot be encouraged to distribute, rather than hold, cash. But there are other arguments from analogy for the immediate taxation of reward tokens. Leaving aside the example of corporate distributions, tokens may be barter income or compensation for the service of maintaining a cryptocurrency network.

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81. Section 301(c)(1).
82. Section 316(a).
83. Section 301(c)(2) (amount applied against basis); section 301(b)(1) and (3) (calculation of amount distributed is property’s FMV on date of distribution); see also reg. section 1.305(b).
84. Section 301(c)(3)(A).
85. *Boulware v. United States*, 552 U.S. 421, 425 (2008) (“Sections 301 and 316(c) together thus make the existence of ‘earnings and profits’ the decisive fact in determining the tax consequences of distributions from a corporation to a shareholder with respect to his stock. This requirement of ‘relating the tax status of corporate distributions to earnings and profits is responsive to a felt need for protecting returns of capital from tax’.”). *See also Goguk v. Commissioner*, T.C. Memo. 2012-13, at 36 (discussing ordinary income, nontaxable return of capital, and capital gain as different components of distributions under sections 301(c) and 316(a)).
86. The taxation of partnership distributions provides a similar analogy. See section 731(a)(1).
87. Section 301(c)(3)(A); see *Boulware*, 552 U.S. at 425 (distributions exceeding the taxpayer’s basis are “ordinarily taxable to the shareholder as a capital gain”).
The first step is to cast doubt on the proposition that block rewards are helpfully viewed as barter income or compensation. The second step is to demonstrate that block rewards are better understood as property that is created by validators and therefore should be taxed like other property created by the taxpayer through the investment of effort and resources.

Barter, for our purposes, is receiving property as compensation for services: “If services are paid for in property, the fair market value of the property taken in payment must be included in income as compensation.” Notice 2014-21 appears to be based on the notion that mining rewards are compensation for services. With cryptocurrency, the services would be clear: maintaining the network. But are the services paid for? Are the rewards compensation? A payment? Notice 2014-21 does not use the terms “compensation,” “payment,” or “paid for,” which appear in the regulation. And the guidance is silent about who or what is providing the property to the taxpayer. It states: “When a taxpayer successfully ‘mines’ virtual currency, the fair market value of the virtual currency as of the date of receipt is includible in gross income.”

Assuming that barter occurs between parties, the question remains: With whom or what is a validator engaging in barter? One possible answer is that the validator barters with the cryptocurrency itself. The cryptocurrency’s computer code, after all, can be said to issue the new digital tokens, and it is also acceptable English to say that tokens thus issued by the protocol are received by validators. But bartering with a cryptocurrency makes little legal sense — or at least no more sense than saying that a farmer barters with the land, which in exchange for the farmer’s services compensates him with valuable wheat. Poetic license allows us to say an apple tree pays its owner in apples, but this license does not extend to the law, at least not under section 61(a)(1), or at least not until Congress (or perhaps Treasury) declares that those apples are income from whatever other source they may be said to have been derived.

Perhaps, then, the validator barters with those who use the cryptocurrency network. Our kitty metaphor would support this account. If the kitty metaphor determines taxation policy, Tezos token holders — validators and non-validators alike — each contribute five tokens to the kitty. In return, all token holders get the use of the network. Validators perform their services and claim their seven tokens as compensation.

Under this account of barter, the validator appears to be paying himself, so the next question is whether he should be taxed on two tokens or seven. Analogies can be marshaled for either conclusion. If he should be taxed only on two, there remains the difficult practical question of how the tax accounting should be done, but at least we have eliminated the gross overtaxation.

Taxing validators on two tokens, however, is not what Notice 2014-21 had in mind. Suppose that the kitty metaphor governs and the IRS is right that validators should be taxed on seven tokens. Validators should ask that the cryptocurrency’s code be changed so that the metaphor no longer governs their case. Instead of all token holders paying into the kitty, only non-validators should contribute. If non-validators put in five tokens, validators can then take out two and thereby avoid overtaxation. As shown by Burn Coin and Haig-Simons Coin, maneuvers like this are possible.

But we should be careful that available metaphors don’t supplant the reality of what is happening in all these cases: Validators increase their stake; non-validators lose stake; and the network gets maintained. On the other hand, any human-readable account of what is happening with a cryptocurrency is already infused with analogies to human experience that are imperfect representations of the computer code. We call

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88 Reg. section 1.61-2(d)(1) (“compensation paid other than in cash”); see also section 61(a)(1) (gross income includes compensation for services) and 83 (“property transferred in connection with performance of services”).

89 Notice 2014-21, Q-8.

90 Black’s Law Dictionary (2d ed.) defines barter as “A contract by which parties exchange goods or commodities for other goods. It differs from sale, in this: that in the latter transaction goods or property are always exchanged for money.”

91 Shakow argues that some kinds of blockchain-based projects are indeed entities for tax purposes, although he also maintains that cryptocurrencies like Bitcoin are not those entities. Shakow, “The Tao of the DAO: Taxing an Entity That Lives on a Blockchain,” Tax Notes, Aug. 13, 2018. p. 929.

92 See Part 1, at Section III.F and Section III.G, respectively.
these things tokens even though we can’t touch them and even though it is sometimes more helpful to view them as a percentage share in a network. Whatever we call them, that these pieces of these networks have economic value is ultimately a fact about humans, not the underlying code.

So metaphors are dangerous, but they’re all we’ve got. Some are more useful than others. A metaphor that leads to untenable results in the less-metaphorical realm of income taxation should be viewed with suspicion, and the taxation of seven tokens instead of two is indeed inequitable. This is true especially if a more illuminating metaphor is close at hand. Therefore, we should be wary of saying that the far-flung strangers who participate in a cryptocurrency network barter among themselves — it would muddle the concept of barter, which can be succinctly summarized as something like a sale transaction except that goods or services take the place of money. The barter analogy also leads to the awkward notion of bartering with oneself with taxable consequences, or else to a notion of barter that must engineer an allowance for self-compensation to prevent overtaxation.

A more illuminating metaphor is indeed at hand. Validators do something that is much more intuitively simple than bartering. It’s still a metaphor, but it is a more helpful one — it maps more closely onto the human experience of productive economic activity, and it also maps more closely onto the actual mechanics of actual cryptocurrencies: Validators create cryptocurrency tokens.

C. Found, Created, and Received Property

Whether the concepts of barter and compensation imply an identifiable counterparty is perhaps not critical, because the legal definition of gross income, circular as it may be, clearly does not require a counterparty: “Gross income means all income from whatever source derived.” But this puzzle concerning the source of cryptocurrency validators’ income is still instructive. It points us to a fundamental, if rarely invoked, distinction in property. The distinction is that between property that is created or otherwise reduced to something valuable through the efforts of the taxpayer, and property that is received by the taxpayer from another party.

This distinction is so seldom worthy of notice that its most cogent treatment in recent literature arises from a distinct tax puzzle. This latter tax puzzle concerns the propriety of taxing some property when it is found or falls into one’s lap versus taxing it when and if it is later sold or exchanged. The classic example is the record-breaking home run baseball. The lucky taxpayer who catches the million-dollar ball — and under national pastime common law therefore owns it — is, experts reluctantly agree, on the hook for its market value come tax time. This is true even if the taxpayer intends to keep the ball to play catch in the backyard.

In an article about the taxation of baseballs and other found property, professors Lawrence A. Zelenak and Martin J. McMahon Jr. argue that such property should not be taxable on receipt except when it is cash. Their conclusion is that the rules on found property should be changed. In support, Zelenak and McMahon note IRS enforcement priorities, as well as regulations that allow for the deferred taxation of, for example, minerals discovered in the earth and fish found in the sea.

In response, professor Joseph Dodge argues that true windfalls from found property should indeed be taxed on receipt, or at least when the finder’s property rights become clear. Zelenak and McMahon’s mistake, according to Dodge, is that many of their examples of found property are better understood as economic activity involving the creation or taking of valuable property. For property obtained through that activity, taxation is indeed proper at the time of disposition, not acquisition:


\[96\] Specifically, Zelenak and McMahon question the so-called treasure trove regulation, reg. section 1.61-14, which provides: “Treasure trove, to the extent of its value in United States currency, constitutes gross income for the taxable year in which it is reduced to undisputed possession.”

In the context of a commercial venture, the “taking” of business inventory, such as fish, game, gold nuggets, manganese nodules, native copper, diamonds, truffles, and the raising of sunken treasure from the sea, as well as the “creating” of inventory, such as art or craft works, are similar to the conventional manufacturing of inventory or the raising of crops by a farmer, as far as investment of capital and labor is concerned. Self-obtained property entails some investment of capital, whether it be in raw materials, supplies and equipment, the labor of others, or transportation. Investment does not give rise to income until gain is realized. . . . That inventory may be produced in stages (as in manufactured or self-created inventory), purchased intact, or “harvested” intact (as in “taken” inventory) sets out distinctions without a tax difference. Looking at the venture as a whole, the actual obtaining of the inventory, by whatever techniques, is not an “end” but rather a “means” (or opportunity) to earn a profit. The sale of the inventory, not the obtaining of it, is the realization event.

Realization of inventory gain is the culmination of the inventory accounting cycle. Section 263A (subject to various exceptions) requires capitalization with respect to property that is either “produced” or “acquired for resale.” The term “produced” includes “develop,” “create,” “raise,” or “grow,” and the term “acquire” is broad enough to encompass “find,” “discover,” “take,” “harvest,” and the like. Similarly, the taxation of natural resources assumes that gross income is realized when the minerals are sold or royalties are received, not when the minerals are acquired or extracted. . . .

Treating self-obtained inventory uniquely as gross income at the time of acquisition would be the equivalent of a one-time marking of such property to market, in contrast to wage income or gains from property created or acquired as the result of investment of capital and/or labor. But, if “self-obtaining” should be a realization event, why would not the acquisition of the right to produce or acquire such property (in the form of a license, lease, contract right, mineral claim, salvage permit, etc.) also be a realization event? But neither approach makes sense, unless there is a good reason to single out self-obtained inventory for more burdensome taxation than “conventional” purchased or manufactured inventory.98

Dodge’s arguments apply directly to the treatment of cryptocurrency block rewards even though he is approaching the issue from a different direction. For Dodge, the question is whether something is windfall found property or “treasure trove” that should be taxed immediately,99 or else created or self-obtained property that should be taxed later. In our case, the question is whether block rewards are compensation for services or some other type of immediately taxable income, or else created or self-obtained property that should be taxed later. The answer is the latter option if block rewards are better viewed as created or self-obtained property akin to Dodge’s examples of fish, gold, artwork, and so on.

D. Validators Create Reward Tokens

This is indeed the argument: Cryptocurrency tokens received as block rewards should be viewed as created property, and in the hands of those who create it, that property should not be treated as income until it is sold or exchanged.

The argument that reward tokens are created is straightforward: All property that previously didn’t exist as such was created at some point. Almost equally straightforward is the argument that reward tokens are created by those who

98 Id. at 697-698 (footnotes omitted).
99 There is no credible argument that cryptocurrency block rewards are treasure trove or any kind of windfall property. Bitcoin and Tezos reward tokens are not stumbled upon; they are the result of intentional, productive, and typically ongoing activity requiring the commitment of resources. Similarly, despite the conventional use of “rewards” to describe these tokens, there is no credible argument that they are prizes or awards whose market value would be gross income under section 74(a). See reg. section 1.74-1(a)(1).
maintain the network. Validators create new blocks in the blockchain. Who else could it be? Just the same, validators create new tokens. If all validators turn off their computers, token creation ceases. In Tezos, the baker who misses the opportunity to bake a block creates neither a block nor new tokens, and no new tokens are created until and unless the next baker in line — or the next in line after that — succeeds in signing a valid block.

In the case of Tezos endorsements, the fact of creation is just as stark. Up to 32 validators can create two reward tokens apiece by correctly endorsing a block. But if a validator fails to validly endorse a block, that endorsement slot goes forever unfilled, and for that block fewer than the maximum of 80 tez are created. It is the same with Bitcoin: New bitcoins are not created until and unless a miner succeeds in producing a solution to a cryptographic puzzle. This happens every 10 minutes on average but can take longer than that, and it will never happen if all miners turn off their computers.

The argument that reward tokens are not property created by validators would emphasize the network and the human-created rules within which the creation of tokens occurs. Without this network, the argument goes, individual validators’ actions are unimportant. Under this argument, tokens are the result of a team effort, like a partnership of sorts, so the better metaphor is that the network creates the tokens and distributes them to validators. And just like that, we are back to a discussion of barter compensation and whether tokens should be taxed like dividends or other distributions.

Tokens might derive their value from the network and the scarcity and security that come from its rules, but tokens’ value is an issue separate from who creates them. A single entity can indeed create tokens, and they might even be valuable. If they’re valuable, it’s because the tokens’ users and potential users find them valuable. But as examples of tokens created by a single entity show, no one would think to tax those tokens as income until their creator sells or exchanges them.

If the tokens’ creator is the central bank of a sovereign nation that requires their use in tax payments and in the state-enforced settlement of debts, the tokens likely will be valuable. This, of course, is called a currency, and special rules apply.

If the creator is you or me, our creation of new tokens might be met with skepticism. Indeed, perhaps no one will want them. But if we mint copper tokens that are especially attractive, we might find buyers at collectibles fairs and among the customers of the Franklin Mint. We might stimulate demand if we credibly commit to limiting the total supply. If we’re lucky, a secondary market will emerge, and with it a market price. If we pledge to smash the dies once 1,000 tokens have been struck, we could even create new tokens in batches depending on demand and then sell them from our inventory at the market price. When we mint 10 new tokens to be ready once the orders roll in, there is no credible argument under existing law that these tokens are income at their market price.

Minting copper tokens is expensive, and trading them is slow and cumbersome. They’re heavy and might even be counterfeited. If we want to make lots of tokens — say, billions instead of hundreds — we could create digital instead of physical ones. As with the copper tokens, we could create new tokens according to demand, but again, it might be important to limit the supply. If we can credibly commit to stop making new ones once the limit is reached, the tokens are more likely to be valuable because of their scarcity. If we create new tokens periodically and then sell them over time, as with the copper tokens, there is no credible argument that these newly minted tokens are income when they are created.

To stimulate demand for these digital tokens, we could build and maintain a global network so that individuals, businesses, and banks could trade and transfer them among themselves over the internet, instantly and at very low cost. We could make these digital tokens in batches, but we could also decide to make them all at once. Perhaps we create 100 billion of them in one fell swoop, and do so in a way that we can publicly

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100 There is about a 95 percent chance that a Bitcoin block will be created within a half-hour. A successful miner can also create fewer than the allowed number of bitcoins, as happened with Bitcoin blocks 124,724 and 526,591.
prove that no more can ever be created. Until those tokens are actually sold, however, clearly our private treasury is not income.

This example is drawn from the digital asset called XRP, previously known as Ripple. In 2013 the Ripple network was launched following the creation of 100 billion of these tokens. The total value of the digital assets on this network is usually given as the product of the market price for an XRP token (currently about $0.25) and the circulating supply. Today the circulating supply of XRP is about 43 billion tokens, giving XRP a value of more than $10 billion. The remaining 57 billion XRP tokens are owned by Ripple Labs Inc., based in San Francisco. The company periodically adds to the circulating supply by selling XRP tokens from its reserves. In 2018 it sold $535.56 million worth.

Once again, there appears to be no basis in existing law for recognizing those tokens as income until their creator sells or exchanges them.

To distinguish the example of Ripple and every other digital asset that is created before its exchange or distribution results in a taxable gain, we would need a story that explains why having multiple parties create tokens is different from having one party do it. We know why public cryptocurrencies like Bitcoin and Tezos do this: It’s one part of a strategy to keep the network secure. In relying on a number of validators who create tokens in the course of maintaining the network, public cryptocurrencies are trying to ensure that no single party (or small group of parties) can undermine the network’s security. It is not clear why this arrangement would create income when there is none in the case of a single token creator. It is true that Ripple Labs doesn’t know how much its 57 billion XRP will be worth when they are traded for dollars. But the same applies to tokens created by Bitcoin miners and Tezos bakers.

Validators do indeed create tokens, but note that we need not lean so heavily on the notion of creation. If miners do not create bitcoins or gold, it is fine to say that they discover them, and it shouldn’t matter for taxation that a particular Bitcoin block or gold lode was bound to be discovered eventually. A trapper does not create fur-bearing mammals, but the fact that a competitor might have trapped a particular animal first, or even would have trapped it eventually, does not sully the successful trapper’s claim to his new property or render it income when it was taken. However we characterize cryptocurrency mining, baking, minting, and forging, what matters for reward tokens is that no one else owned them first, so that the tokens are not received from another party in a way that would render them compensation or payment (from whom?) or some other form of immediate income.

One might ask: If the metaphor of created or self-obtained property is so powerful, why has it not yet won the day? After all, the metaphor of mining tokens is as old as Bitcoin and is an apt description of the Bitcoin validator’s quest, and Bitcoin and its groundbreaking technology continues to dominate the popular conception of a public cryptocurrency. But as discussed in Section VI.A, when it comes to taxation, the analogy to corporate distributions and other forms of compensation is more convincing when applied to proof-of-work mining rewards. Beyond this, cryptocurrency simply looks a lot like money, and it is an argument of this section of the report that the distinction between received property and created property is overlooked and understudied because the need for the distinction arises so rarely. Cryptocurrency revives that distinction. The following discussion examines existing law on created or self-obtained property for further insights into the proper taxation of reward tokens.

102 Ripple, “Market Performance.”
104 “Minting” and “forging” are two other terms sometimes used to describe validation and the creation of new blocks and rewards, particularly in proof-of-stake cryptocurrencies.
105 This concept of first ownership is suggestive and might lead to a helpful account of new property such as cryptocurrency that is properly taxed at its disposition. But note that property acquired from others is also routinely taxed only at its later sale, as with ordinary business inventory. Even with property that is lawfully found or taken, the finder or taker is not always the property’s first owner, or even the party with the strongest rights in the property. This latter issue bears on the tax treatment of treasure trove. See, e.g., Dodge, supra note 97, at 687 (discussing the claim of right doctrine).
E. Created Property and the Realization of Income

Dodge, focusing on windfall found property, did not explore the line that distinguishes created property from property received from some other party as compensation. But he did observe that important (if rarely confronted) issues arise from the treatment of property as income, and the distinction between created and received property is implicit in each example he cites and in countless others.

Fish, gold nuggets, artworks, and so on can be income, but they generally are not income in the hands of those who catch, pan, or paint them. As Dodge explains it, “in the case of self-created property, income is not realized until the self-created objects are sold.” Dodge presents this point as obvious, but it is worth noting that this treatment of self-obtained property cannot be gleaned from any single rule or provision of the tax code. Zelenak and McMahon, for their part, also argue in support of “the universal understanding that self-created property is not taxable unless and until it is sold,” but they, too, do not ground this understanding in positive law.

The uniform capitalization (UNICAP) rules in section 263A support this understanding that created property is not income until sold. But these are rules on how specific taxpayers must account for specific business expenses concerning the sale of specific property. They assume, but do not define, a universe of created or self-obtained property, and they do not fix the circumstances under which that property generally is, or yields, gross income.

The UNICAP rules say that for taxpayer-produced property, the term “produce” includes “construct, build, install, manufacture, develop, improve, create, raise, or grow.” Notably, however, these accounting rules apply only to “real property or tangible personal property produced by the taxpayer,” so it would be difficult to argue that cryptocurrency tokens are property included in the rules.

The closest we have to a principle determining the proper timing of property’s taxation is the general rule that a gain must be realized before it may count as income. When the law is otherwise silent on the matter, creators of property are unlikely to think they’ve got income until they’ve converted the property to cash or something else of value. But this is more common sense than it is the application of a rule. The so-called realization requirement describes common practice, but as a rule it is of dubious assistance; the requirement is not self-explanatory. As Dodge and many others have noted, realization could be deemed to occur at any of several stages. Mineral wealth could be realized and taxed when the minerals are located, or when the permit for their extraction is granted. Wheat could be taxable income at the moment of its harvest. Fish could be income when pulled from the sea.

When regulations or legal decisions do speak to the realization of income from created or self-obtained property, it is usually to clarify that realization occurs at the property’s sale or

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106 See id. at 688.
107 Id.
108 See Zelenak and McMahon, supra note 95, at 1306. Note, however, that they later comment that “self-created cash — if such a thing were possible — should be taxable.” Id.
109 Section 263A concerns business expenses that may not be deducted on an ongoing basis and instead must be capitalized or included in inventory costs to align the eventual income with the expenditures that give rise to that income. It does not apply to most small businesses. See sections 263A(i)(1) and 448 (exempt if less than $25 million in annual gross receipts).
exchange. Several examples provide insight on the proper tax treatment of block rewards.

1. Crops, crop shares, and shared block rewards.

Crops do not generate income until they are sold or exchanged, according to reg. section 1.61-4. And in a rule that’s relevant to the division of block rewards between delegators and validators, the regulation further provides that “crop shares (whether or not considered rent under State law) shall be included in gross income as of the year in which the crop shares are reduced to money or the equivalent of money.” Crop shares, in other words, are not taxable compensation when the tenant receives the crops, just as the landlord’s crops are not income when they are harvested.

In Tezos, block rewards are shared among delegators (whose stake determines validation opportunities) and bakers (who manage the accounts that actually sign blocks, put deposits at risk, and initially take possession of the reward tokens). A similar dynamic exists in other proof-of-stake protocols and also in proof-of-work validation, where mining pools allow smaller miners to reduce the volatility of mining by sharing in the rewards generated by the pool’s participants, proportionate to the computing power lent to the effort, minus a fee deducted by the pool operator.

Legal commentators will likely suggest that the tax treatment of rewards is complicated by this delegator-delegate relationship. The example of sharecropping — and no doubt many other uncodified examples of parties divvying up the (proprietary, noncash) spoils of their productive contributions — suggests that established tax principles can equitably and parsimoniously account for the conventions that enable the dispersed participation in network maintenance that is required to maintain network security. Tax lawyers might welcome the work that comes with the risk of unintended legal partnerships, but hopefully our assistance won’t be required. If absolutely necessary, no doubt cryptocurrency designers could adjust the underlying code to ensure that validation doesn’t trigger undesirable legal entanglements.  


The example of livestock is also illuminating. The birth of new property is generally not a taxable event. In proof of stake, tokens have the potential to beget new tokens. These new tokens, it has been argued here, should not induce tax liability at their inception. A common, if generally dismissed, concern with taxation of property is taxpayer liquidity: Taxes, nowadays, must be paid in dollars. If block rewards, new calves, or even stock dividends create a tax liability, their owners might not have the money to pay. Owners of publicly traded equities garner little sympathy on this count. But forcing ranchers to sell in order to pay could interfere with the economic cycle of livestock and with those business owners’ strategy for replenishment and growth in a way that, for example, taxing gold on its discovery would not. Unsold gold nuggets don’t yield more of themselves. Heifers and tokens in proof-of-stake cryptocurrencies can.

The livestock analogy is important for a related reason, which is the favorable long-term capital gain treatment of some raised livestock. This report largely skirts the issue of the type of

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118 In Tezos, reward tokens first appear in the account of the baker who signs the transactions, who then relays tokens to delegators according to whatever agreement the baker and delegator might have. For example, if the baker’s initial possession of those tokens is deemed a fact of unavoidable legal significance, presumably the protocol could be amended so that the delegator receives the tokens directly. We should hope, however, that such influences on protocol design are not inevitable, just as a deflationary token supply should not be required to ensure equitable taxation (see Part I, at Section III.F). Cryptocurrency designers should focus on network security, not taxation policy.

119 Gross income for the cash accounting rancher includes “the amount of cash and the value of merchandise or other property received during the taxable year from the sale of livestock... which he raised.” Reg. section 1.61-4(a)(1). For the small minority of farmers and ranchers that use an accrual method, the year-end inventory value of raised livestock can contribute to the calculation of gross income (see reg. section 1.61-4(b)), but it remains true that the birth of livestock is not a realization event. See also Strong v. Commissioner, 91 T.C. 627, 632 n.7 (1988).
gain or loss that might be realized on the sale of reward tokens. Its primary concern is when reward tokens should be taxed, to ensure that gains and losses are correctly determined and to avoid excessive compliance burdens. But gains treatment is an important issue, and not just because taxpayers tend to prefer lower taxes.

Token holders today do expect that cryptocurrency is, in most cases, a capital asset, just as “stocks, bonds, and other investment property are generally capital assets.” But created or self-obtained property is often treated as inventory the sale of which yields ordinary and not capital gain, introducing the possibility that reward tokens, unlike purchased tokens under current guidance, could be subject to different taxation.

Livestock taxation — and the reasons for it — strengthen the case for the capital asset status of all tokens, even for taxpayers who create new tokens as a business. All property is a capital asset unless the law says it isn’t, and section 1221(a)(1) carves out a large exception for business inventory. It provides that the legal term “capital asset” does not include:

stock in trade of the taxpayer or other property of a kind which would properly be included in the inventory of the taxpayer if on hand at the close of the taxable year, or property held by the taxpayer primarily for sale to customers in the ordinary course of his trade or business.

Accordingly, livestock raised for sale yields ordinary income when sold. But livestock that is held for use in the farmer’s or rancher’s business can be treated as a capital asset. This exception to the general treatment of farm and ranch income is most commonly applied to breeding animals, and it means that the cows that produce more cows for the same owner are subject to long-term gain treatment if they are later sold. Finally, the costs of raising breeding stock are ordinary operating expenses, deductible in the year expended. This means that with raised livestock, the capital gains tax rate applies to the full sale price of the animal.

Like the rancher’s raised replacement heifers, reward tokens add to a validator’s (or delegator’s) stake and thereby produce additional block rewards, replenishing their owner’s stake against the effects of dilution. The rationale behind the capital asset status of breeding livestock thus also supports the capital asset status of proof-of-stake block rewards.


As noted, gross income from mined minerals is realized at the time of their sale, not when they are claimed or extracted from the earth. Generally, the cutting of timber is not a realization event, though a farmer may elect to treat it as one in some circumstances. In some cases timber can also be a capital asset subject to long-term gain treatment. Tax guidance for fishermen has even

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120 This report also does not address the question of tokens’ cost basis for the purpose of establishing taxable gains and losses. The recent IRS guidance presents a default rule of “first in, first out,” with an option for taxpayers to identify specific units of cryptocurrency that are sold. IRS FAQ at Q-36 – Q-38; see also James T. Foust, “A Duty to Answer: Six Basic Questions and Recommendations for the IRS on Crypto Taxes,” Coin Center, at 11-17 (Apr. 2019).
121 If reward tokens are taxed only on their sale, the simplest option for most taxpayers would be for reward tokens to have a tax basis of zero, which would follow the example of raised livestock held for breeding purposes, which have a tax basis of zero for those using a cash basis of accounting. See infra discussion at note 126 and accompanying text; see also Gary Bredensteiner, “Income Tax Issues Related to Scaling Down or Liquidating a Beef-Cow Operation,” C96-1301-A, University of Nebraska-Lincoln Extension (1996). Animals, of course, are not fungible, while with cryptocurrency fungibility is a more complicated issue.
122 Notice 2014-21, Q-7.
123 Id.
124 Section 1221(a)(1).
125 “Livestock used in farm business. If livestock is held primarily for draft, breeding, dairy, or sporting purposes, it is used in your farm business.” IRS Publication 225, “Farmer’s Tax Guide,” at 53 (2018).
126 Provided that the property is held long enough. To qualify, horses and cattle must be held for two years; “hogs, mules, donkeys, sheep, goats, fur-bearing animals, and other mammals” must be held for one year. Id.
127 See reg. section 1.61-4(a) and (b); section 263A(d)(1)(A)(i); and reg. section 1.263A-4(a)(2). See also Bredensteiner, supra note 120. As noted earlier, the issue of tokens’ tax basis is beyond the scope of this report, but the livestock example provides a rationale for a simple approach to zero-basis reward tokens.
128 Reg. section 1.61-3(a).
129 Section 631(a) (“Election to consider cutting as sale or exchange”). See also IRS Publication 225, at 54 (2018) (“Under the general rule, the cutting of timber results in no gain or loss. It is not until a sale or exchange occurs that gain or loss is realized.”).
130 “Standing timber you held as investment property is a capital asset. Gain or loss from its sale is capital gain or loss reported on Form 8949 and Schedule D (Form 1040), as applicable. If you held the timber primarily for sale to customers, it is not a capital asset. Gain or loss on its sale is ordinary business income or loss.” Id.
mentioned that gross income is calculated as the proceeds from fish “caught and sold during the year.”

Most examples of created or self-obtained property escape explicit treatment in the code and regulations simply because there is no argument that they should be taxed sooner than their sale. Viewed from some angles, cryptocurrency tokens are computer code or a form of intellectual property. Valuable as they may be, these forms of property are also not taxed when they are created.

Although the IRS does not view cryptocurrency as real currency, no doubt cryptocurrency’s money-like properties encourage the view that block rewards are income when received. But when cryptocurrency’s status as property is taken seriously, reward tokens can be seen as just another form of created or self-obtained property that, usually without controversy, is properly taxed only when it is sold or exchanged.

VI. Bitcoin and Proof of Work Revisited

If block rewards are created property, this should be true whether validation opportunities are distributed according to proof of validators’ work on the network or proof of validators’ stake in the network. But as mentioned in Part I, there are reasons that taxation policy is less critical in Bitcoin than it is for Tezos and proof of stake. As Dodge noted, “Treating self-obtained inventory uniquely as gross income at the time of acquisition would be the equivalent of a one-time marking of such property to market.” For Bitcoin, the burdens of this approach are smaller and affect a smaller fraction of token holders than in Tezos and other proof-of-stake systems.

A. Dilution in Bitcoin and Proof of Work

As a practical matter, mining has ongoing costs, and an annual tax bill is just another expense. This one-time mark to market also simplifies the question of capital asset status. New bitcoins, once marked to market at the time of their creation, can presumably qualify for capital gain tax treatment after a year. Once gross income from new bitcoins is adjusted by allowable deductions and taxed, all bitcoins become equal and are capital assets that can be held without triggering further taxable events. Only a small minority of Bitcoin users have income from mining, so the burdens of ordinary income taxation fall only on a few. We should also acknowledge the reality that although reliable statistics are scarce, mining can be done anywhere on Earth, and most takes place beyond the reach of the IRS.

But more important, the structure of Bitcoin means taxation upon creation is less distortionary than it is for proof-of-stake reward tokens. It is important to understand why this is true, because the explanation is not that proof-of-work systems are immune to the effects of dilution. Bitcoin does indeed work the same way as any system based on the creation of new tokens: These new tokens necessarily distribute stake away from all token holders and to miners. But with proof of work, and especially Bitcoin, this effect is obscured for several reasons.

First, with Bitcoin the dilution effect is obscured because of the cryptocurrency’s finite token supply and its unique token creation schedule. Bitcoin came into existence in January 2009 with 50 tokens on its network, and the supply has since grown solely through the block rewards created approximately every 10 minutes. In its first four years, about 10.5 million bitcoins were created. As set by the original blueprint, bitcoin creation then halved, and each four years halves again. Initially each block introduced 50 new bitcoins; today it is 12.5, and

131 Notice 2014-21, Q-2.
132 Part I, at Section II.C.
133 Dodge, supra note 97, at 698.
134 In proof of stake, delegators and even “home validators” may have no ongoing expenses beyond the required initial investment of tokens, or at least no expenses worth the time and effort to account for.
135 Christopher Bendiksen, Samuel Gibbons, and Eugene Lim, “The Bitcoin Mining Network: Trends, Composition, Marginal Creation Cost, Electricity Consumption and Sources,” CoinShares Research, at 6 (Nov. 26, 2018) (estimating that up to 60 percent of Bitcoin mining takes place in China).
136 Tezos, in contrast, began with 764,317,931 tokens when its first block was published June 30, 2018. See tzstats.com.
137 Bitcoin wiki, “Controlled Supply.”
sometime in May 2020 it will drop to 6.25. If the schedule persists, the last fraction of a bitcoin will be created sometime in the year 2140, and no more than 21 million bitcoins will ever exist. According to Bitcoin’s inventor, at that point any financial incentive to validate transactions could be supplied by transaction fees.\(^{138}\)

Because of this staggered, disinflationary, and finite creation schedule, Bitcoin is not conveniently described in terms of a token creation rate.\(^{139}\) But Bitcoin is like any currency or cryptocurrency whose value is not pegged to some other form of property like gold or the U.S. dollar; its value is determined by facts and perceptions about supply and demand. Those who establish Bitcoin’s value indeed do so against the backdrop of its scarcity, both today and as expected into the future. For Bitcoin, this year’s creation rate is just one consideration,\(^{140}\) and because of its 21-million-token cap, one is as likely to hear bitcoin holders define their stake in terms of the token cap as against the current supply of about 18 million.

But if Bitcoin’s supply were not finite and instead continued to expand forever at the rate of, say, 12.5 bitcoins per block, taxing these new bitcoins at their creation would still be less problematic than for a comparable proof-of-stake system. The reason is that miners need not own tokens to mine new ones.\(^{141}\)

Dilution is a feature of the cryptocurrency incentive structure. It is the price paid for network maintenance, but different cryptocurrencies impose this cost on different constituencies. In proof of work, the cost is borne by all token holders — or, more precisely, by token holders who are not also miners. In proof of stake, the cost is borne by token holders who do not participate in validation.

This difference means that in proof of work, the effects of dilution are not magnified by any quirks of taxation policy. But this difference also means that in proof of work, the effects of dilution are indeed magnified for the constituency that should care the most about dilution: token holders. The effect of dilution on token holders is discussed in the next section; first, the taxation issue.

To maintain a consistent stake in a proof-of-work cryptocurrency, one must buy more tokens or expend resources to mine one’s own. The miner concerned with the dilution of his new tokens is free to immediately sell them without affecting the ability to mine more in the future. Proof-of-work token holders, like non-validators in proof of stake, see their stake eroded by dilution, but in both cases this has no adverse annual tax consequences beyond the effect that unrealized losses have in any situation involving dilution.

The analogy to corporate distributions is helpful. Proof-of-stake block rewards such as in Tezos look a lot like stock dividends (or, more accurately, like distributions that return capital and sometimes provide a gain\(^{142}\)), while proof-of-work block rewards look a lot like stock distributions made to vendors that provide services to the corporation. New shares in a corporation distributed to a vendor are that vendor’s gross income at FMV of the shares when received.\(^{143}\) Leaving aside the flaws in the corporation analogy,\(^{144}\) just as new shares distributed to vendors dilute all shareholders, the new tokens received by proof-of-work miners dilute the stake of all token holders. Unlike most corporations, of course, cryptocurrencies don’t have much say in the matter; they never have cash to distribute. If a cryptocurrency is paying too

\(^{138}\) See Satoshi Nakamoto, “Cryptography Mailing List” (Jan. 8, 2009). Network transaction fees, which are paid in tokens by those who initiate transactions on the network, are typically received by those who validate the transactions. Transaction fees are a way to secure the network (for example, against network-clogging spam transactions) and to harness market principles to prioritize higher-value transactions. As a more or less direct payment to validators, those fees are likely income under current law. In terms of the administrative costs of income taxation, this is an inconvenient fact about cryptocurrency, but relief might require a legislative solution.

\(^{139}\) Six months into Bitcoin’s existence, its token creation rate for the ensuing year was 200 percent. Two years into its existence, the token creation rate for its ensuing third year was 50 percent, equivalent to the creation rates used the hypothetical Standard Oil Coin and Hardship Coin cryptocurrencies in Part I (Part I, at Section III); see “Controlled Supply,” supra note 137.

\(^{140}\) The bitcoin creation rate is currently about 3.7 percent. Id.

\(^{141}\) As an aside, it is important to note that because proof-of-work reward tokens are not tied to a miner’s stake, mining rewards are not susceptible to misleading characterization as interest or dividends awarded as a percentage of the miner’s holdings.

\(^{142}\) See the discussion of sections 316 and 301(c), supra Section V.A.

\(^{143}\) Section 61(a)(1); reg. section 1.61-2(d) (“compensation paid other than in cash”); and section 83 (“property transferred in connection with performance of services”).

\(^{144}\) See supra Section V.A.
much for its network’s maintenance in the form of excessive dilution, victims of that dilution have a complaint with the cryptocurrency’s protocol.

Analogizing Bitcoin mining rewards to corporate distributions made to vendors is not unreasonable, and perhaps it explains the IRS’s announcement in Notice 2014-21 that it views those rewards as income when received. But this does little to undermine the notion that new tokens are best viewed as created property, whether they are created by proof-of-stake validators, proof-of-work miners, or entrepreneurs who manage to create a scarce and valuable supply of tokens through other means. As with any other form of created property, Treasury will be able to impose its tax when the property is sold or exchanged.

Previously, this report established that Treasury does not have a strong argument to tax proof-of-stake block rewards immediately because block rewards are zero-sum: Validators’ gains are limited to non-validation losses. Net income from a sale or other taxable event involving cryptocurrency is limited to the appreciation of the cryptocurrency network’s value over the taxpayer’s basis. Of course, Congress might like to tax capital gain sooner rather than later, but unlike the case of corporations shielding accrued profits from taxation, there is no special justification for doing so here.

It is true that the injustice of this approach is salient only when the taxed gains and unrealized losses are held by one and the same taxpayer, as in Tezos and proof of stake. But it remains true that miners’ gains are paid for by non-mining token holders through dilution. Deferring the taxation of proof-of-work gains until the time of the tokens’ sale preserves this symmetry. And as a practical matter, miners tend to liquidate their reward tokens to pay their expenses, while the token holders who pay for miners’ profits tend to hold their diluted tokens longer. In practice, Treasury will still get the advantage of immediately taxable gains and the deferred recognition of token holders’ losses.

B. Proof of Stake Versus Proof of Work

Taxation issues aside, the effects of dilution are magnified in proof of work because the costs are borne by all token holders. This is an important consideration in the comparison of the two methods of allocating network maintenance opportunities.

Dilution occurs in both proof of stake and proof of work, but in the latter there is the added cost of the “work” on the network that serves to allocate the opportunity to create blocks and block rewards. The example of Ethereum is instructive here. Ethereum is the second largest cryptocurrency measured by network value, behind only Bitcoin. Unlike Bitcoin, under its proof-of-work system, new Ethereum tokens (ether) are created without a cap.\(^{146}\) Under the current incentive structure, about 13,400 new ether are created each day.\(^{146}\) Applied to the total ether on the network, this translates to a token creation rate of about 4.8 percent.\(^{147}\) Ether holders who do not mine or buy additional tokens will see their stake diluted at the rate of 4.58 percent.\(^{148}\)

As mentioned, this work is expensive, and necessarily so. Mining new tokens is predicated on the irrevocable use — some call it transformation — of real-world resources, because miners pay manufacturers for computer hardware and power companies for electricity. If the network increases in value, so does the value of a block reward, making mining more expensive as the greater reward justifies greater expenditures. With proof-of-work systems, the resource costs of mining are the most visible cost of new tokens, which can further obscure the costs imposed by dilution.

This applies with special force to cryptocurrencies like Bitcoin that are predicated on a cap on the number of tokens that will be created. At present these cryptocurrencies rely on dilution to fund network maintenance, but the cap simultaneously serves as a salient conceptual limit on the future costs of dilution. However,

\(^{145}\) Note, however, that since Ethereum’s inception in 2014, its token creation rate has been reduced twice, and the network’s developers are preparing for a transition to a proof-of-stake system that is expected to further reduce the token creation rate. See EthHub, “Monetary Policy.” As with any cryptocurrency, predictions about future token supply will inform present valuations.

\(^{146}\) ConsenSys, “The Thirdening: What You Need to Know” (Jan. 10, 2019).

\(^{147}\) Id.

\(^{148}\) \(D = (1 - (1/(1 + T)))\). If the token creation rate \(T\) is 0.048, the dilution rate \(D\) is 0.0458. See Part 1, Section III.B.2.
dilution pays for network maintenance. So who will pay when block rewards slow to a trickle and then stop? As noted, one solution is for cryptocurrencies to fund their maintenance with transaction fees. But there is reason to fear that transaction fees might not pay for adequate network security. Using the kitty metaphor, with Bitcoin today, all token holders are forced to put tokens into the kitty, and miners get to take them back out. When the cap is reached, token holders are no longer forced to contribute to the kitty; they contribute only when they make a transaction. A token holder can reduce his costs by forgoing transactions, thus increasing the per-transaction cost of network maintenance and further discouraging the use of the network that is required to pay for its maintenance.

As has been stressed in this report, there are several methods to structure the funding of network maintenance. Some are more elegant than others, some sit better with our prior assumptions about how money and finance should work, and — if we’re not careful — some will be taxed unfairly based on their form rather than their function. The idea of a token cap is attractive to many, perhaps because it appears to counter the threat posed by more obviously human institutions such as central banks, with their history of politically expedient inflation. If the metaphor of a fixed money supply is truly valuable to the humans whom cryptocurrency is intended to serve, it could be achieved by directly taxing token holders to fund the validators’ kitty. Just like inflation, however, a highly visible tax on wealth is anathema to many. But one way or another, network maintenance must be paid for.

Reliable statistics are again hard to come by, but presumably mining is profitable. Whatever the miner’s profit margin, the hardware and electricity expended in mining contribute to the total cost of maintaining the network. This makes proof of work more expensive than proof of stake, but that’s not all: In proof of work the barriers to entry are relatively high. Mining takes effort and, more importantly, capital, and there are returns to scale, which encourage larger mining operations. Accordingly, most proof-of-work token holders don’t mine. Although it is an exaggeration, it is helpful to imagine that token holders and miners comprise two distinct classes. Token holders as a class — the ones who hold and use the cryptocurrency, and who therefore prefer to pay as little as possible for the privilege — are the ones who pay for the maintenance of the network through dilution. Holders benefit from having a network that works, but only miners (and their hardware and electricity suppliers) directly benefit from the creation of new tokens. Holders are not taxed on any imaginary gains, but that is not because of tax policy. It’s because the structure of proof of work prevents those token holders from offsetting the costs imposed by dilution.

In proof of stake, in contrast, the barriers to entry are relatively low. Tokens replace the investment in hardware and electricity required in proof of work. Aside from the cost of these tokens, validation is not particularly expensive. As also shown by Tezos, the delegation model further reduces the costs of participating: Today a token holder can get 90 percent of the benefit of being a validator by delegating tokens to a professional baker who keeps 10 percent of the rewards as a fee. Proof of stake thus does a better job enabling token holders — the ones who care about maintenance costs — to minimize the effects of dilution and therefore reduce their cost of participating in the network. Network maintenance costs, in other words, are distributed more equitably in proof of stake than they are in proof of work. Proof-of-stake technology eliminates costly computer work and shifts the responsibility for network maintenance to the token holders themselves. It would be ironic if this eco-friendly innovation came at the cost of an unreasonable taxation policy.

149 See supra note 138.
152 Whether the resources consumed in proof of work provide a degree of increased network security that justifies the higher costs imposed on token holders is beyond the scope of this report, but is a question well worth examination.
Ultimately, most differences between proof of work and proof of stake, as they concern taxation, disappear on close examination. The conspicuous overtaxation of proof-of-stake rewards under Notice 2014-21 results from the requirement that validators own tokens in order to create new ones, which overstates the gains from validation. But in both proof of stake and proof of work, under Notice 2014-21, Treasury gets the benefit of immediate taxation of validators’ gains while also capturing the benefit of the deferred realization of token holders’ losses from dilution. This disparate treatment is not easily justified. And in both proof of stake and proof of work, the problem is solved by viewing reward tokens as created property properly taxed at their sale or exchange.

VII. Conclusion

Despite the novelty of cryptocurrency, the taxation of block rewards should be relatively straightforward. Reversing the order of this report’s two arguments, reward tokens are new property created by the validators who are the first to own them. Like the initial owners of other forms of created or self-obtained property — including, without controversy, the creators of other digital assets such as Ripple’s XRP — those who participate in network maintenance should not be taxed when the reward tokens are created. To argue otherwise requires a compelling story about the uniqueness of reward tokens and why they should be singled out for special treatment among the universe of created property. Or it requires a story that shows tokens are not created by validators and are instead akin to corporate distributions, or are a new type of barter compensation, or are some new species of income “from whatever source derived.” To date, no such story has been forthcoming. Presumably, Notice 2014-21 is based on a theory of barter compensation or an analogy to corporate or partnership distributions, although the notice’s careful omission of the source of Bitcoin miners’ gross income is itself noteworthy.

To be fair, the novelty of cryptocurrency makes a novel theory of income seem plausible. Cryptocurrency looks a lot like money, and from different angles it looks like a lot of things. On examination, however, the novelty of cryptocurrency argues in favor of traditional “created property” treatment, not against it.

Counting block rewards as gross income when received renders total gross income a function of the token creation rate without regard for validators’ true gains. In both proof of work and proof of stake, token holders should not pay more than necessary for network security, but this is a challenge for cryptocurrency designers. A token creation rate should indeed be arbitrary from the perspective of taxation.

With its low barriers to participation in validation, proof of stake is designed to reduce the importance of the creation rate by allowing the participation rate to fluctuate, with minimal friction, in response to market factors. Proof of stake also eliminates the competitive consumption of real-world resources to allocate validation rights. This makes network maintenance more efficient, but under Notice 2014-21, the reward for this innovation is the overtaxation of validators. For proof-of-stake validators who hold on to their stake and continue to create new blocks and block rewards, taxing reward tokens at their value when received will always overstate the gains from validation. With Tezos, the gain from validation is overstated by more than 350 percent. As shown in Figure 2, as participation in validation gets closer to 100 percent, the disparity intensifies as validators’ actual gains approach zero and their gross income approaches the token dilution rate. The dilution rate is a function of the creation rate, which is established by cryptocurrency designers to maximize security at a reasonable cost to token holders. The goal of token creation is not to enrich validators at the expense of non-validators, and the token creation rate should not determine taxable income.

Using the kitty metaphor and the example of Tezos, the challenge for taxation is to tax the validator on her two tokens of actual gain, not the seven tokens she took from the kitty. Existing law provides a number of methods to ensure that an amount of money or property is properly adjusted before it’s subjected to taxation. This report explored several that could be applied to

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153 Part I, at Section III.E.
cryptocurrency: annual marking to market of cryptocurrency holdings; capitalization of token costs; a return of stake doctrine similar to section 301’s nontaxable return of capital; and a theory of barter compensation that excludes amounts paid to oneself from the calculation of income. Any of these approaches could work, and even more methods could be found by analogy to existing tax provisions. But methods of taxing two tokens instead of seven while insisting that those two tokens are income when received would also require a complex accounting framework ill-suited to cryptocurrency. And because block rewards are zero-sum redistributions of stake, some methods of taxing net gains would leave intact the asymmetrical treatment of gains and losses, so Treasury would continue to capture the benefit both of immediately taxed gains and the deferred recognition of non-validators’ corresponding losses.

A better option is available. Taxation when reward tokens are sold — the natural result of treating those tokens as created property — eliminates the need for unwieldy accounting mechanisms and promotes the equal tax treatment of both validators and non-validators.

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Taxation of block rewards is just one of several unresolved issues involving the taxation and regulation of cryptocurrency. Given the variety and complexity of these matters, a legislative framework is recommended to bring certainty and fairness to all concerned. This report provides context to help ensure that any legislative solution to this particular tax issue is equitable, not unduly burdensome, and based on an adequate understanding of how public cryptocurrencies work. But if the 10 years since the invention of Bitcoin are any indication, congressional action might not be immediately forthcoming. In the meantime, it is a reasonable interpretation of existing law to report gains from reward tokens at the time of their sale or exchange.

154 For example, the creation of new reward tokens can be likened to an (ongoing) tax-free corporate reorganization, such as a recapitalization under section 368(a)(1)(E). See also Brian Hamano, “Staking Out New Territory: Taxation of Proof-of-Stake Protocols,” Tax Notes, Jan. 28, 2019, p. 393, at 399 (analogy to partnership distributions under section 731(a)(1) and to partnership recapitalizations).