Brief in Support of Taxpayer Joshua Jarrett's
1040-X Amended Return and Claim for Refund

July 31, 2020

Joshua Jarrett's 8,876 New Tezos Cryptocurrency Reward Tokens Are Not Taxable Income in 2019 Under the Internal Revenue Code.

1. Brief in Support
2. Appendix: *Dilution and True Economic Gain From Cryptocurrency Block Rewards*

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The "Appendix 1" cited in this July 31, 2020 brief was subsequently published in *Tax Notes* as Mattia Landoni and Abraham Sutherland, "Dilution and True Economic Gain From Cryptocurrency Block Rewards," Tax Notes Federal, Aug. 17, 2020, p. 1213. That article is appended to this brief and is available at https://www.taxnotes.com/special-reports/cryptocurrency/dilution-and-true-economic-gain-cryptocurrency-block-rewards/2020/08/14/2ctmc.

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Table of Contents

Table of Authorities

Constitution

Statutes

Regulations

Cases

IRS Guidance

Other Authorities

I. Introduction

A. Amended Return and Claim for Refund

United States taxpayer Joshua Jarrett submits this brief in support of his 1040-X Amended U.S. Individual Income Tax Return. The amended return seeks to adjust Schedule C, line 8 of his 2019 Form 1040, which reported "other income" of $9,407. The amended return removes this entry on the grounds that the taxpayer property at issue should not be included in income in 2019.

This property consists of 8,876 digital Tezos cryptocurrency tokens owned by taxpayer Jarrett at the end of 2019. The taxpayer did not own these tokens at the beginning of 2019 and did not purchase them during 2019. He did not receive them from another party as interest or dividends or any other type of payment. No one owned these 8,876 tokens before 2019, because the tokens did not then exist. Rather, Jarrett owned them at the end of 2019 because he caused them to exist.

Jarrett owned 102,708 Tezos tokens at the start of 2019, and during the year he purchased 98,554 more. During the year he also sent 460 tokens to others as payment for goods or services, and the gains and losses from these 460 tokens were properly reported on his Form 8949, Sales and Other Dispositions of Capital Assets, and on Schedule D, Capital Gains and Losses.

At the end of 2019, Jarrett owned 209,678 Tezos tokens. Neither the 460 spent tokens nor the remaining 200,802 initial and purchased tokens are the subject of this claim for refund. This refund claim concerns the 8,876 he acquired, but did not purchase, in 2019.

The 8,876 tokens at issue are commonly referred to as block rewards or reward tokens. Reward tokens are created in the course of maintaining public cryptocurrency networks such as Tezos. The opportunity to create reward tokens serves as an incentive for people to help maintain such networks. The reward tokens created in 2019 increased the total number of Tezos tokens in existence by 39,529,621 tokens.

Throughout 2019 Jarrett helped maintain the Tezos network by "staking" his Tezos tokens. Staking will be explained and illustrated shortly, but the key fact is this: Jarrett owns these 8,876 tokens because he staked. Had he not staked his tokens, he would not own these 8,876 new ones. Had no other Tezos token holders staked their tokens either, none of these 39,529,621 reward tokens would have been created at all.

The reason Jarrett's 8,876 tokens *are not* income in 2019 is that under current law, new property is never income in the hands of its creator or discoverer. The reason these tokens *should not* be taxed as income in 2019 is that doing so would result – always – in an overstatement of the taxpayer's gain. It would also introduce notable compliance challenges. In this case, treating Jarrett's 8,876 tokens as income would involve more than 100 individual taxable events and overstate his gain by several hundred percent.[1]

B. Joshua Jarrett's 8,876 New Tezos Cryptocurrency Reward Tokens Are Not Income in 2019 Under IRC Section 61

The Internal Revenue Code ("IRC") and Treasury Regulations do not directly address the tax treatment of Jarrett's reward tokens. None of the 14 enumerated items in section 61(a) refer, explicitly or implicitly, to cryptocurrency reward tokens, and neither are such tokens among the items specifically included in gross income in any provision in part II of the subsection, nor in any of the regulations thereunder. Reward tokens are not specifically excluded from gross income under any provision in part III.

However, this does little to demonstrate that reward tokens are not gross income, as section 61(a) provides that "gross income means all income from whatever source derived," which expressly is "not limited to" the 14 enumerated items in section 61(a) – nor, for that matter, to these items plus the items listed in part II. What must be shown to establish that reward

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[1] Facts in this brief are supported by the Declaration of Joshua Jarrett (taxpayer), Declaration of Robert Witoff (Tezos expert), and Declaration of Henrik Moe (cryptocurrency researcher), along with the associated Exhibits.

The evaluation of Jarrett's gains is drawn from Appendix 1, Mattia Landoni and Abraham Sutherland, *Dilution and True Economic Gain From Cryptocurrency Block Rewards*, July 2020 (forthcoming in Tax Notes, August 2020) (hereinafter *Dilution and True Economic Gain*). *Dilution and True Economic Gain* draws from the same taxpayer and blockchain data that is the basis for this refund claim. The data used for the calculations developed in *Dilution and True Economic Gain* are drawn from Tezos token supply and price data from 2019, *see* Exhibit A to the Declaration of Henrik Moe, and from taxpayer Joshua Jarrett's 2019 Tezos records, *see* Declaration of Joshua Jarrett and its Exhibit A.

For a detailed explanation of the Tezos cryptocurrency, *see* Appendix 2, Abraham Sutherland, *Cryptocurrency Economics and the Taxation of Block Rewards*, 165 Tax Notes 749 (Part 1; Nov. 4, 2019) and 165 Tax Notes 953 (Part 2; Nov. 11, 2019) (also available at ssrn.com/abstract=3466796) (hereinafter *Taxation of Block Rewards*).

For a discussion of proof-of-stake technology and its economic potential, *see* Appendix 3, Paul Hastings LLP, *Proposed Tax Treatment of Earning Proof of Stake Awards*, Proof of Stake Alliance (POSA) White Paper (2020) (also available at https://drive.google.com/file/d/1l_Tfrc5Eb44B5z3xfQpxHgJr7Gn9mF-U/view).

tokens are not income is that the catch-all clause of the gross income statute does not reach the tokens at issue.

The principle that determines the taxation of these 8,876 tokens is a fundamental one, so fundamental that it is rarely invoked and makes no appearance in the code or regulations. Indeed, it is so deep an assumption underlying the tax code that it appears no court has ever had occasion to declare it. It is this: *taxpayer-created or taxpayer-discovered property is not income*. Accordingly, Jarrett's 8,876 new tokens are not gross income under section 61(a).

Whether Congress could deem Jarrett's reward tokens to be income under section 61(a), or under the 16th Amendment, or whether such tokens could be taxed on some other grounds are all nice questions that, while hypothetical here, shed light on this case. These issues are touched on below. But to grant Jarrett's application, it is enough to establish that his tokens are not income under section 61(a). As a matter of current law and doctrine, this is established by showing that reward tokens are not the taxpayer's gross income under the modern standard established with *Commissioner v. Glenshaw Glass Co.*, 348 U.S. 426 (1955).

A person who creates valuable new property would appear to experience an "accession[] to wealth." *Id.* at 431. Consider the craftsman who whittles pieces of driftwood into handsome and collectible tokens, or the professional truffle hunter who unearths an ounce of *Tuber oregonense*. Assuming clear ownership and control of the tokens and truffles, it would appear that each becomes wealthier.

But the IRS would concede that their new property is not income, despite no mention of handicrafts or wild fungi in the code or regulations. As a matter of modern doctrine, the craftsman's and hunter's new wealth has not been realized, because with self-created property the realization event is the sale or exchange of the property. Such a sale – if there is one – is the culmination of the taxpayer's investment of labor and/or capital that includes, but does not end with, the creation or discovery of the property. Just as the income that derives from a worker's labor is not the labor itself but rather the wages, the income derived from the taxpayer's investment of labor and capital to create property is not the property itself but the gains realized with the property's sale. And so, as with the truffles and hand-carved tokens, any income or taxable gain from Jarrett's new tokens will be realized at the time of their sale or exchange.

In current law, the closest thing to an exception to this principle is the regulation stating that "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." Treas. Reg. section 1.61-14. Treasure trove, left undefined in the code and regulations, is "Money or coin, gold,

silver, plate or bullion *found* hidden in the earth or other private place, the owner thereof being unknown." Black's Law Dictionary (4th ed., 1951) (italic in original, as *trove* comes from the French for *found*). Treasure trove previously *had* an owner. Equally important, it is an economic windfall to its finder. Unlike treasure trove, tokens and truffles are the result of concerted economic activity. Jarrett's 8,876 reward tokens are not treasure trove.

C. Taxing Reward Tokens as "Income at the Time Received" Would Be Inequitable

Although new property is never income to its creator or discoverer, one could certainly imagine it being taxed as such. Suppose Congress legislated that paintings and sculptures, once placed in a gallery (or even the artists' studios), were income at their fair market value. Or, that the writer's novel or screenplay were income at the time of its completion. Or that gold, once taken from the earth and processed to a certain purity, were its miner's gross income at that day's reported spot price. Or, that fish were income on the day caught, again at the day's market price. Leaving aside any practical or even constitutional problems, at least arguably such provisions would be fair.

It's different with Jarrett's reward tokens: Taxing them as income upon creation would be demonstrably inequitable. Suppose that the law provided that "the fair market value of [Tezos reward tokens] as of the date of receipt is includible in gross income," to borrow from 2014 IRS guidance aimed at a different type of cryptocurrency.[2] The result would be a dramatic overstatement of Jarrett's economic gain.

During 2019 Jarrett "received" 8,876.260461 reward tokens, with his receipts occurring on more than 100 different days. Using a market data service, Jarrett entered the date and time each new token came into his control. Assigning a dollar value to each token based on historical market data, the result was $9,407 worth of new Tezos tokens. But Jarrett's gain was not $9,407 – not even close.

On the most rigorous and accurate accounting, Jarrett's actual gain was $1,458. Under the most conservative accounting treatment – the one that maximizes Jarrett's realized income – his gain was $4,723. On a third methodology – simpler than the others, but dependent on more Tezos-specific data – Jarrett's gain was $2,524.[3] To see why, and to see how Jarrett in fact created his new tokens, requires some explanation of the economics and mechanics of Tezos.

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[2] IRS Notice 2014-21, 2014-16 IRB 938, Q-8 (Mar. 25, 2014).

[3] Appendix 1, *Dilution and True Economic Gain* at 15; discussion below at part II.D.

II. Background

A. Taxpayer Joshua Jarrett

Taxpayer Joshua Jarrett lives in Nashville, Tennessee with his wife and their three sons.[4] He is an insurance executive and also the founder of a data-driven fitness gym. His gym, Quantify Fitness, uses the latest technology to provide detailed data and analytics on clients' workouts and athletic performance. Combining his three professional interests, Josh is working on a health and insurance tool made possible by the data verification and transparency features of the Tezos blockchain.

The highly computerized equipment at Quantify Fitness generates reports detailing individuals' workouts as well as evaluations of overall health and fitness. This data can be encrypted and recorded on the Tezos blockchain, with access given to those of the individual's choosing. This data might be of value to an insurance company. So long as an insurer is assured that the workout data is honestly generated by the individual in question and is accurate as of the time it is recorded on the blockchain, the insurer could access and use the data to evaluate insurance risks and tailor policies and incentives to the individual's performance.

Jarrett is also developing an application for Quantify Fitness members, whereby time or workouts logged in the gym would be converted into special digital tokens that would be securely held on the Tezos blockchain (but would be distinct from the "native" Tezos tokens that are at issue here). Such tokens could be redeemable for merchandise, discounts, or an end-of-year rebate based on number of workouts or other performance metrics.

Jarrett views his participation in the maintenance of the Tezos network as a prerequisite for his reliance on the network. By staking his tokens – and in his case, by operating a full Tezos node and participating directly in all aspects of transaction validation and decisions on Tezos software upgrades – Jarrett contributes to, and can evaluate and confirm, the network's security.

In addition, Tezos tokens are required in order to use the network for the business applications Jarrett is developing. As explained in the following sections, participating in network maintenance allows Jarrett to maintain a consistent proportionate stake in the Tezos network over time – and, to the extent that some token holders do not participate in network maintenance, to actually increase his proportionate stake.

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[4] For facts in this section, *see* Declaration of Joshua Jarrett.

Throughout 2019, Josh Jarrett helped maintain the Tezos cryptocurrency network by staking his Tezos tokens. His staking resulted in the 8,876 tokens at issue. Initially, he staked by delegating his tokens to others.[5] In June 2019, Jarrett set up a publicly accessible copy of the Tezos blockchain and began delegating his tokens to himself. From his home, using a dedicated MacBook Pro with a high-speed internet connection, backup hard drive and backup power supply, he began using this equipment to validate transactions on the Tezos network.

B. Tezos, Network Maintenance, and Staking

Tezos tokens, also known as tez or XTZ, are the native digital tokens that exist on the Tezos cryptocurrency network. Among other uses, the Tezos network allows tokens to be transferred from one account to another. The record of these accounts and transactions becomes a part of the Tezos blockchain, and identical copies of the blockchain are stored on a number of computers around the world. Those who store these copies of the blockchain and help relay, validate, and record these transactions provide a public service to other users of the network. In order to help with this network maintenance (and to prevent would-be hackers from corrupting the process), participants must "stake" some valuable amount of XTZ. As explained below, stakers also create new Tezos tokens in proportion to their participation in maintaining the network.

At the beginning of 2019, 781,346,794 XTZ tokens existed on the Tezos network. At the end of 2019, the total supply of tez was 820,876,415. The difference – 39,529,621 tokens – were created during 2019. These tokens were created by those, like Jarrett, who staked their tokens to help maintain the Tezos network. At the close of 2019, a single Tezos token could be bought or sold for about $1.32.

One element of Tezos' design is especially important for understanding both why and how Jarrett creates new tokens through staking. Public cryptocurrencies such as Tezos or Bitcoin are not operated or maintained by a single person or entity such as a corporation or central bank. But just as importantly, a public cryptocurrency *must not* be maintained by a single person, or else it wouldn't work as designed – because, in short, that person could cheat. Ensuring the diversity of people required to keep a cryptocurrency secure and prevent the possibility of cheating is perhaps more

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[5] *See Taxation of Block Rewards* at 757 for an explanation of delegation. In short, every Tezos token holder can create tokens and contribute to network maintenance and security by staking. Delegation allows stakers to combine account balances for purposes of obtaining maintenance opportunities, as it is not necessary or desirable (or, at present, technologically feasible) for, say, hundreds of thousands or millions of token holders to maintain the hardware and software as Jarrett chose to do beginning in June 2019.

difficult than it sounds. It's what accounts for most of the expense of running a public cryptocurrency. It's also what accounts for most of the complexity.

The easier part is ensuring that enough people *want* to participate in network maintenance. It's done by allowing those who participate to create new tokens, such as a share of the 39.5 million tez that Tezos token holders created in 2019.

The harder part is making sure enough people *get* to participate. It's critical that no single person performs all, or even most, of the network maintenance. It's not as simple as asking for volunteers and then choosing, say, 10 or 10,000 at random. If a human being got to oversee this process, that person might be corruptible and select only his or her friends, or even the same friend for all the positions. Computers must do the choosing, and the selection method must ensure that no one can trick the system to unfairly obtain a position or, even worse, obtain a majority of them. This isn't easy to accomplish, especially when there are billions of dollars at stake and hackers are circling. Plus, "computers" can't actually do much on their own other than follow rules. And those rules get written by humans.

C. Proof of Work and Proof of Stake

"Proof of work" and "proof of stake" describe two different approaches to solving this problem. They describe methods of selecting volunteers in a way that is fair and prevents a dangerous concentration of power. Bitcoin, the original cryptocurrency, is based on proof of work. Bitcoin allocates opportunities to add new blocks of transactions to the Bitcoin blockchain in proportion to participants' "work," or computational power, dedicated to the network. In the jargon, those who do this work are called miners, and if miner A applies twice the computational power of miner B, miner A can expect to create twice the new blocks that B will. Simplifying a bit, so long as no single miner controls a majority of the computational power, no single party can control Bitcoin.

Tezos is a proof-of-stake cryptocurrency. Unlike Bitcoin and proof of work, it does not rely on expensive hardware and electricity. Instead, using normal computers, opportunities to create new blocks on the Tezos network (and to create new tez) are allocated in proportion to participants' ownership of Tezos tokens. If Alice stakes twice the tokens staked by Bob, then Alice can expect to create twice the new tez that Bob will. And this is how Tezos solves the concentration of power problem: Simplifying a bit, so long as no single person controls a majority of the staked tokens, no single party can control Tezos.

Both proof-of-work and proof-of-stake cryptocurrencies require participants to prove their commitment to honestly maintaining the network, either by expending costly computing power (proof of work) or by owning and

temporarily dedicating valuable tokens (proof of stake). These commitments ensure that would-be attackers cannot obtain significant power on the network without suffering an even more significant cost.

In this brief, "staking" is the term used for what people do to maintain the Tezos network. As just explained, staking is how Tezos maintenance remains decentralized, and maintaining this decentralization is the most critical part of network maintenance. New blocks, and new tokens, *must* be created by a number of different people, or else Tezos wouldn't work as a public cryptocurrency. For purposes of the tax treatment of new tokens, it really is as simple as that. And if no one staked, there would be no new blocks, no new Tezos tokens, and the blockchain would halt.

Most importantly, this maintenance involves the tasks and actions required to allocate block and token creation opportunities according to participants' stake – steps that must be completed without oversight by any single authority other than the impersonal and indifferent computer code of the Tezos protocol itself. At a more granular level, elements of network maintenance also include keeping an up-to-date copy of the blockchain, running software that collects and vets proposed transactions, assembling and publishing blocks of valid transactions to that blockchain, and confirming that blocks published by others are valid.[6]

The mechanics of staking are complicated. Most people leave the details to specialist computer scientists. For the lay public, such ignorance is usually rational: since we are ultimately talking about the ones and zeroes of computer code, a cryptocurrency's mechanics are not always easy to observe or to translate into human-readable terms.

Unfortunately, the alternative to understanding how cryptocurrency actually works is to focus exclusively on the apparent financial and economic character of tokens and block rewards. Cryptocurrency looks a lot like money, so it is easy to describe Tezos reward tokens in terms of yields and percentages. Matters of taxation require a focus on dollars and cents, which also encourages a financial and economic lens. But this can lead to misunderstandings, such as the impression that Jarrett's 8,876 new tokens represent a gain of $9,407. A financial and economic lens is indeed needed to demonstrate why this is a mistake, and we turn to this demonstration in the next section.

But the more important part of this refund claim is the explanation of how Tezos works and how Jarrett acquired the tokens at issue. Talk of yields and percentages must not obscure a critical and undisputed fact: Tezos

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[6] "Validation" is therefore another common term for what this brief refers to generally as network maintenance or, in the case of Tezos and proof-of-stake cryptocurrencies, staking.

tokens are not dollars – for tax purposes, they are property.[7] Like all new property, Tezos reward tokens are created or discovered at some point. Unlike typical yields, staking rewards are not paid to the staker by some other person or entity; they are created, not earned. So, after establishing Jarrett's true economic gain from his new tokens, we will return to this issue to better understand how stakers like Jarrett create new Tezos tokens.

D. The Economics of New Tezos Tokens

The Tezos network is maintained by its token holders. Those who participate in this maintenance keep the network running by staking their tokens (as explained later). Those who stake their tokens create new tokens on the basis of the tokens thus staked. One might also say stakers "receive" these tokens, but this locution is misleading because in fact they are not received from any counterparty and did not exist before their creation by the staker. At the outset of 2019, there were 781,346,794 Tezos tokens in existence. The total supply increased by 39,529,621 tokens in 2019, so the token creation rate for 2019 was about 5 percent.[8]

If every token holder had staked and acquired a proportionate share of the new tokens, then each would have ended 2019 with 5 percent more tokens. Someone starting with 1,000 tokens would end with 1,050. But this increase in the number of tokens would not translate one-for-one into economic gain. The token holders would not have increased their stake in the network at all. Their gain from new tokens is best analogized to an investor's gain following a 21 for 20 stock split: *nil*. For each 20 tokens initially held, the token holder would end the year with 21. New shares issued in a stock split or a pro rata stock dividend are not taxable income, because increasing the number of units is correctly understood to not create any shareholder gain.

In reality, it is not true that 100 percent of Tezos tokens are staked. The staking rate in 2019 was, on average, about 70 percent. Holding constant a few variables that will be introduced later, this means that those who staked would acquire about 7.2 percent more tokens over the course of 2019.[9] Someone who started the year with 1,000 tez would end the year with 1,072.

Unfortunately, this "return" of 7.2 percent is sometimes misunderstood by the public – and even finance and technology writers – to mean "income"

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[7] *See* IRS Notice 2014-21, 2014-16 IRB 938.

[8] 39,529,621/781,346,794 = 0.05059.

[9] In other words, the 39,529,621 reward tokens would be shared proportionately among owners of 70 percent of the initial supply of tokens, or among the owners of the (0.7*781,346,794) = 546,942,755 staked tokens. 39,529,621/546,942,755 = 0.07227.

or economic gain.[10] This is indeed regrettable. On the bright side, even confused token holders are likely to be aware of what really matters, which is the value of their share in the Tezos network over time. The value of their share is the product of tokens owned and the market price of each token.

The same error is more consequential, however, if made by Congress or the Treasury Department. Applied to tax policy, this error could lead to the taxation of reward tokens as though they were income, on the mistaken impression that such tokens represent taxpayers' economic gain. And in the context of tax, the error would not be trivial: The mentioned 7.2 percent "gain" in tokens equates to a true economic gain of just two percent.[11] On these simplified assumptions, treating reward tokens as income overstates the taxpayer's gain by 250 percent.[12]

The error can be difficult to catch in the real world, where variables affecting stakers' gains and losses fluctuate over time. As seen with Jarrett's 8,876 reward tokens, these fluctuations make true gains and losses difficult to calculate. The factors that fluctuate are these: the value of the Tezos network (or of individual Tezos tokens) expressed in U.S. dollars; the taxpayer's own share in the network (which changes as tokens are created, or are bought and sold by the taxpayer); and finally the staking rate and the rate at which a staker creates new tokens.

These complicating factors can indeed be accounted for. In other words, if Congress were determined to tax gains from staking annually by treating stakers' acquisition of new reward tokens as a taxable event, there are ways to adjust the market value of such reward tokens to arrive at a fairer statement of stakers' gains. But given these complicating factors, such a method would not be simple. And, it cannot be perfect: there is not one single way to make such an adjustment.

The challenge of establishing Jarrett's true economic gain is set out in Appendix 1, *Dilution and True Economic Gain From Cryptocurrency Block Rewards*. Dilution presents unique challenges for the calculation of gains and losses, and dilution is not easily addressed within our realization-based income tax. Three different options are presented in *Dilution and True Economic Gain*, each requiring different data as inputs and each with its own strengths and weaknesses. Applying the most accurate method, which adjusts the market value of awards by the market value lost to dilution, Jarrett's true economic gain was $1,458. Under a second approach based on a principle of depreciation or depletion, which prioritizes consistency over

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[10] *See Taxation of Block Rewards* at 758 for examples of this error taken from media reports on Tezos.

[11] (1 + 0.07227)/(1 + 0.05059) = 1.02064.

[12] 0.07227/0.02064 = 3.501.

accuracy, Jarrett's true gain was $4,756. Under a third approach, which values simplicity over consistency or accuracy but would overstate Jarrett's gain in this case, it was $2,524.

Jarrett added to his staking balance during the year by purchasing tokens. This makes certain calculations difficult, but ultimately in 2019 Jarrett created new tokens at an average annualized rate of 5.74 percent of his staked token balance.[13] Recall that on the simplified model introduced above, in 2019 a Tezos staker could expect to end the year with 7.2 percent more tokens, against the network-wide increase of five percent. Jarrett's new tokens, after adjusting for his purchases, reflect an annual rate of increase in tokens due to staking of just 5.74 percent. Expressed as a percentage of his staking balance and accounting for the five percent new tokens network-wide, Jarrett's economic gain in 2019 was therefore just 0.65 percent.[14] The three methods are different ways of quantifying Jarrett's 0.65 percent gain, expressing the result in dollars and based on the more than 100 instances his token balance increased due to staking during 2019.

Any of these accounting measures would make annual taxation of reward tokens more fair. The key point is that the cash value of his reward tokens vastly overstates Jarrett's actual gain if such tokens are included in gross income when received.

III. Jarrett Created 8,876 Tezos Tokens in 2019

The Tezos blockchain consists of a series of blocks, each containing a record of new operations that becomes a permanent part of the blockchain. During the 525,600 minutes of 2019, 509,356 new Tezos blocks were added to the blockchain. New Tezos tokens are created with the same frequency as blocks, with up to 80 new tokens per block. By staking his tokens, Jarrett created 8,876 of the 39,529,621 tokens that came into existence during 2019, initially by delegating to others and later by delegating to himself. To see how Jarrett created these tokens, it is helpful to isolate a few days in September to focus on how he created 18 of them in particular.[15]

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[13] I.e., Jarrett's Tezos-denominated time-weighted return for 2019 was 5.74 percent. Appendix 1, *Dilution and True Economic Gain* at 12.

[14] (1 + 0.0574)/(1 + 0.05059) = 1.00648.

[15] Facts presented in this section are publicly available and verifiable using Josh Jarrett's 2019 Tezos address, which is tz1gCx1V63bSaQnPZoQreqNgVLuFMzyMcqry. Tezos is open source and its mechanics are publicly reviewable as well. In Tezos, all critical information is published in blocks that are a public and permanent part of the Tezos blockchain. Some useful information is derived and then stored, often temporarily, on Tezos nodes. All up-to-date or "synchronized" nodes are globally connected to form a single computer network. The nodes maintain copies of the blockchain as well as store additional information derived from blockchain data. Some other information is not necessarily stored

A. Jarrett Created 130 Tokens During Tezos Cycle 151 (September 22-25)

During the time in question, the 80 tokens in a block included 16 for the person who created the block and two tokens for each of up to 32 others. In early September, Jarrett owned about 160,000 tokens, out of a total supply of about 808 million. About 577 million of those tokens were participating in the maintenance of the network.[16]

Each block in the Tezos blockchain has a number, also known as the block's level or height, and a cycle consists of 4,096 blocks. Because the time between blocks is at least 60 seconds, a cycle lasts for at least 4,096 minutes, or about three days.

The 151st cycle began on September 22, right after cycle 150 ended with the publication of block 618,496 at 7:11:45 a.m.[17] Cycle 151 ended on September 25, at 4:32:51 a.m.[18] During that 69-hour period, 324,907 new tokens came into existence, and of those Jarrett was responsible for 130.[19]

To understand *how* Jarrett created these 130 tokens, we must first go back in time. The *why* was explained earlier: Tezos would not work if a single person could create all 4,096 blocks in a cycle, so opportunities to create blocks are apportioned according to the number of tokens each participant

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anywhere because it can be quickly derived from the critical and useful information stored elsewhere. Several Tezos "block explorers" are available on the internet, which allow the public to more easily retrieve certain Tezos information. Such information might be drawn and verified directly from blockchain data by querying one of the globally connected nodes, or more simply by accessing a block explorer, or generated as needed.

Most facts in this section are easily verified using a Tezos block explorer, such as www.tzkt.io or www.tzstats.com. The Declaration of Robert Witoff, an expert in proof-of-stake technology, affirms the basic facts and description of Tezos mechanics presented in this brief and especially this section. Repetitive citations to this declaration are omitted. Selected facts in this section are further supported with links to block explorers or to blockchain inquiries that are supported by a Tezos block explorer. As explained below, Exhibit A to the Declaration of Robert Witoff is an excerpt from one of the Tezos blocks discussed in this section.

[16] These figures provide the staking rate, which was then 71 percent: 577/808 = 0.7141.

[17] All times are Greenwich Mean Time.

[18] A summary of cycle 151 can be viewed at https://tzstats.com/cycle/151.

[19] This figure for reward tokens created in cycle 151 includes tokens created by publishing blocks and endorsements, adjusted downward to reflect 16 tokens that were burned, or destroyed, before the tokens were added to stakers' spendable balances. The figure also does not include the 15.875 tokens that were created during cycle 151 by other means (namely, seed nonce revelations). https://api.tzkt.io/v1/rewards/bakers/tz1gCx1V63b SaQnPZoQreqNgVLuFMzyMcqry/151 returns a summary of Jarrett's cycle 151 results.

has staked. In other words, new blocks and new tokens are a function of the tokens staked. Every staker is not required to perform every task that goes into network maintenance, but every token holder can contribute to the fundamental security requirement – often described as "decentralization" – by doing what is required to have their tokens counted for this apportionment. This can be done by delegating one's tokens to another account, as Jarrett did in the first months of 2019. This way, a number of accounts contribute to a single staking balance for apportionment purposes. Or, it can be done by delegating one's tokens to oneself, as Jarrett began to do in June. Delegators still own their delegated tokens, but staking them can prevent their use for other purposes and can also involve a risk of forfeiture. For security reasons, the apportionment of maintenance opportunities is done ahead of time. The rights to create blocks in cycle 151 were established weeks earlier. Two moments, during cycle 144 and 145, are important here.

B. Jarrett Proved His Stake on September 3

First, the most important event. On September 3, during block 592,640 in cycle 144, the Tezos software took a "snapshot" of the accounts and account balances on the network. Jarrett's staking balance in this snapshot is the proof of his stake that established his right to create blocks, and tokens, in cycle 151.[20] More generally, the staking balances captured in snapshots such as this one are the proofs of stake that make Tezos a proof-of-stake cryptocurrency.

More specifically, the snapshot established the number of "rolls" in each staking balance, where a roll consists of 8,000 staked tokens. On September 3, Jarrett's staking balance was 160,146 tokens, giving him a roll count of 20.[21] The snapshot counted a total of 71,476 rolls on the network, and each roll was assigned a number.[22] These figures established that Jarrett deserved a 0.02798 percent chance of receiving any particular block creation rights during cycle 151. But ensuring Jarrett actually got his 0.02798 percent allocation would require a few more steps.

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[20] Sixteen of these snapshots were taken during cycle 144, with this one later selected at random using the random number seed, as explained below.

[21] 160,146/8,000 = 20, remainder 146. *See* https://api.tzkt.io/v1/rewards/bakers/tz1gCx1V63bSaQnPZoQreqNgVLuFMzyMcqry/151

[22] Jarrett's 20 roll numbers, which were eligible to be assigned specific maintenance rights in this lottery, were 34,293, 58,293, 61,502, 62,703–62,709, 64,071–64,076, 64,408, 64,409, 64,545, and 70,808. The link https://mainnet-tezos.giganode.io/chains/main/blocks/618497/context/raw/json/rolls/owner/snapshot/151/10?depth=1 returns a list of all rolls that were participating in staking at the time of this snapshot.

C. On September 7, Jarrett's Stake Entitled Him to Three Block Creation Opportunities

The second important moment came on September 7, at the end of cycle 145. This is when maintenance opportunities for cycle 151 were actually assigned. To keep things fair, Tezos performed a lottery, using 71,476 roll numbers from the September 3 snapshot along with a special number, a random number seed, to ensure the results could not be predicted or gamed.

This special number is important, because it helps illustrate why it is misleading to say that *Tezos* creates new tokens. We can use the word Tezos as the subject of a sentence, e.g. "Tezos performed a lottery," but there is a risk of ascribing a false sense of agency to a piece of software, or to the actions of the far-flung people around the world who use Tezos tokens and thus interact with the network.

The Tezos software has no agency or discretion. It is a set of rules. Those rules respond, with complete predictability, to the actions of stakers and others who interact with the network. As we will soon see, the Tezos software cannot even be trusted to pick a random number out of a hat. One might say that trees produce apples, just as cows bear calves; in these familiar realms we understand that, for tax purposes, it is still the farmer whose actions count. Saying that Tezos creates new tokens or performs a lottery may be useful shorthand, but it is important to see why this locution is not helpful for purposes of taxation. It is unhelpful for the same reason it is unhelpful (for tax purposes) to say that a word processor creates a screenplay which the screenwriter then "receives" from that computer program.

A similar point applies to the role of other token holders. Tezos stakers do have agency, but the function of the Tezos software is to carefully limit their power to reflect their proportionate stake in the network. All stakers play by the same rules, but it is not helpful, or accurate, to say they are partners in a common enterprise. This is for the same reason we would not say competing fishermen form a joint venture. Each might respect the others' rights of way in the sea lanes, and each might even act to preserve the long-term sustainability of the sea. One could even say that collectively, the competing fishermen maintain the fishing ground. But, for tax purposes, each fishes on his own.

In our case, Jarrett's own actions established his entitlement to 20 numbers in the lottery – specifically, his acquisition of 160,146 tokens, and his delegation of them to himself, to then be counted as 20 rolls in the snapshot. Other stakers' actions established their quantities of tickets, with a total of 71,476 participating in this lottery. But for Tezos to stay secure, neither Jarrett nor anyone else can be allowed to influence or predict the results of these lotteries.

Randomness is not easy to achieve. If the Tezos software tried to perform a random lottery on its own, the deterministic nature of software might allow stakers to predict or influence the results, undermining security. Since the Tezos software can only follow rules, thwarting such attempts is tricky and requires a few steps. It is worth going through them to help show that it is a mistake to attribute the results of Tezos maintenance or Jarrett's 8,876 reward tokens to "Tezos" or to other token holders, at least in any sense that is meaningful for income tax policy.

D. Ensuring Stakers Obtain Maintenance Opportunities in Proportion to Their Proof of Stake

To prevent stakers from exploiting the software's rule-bound naiveté, the element of chance is introduced by the stakers themselves. In each cycle, up to 128 staker-provided numbers are used to create a final number, called a random number seed, that determines how each lottery will play out. This number seed, even if it cannot be proven to be random, is close enough to random to prevent the prediction of the lottery results.

But, the last staker to publish a number might not choose one at random, but instead pay attention to the other numbers and then figure out which specific number, once added to the mix of the others' numbers, would end up tilting the lottery in favor of that staker. It is difficult to make sure all stakers publish their numbers at the exact same instant. This is solved by having stakers commit to a number ahead of time, which they do in Tezos by publishing that "commitment" in a block. A commitment takes the form of a hash of the secret number. A hash is like a fingerprint. A given number will always generate the same hash, but the hash cannot be used to generate the number.

In our case, the 128 commitments were published during cycle 144. After all the commitments are published, it is safe for each staker to reveal the underlying number. This happened during cycle 145. So long as the revealed number generates a match with its previously published hash, the revealed number is included as an input in the function that results in the random number seed. At the end of cycle 145, the revealed numbers were used to generate our seed, a 256 bit number that, if converted to base 10 numerals, can require up to 78 digits to express.[23] Once this number and the 71,476 roll numbers were fixed, in a sense the lottery was already over, because this data determined all maintenance assignments for cycle 151.

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[23] The random number seed determining this lottery can be expressed as 28,628,649,905,182,598,951,222,332,989,354,003,241,534,136,811,933,916,636,268,869,010,419,700,938,805. For the random number seed expressed in hexadecimal format, *see* https://api.tzkt.io/v1/cycles/151.

Based on his odds, Jarrett could expect to draw one first-priority right to create a block during cycle 151.[24] This time, he drew three. One of these was block 618,748.

E. On September 22, Jarrett Created Block 618,748 And With It 16 New Tezos Tokens

In Tezos, creating a new block is also known as "baking." The lottery also established a list of backup bakers who could step in to bake the next block if for any reason Jarrett failed. To bake block 618,748, Jarrett's computer needed to be online and running the right software, so that his software could collect and validate new network operations to include in the new block.

In this case, the new operations Jarrett collected and vetted included several valid token transfers – that is, requests from one account to transfer a quantity of Tezos tokens to another account, including a small fee to be collected by the baker who includes the transaction in the new block.[25] (If someone had attempted an invalid operation – for example, a token transfer that had previously been accepted and added to the blockchain – Jarrett's creation of a valid block would depend on his excluding that invalid transaction from the new block.)

The operations Jarrett collected also included 32 "endorsements" offered by other bakers. Endorsements serve to confirm that the preceding block is a valid addition to the Tezos blockchain. Like block creation rights, endorsement opportunities are allocated by lottery. Endorsements, like other operations, are pushed onto the network and – hopefully – quickly received and relayed around the globe until they reach everyone who needs to receive them. Until and unless Jarrett's software collected an adequate number of valid endorsements, his ability to create and add a valid block to the chain would be delayed and, in certain circumstances, forfeited.

The block that Jarrett assembled also includes a number of other operations and pieces of information. For example, it includes a hash that identifies the preceding block and its contents, ensuring the preceding block's operations (as well as all operations in blocks preceding that one) remain a part of the blockchain.

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[24] (20/71,476)*4,096 blocks = 1.146 blocks.

[25] For example, one of these transactions involved the transfer of 2,505 tez from one account to another. Fees discourage network-clogging spam transactions, and in this case the sender's fee was 0.001637 tez. If converted to dollars on the date of the transaction, the fee amounted to 0.17 cents. Transaction fees collected by Jarrett in 2019 are de minimis and are not separately accounted for among Jarrett's 2019 gains from staking.

F. Creating Block 618,748 Required Jarrett's Unforgeable Signature

Importantly for our purposes, the block includes Jarrett's signature. This signature can be examined in order to prove that Jarrett, and no one else, created block 618,748 and the 16 tez it added to the total Tezos token supply. This signature is the critical link to Jarrett's stake in the network that established his right to create these tokens in the first place.

Signing block 618,748 was Jarrett's final act to complete the block. All the other block data had to be in place first, because the signature is created using selected data from the block being signed. Jarrett put his private key (which he must always keep secret) and this data into a kind of one-way signature machine, and a 96-character string beginning with the letters "sig" came back out. This signature was added to the introductory section of the block being signed, providing proof that Jarrett's account was entitled to create this block – and the 16 new tokens – as a result of the random allocation of block creation rights according to stake conducted two weeks earlier. With his signature in place, Jarrett's software sent the proposed block out over the internet to the Tezos network.

G. Jarrett's Creation of Block 618,748 Is a Public Fact

How do we know that Jarrett successfully added block 618,748 to the blockchain and created 16 new tokens? We know because his block, published at 11:33:55 a.m. on September 22, is now part of the Tezos blockchain.[26] One minute later, another block was published, which identified Jarrett's as the preceding block and included 32 endorsements, each one helping to confirm that Jarrett's block was valid and deserved its place on the blockchain and, similarly, confirming that Jarrett's 16 new tokens should be recognized on the network.[27]

Anyone can check what is in block 618,748. An excerpt from this block, converted from raw data to the more human-readable JSON format, is attached as Exhibit A to the Declaration of Robert Witoff. The excerpt shows

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[26] More accurately, we know that Tezos account tz1gCx1V63bSaQnPZoQreqNgVLuFMzyMcqry baked block 618,748, because this is a fact anyone can confirm; we know that this is Jarrett's account because he told us that it is. Jarret Decl. ¶ 13.

[27] Strictly speaking, the addition of a block and its new tokens to the blockchain remains provisional for a period of time. For security reasons, new reward tokens are initially frozen, and are released after five complete cycles have elapsed.

the elements discussed above and, most importantly for our purposes, the receipt showing the addition of Jarrett's 16 new tokens to the blockchain.[28]

H. On September 22, Jarrett Also Created Two Tokens When He Validated and Endorsed Block 619,022

As mentioned, endorsement opportunities are also allocated by lottery. With 32 endorsement slots available for each of 4,096 blocks, going into the lottery Jarrett could expect to receive about 37 endorsement opportunities during cycle 151.[29] In fact, he received 41. For example, about four and a half hours after he baked block 618,748, Jarrett had the opportunity to endorse one block to be added to the blockchain at block height 619,022.[30] A baker proposed a block at that height at 9:10:36 a.m., giving Jarrett approximately one minute to verify and endorse it.

On its face, the baker's signature in a proposed block is just a string of characters, just as an ink signature is just a mark on paper. Verifying an ink signature requires comparing it to a known specimen. This is expensive and time consuming, so we often place trust in a third party who says that they have verified it, such as a bank with a specimen on file or a witness to the signing who knows the signer and whose notary stamp is easier to verify than the signature itself. Verifying a Tezos signature likewise requires a few steps. But unlike with ink signatures, there is never any trust involved. Every Tezos signature is always verified, and the cryptography involved allows Jarrett – or anyone at all – to verify any signature without ever seeing the signer's private key.

Every private key is matched to a public key, and that public key is used to create a unique address, or account. A Tezos account is indicated by a 32-character string that always starts with the letters "tz." Anyone can create a unique 32-character address, but to become an active Tezos account, it

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[28] Block explorers offer an easier way to find information published in blocks. *See, e.g.*, tzstats.com/618748 or tzkt.io/618748. The latter page also includes a link to view the complete, unedited block in JSON format.

[29] (20/71,476)*(4,096*32) = 36.676.

[30] But no more than one block numbered 619,022, because a purpose of endorsements is to establish one and only one addition to the blockchain. If an endorser endorses more than one block at the same block height – or if a baker bakes more than one block – he can be forced to forfeit tokens. Some forfeited tokens are shared with the baker who catches the offense, while for security reasons some are "burned," or destroyed. Tezos tokens are burned in several different situations reflecting various security concerns. In 2019, the majority of burned tokens resulted from these offenses of "double baking" and "double endorsing." A total of 118,658 tokens were burned in 2019. For consistent accounting and to match the approach taken in Appendix 1, *Dilution and True Economic Gain*, the total tokens created in 2019 is net of all tokens burned in 2019.

must be published to the blockchain in tandem with its associated public key. This ensures that everyone else has access to the information needed to verify signatures purporting to be made by that account.

For this signature verification step of the validation process, Jarrett's software required some data from the proposed block: the account listed as the block's baker, the signature, and the block data used with the baker's private key to create the signature. The account address led to the account's public key that was published on the blockchain when the account was first activated.[31] Putting this public key and the block data into a kind of verification machine, the result came back "valid." This meant the signature was indeed created with the baking account's private key. The last step was to verify that the lottery held at the end of cycle 145 did in fact authorize this account to create a block at height 619,022: also yes. Jarrett's software performed a similar check on all the other signatures appearing in the proposed block, which also came back affirmative.

The block was valid, so Jarrett issued his endorsement, complete with his own digital signature that would subsequently be verified and checked to prove *his* right to issue the endorsement under the lottery. His endorsement was successful: the baker of the next block received it and judged it to be valid, and Jarrett's endorsement and his two new tez were recorded in block 619,023.

I. Jarrett, and No One Else, Created These 16 + 2 Tokens

The point of this detailed retelling of several moments in September 2019 is to establish that Tezos stakers create tokens on account of their stake, or share, in the network. This is a defining fact about Tezos: The decentralization of token creation according to stake, made possible by cryptography and enforced only by the indifferent rules of the software, is what makes Tezos a public cryptocurrency. And, to token holders like Jarrett, it is what provides the assurance that tokens will remain scarce and valuable and that the network will continue to be maintained.

For tax purposes, Tezos tokens are property. This story of how Jarrett created these 16 + 2 tokens, as well as the block and the endorsement in which the tokens sprang into their digital existence, should also establish that reward tokens are *new* property. They did not exist until Jarrett created them. And the likelihood that approximately 39.5 million new tokens would have been created in 2019 with or without Jarrett's help does not affect the analysis. That a particular coyote or fish or gold nugget would have been

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[31] A Tezos public key is a string of characters which starts with the letters "edpk," "p2pk," or "sppk," depending on the cryptography used. Jarrett's public key, for example, is edpkui8eYJiQdTjSoYqK8uyuEKiJezVhsCPxX493ko7e7U6itQ7y6r.

taken by the next hunter or fisherman or prospector to come along doesn't tarnish the victor's claim over his or her new property. It cannot be said that Jarrett's tokens were created by Tezos or by the community of stakers or by all token holders.

J. Missed Opportunities Further Prove that Stakers Create New Tokens

If any doubts linger on this point, it is helpful to note how matters could have unfolded differently. For example, on September 12, during cycle 147, Jarrett held the right to create block 605,327 and, with it, 16 new tokens. But something went wrong.

At 11:42:36 p.m., the preceding block was published, starting the clock on Jarrett's opportunity to collect operations and, with a timestamp a minimum of sixty seconds later, publish the next block. Most Tezos blocks carry a timestamp exactly 60 seconds after the preceding block, but not this time.

Jarrett's power or internet could have gone out, though in this case it seems a software glitch caused Jarrett's baking software not to recognize that it had, in fact, collected the number of endorsements required to publish a valid block. Jarrett Decl. ¶ 31. The seconds ticked by until the rules allowed the next baker in line to publish a valid block. This backup baker had successfully collected and processed the required endorsements, and this substitute block went on to garner the endorsements required over the subsequent 60 seconds. Block 605,327 was added to the blockchain, but not by Jarrett, and not until 135 seconds had elapsed since the preceding block. Whatever the cause, Jarrett missed out on 16 tokens. And, due to the 135 second block time, it is also true that had Jarrett created that block on time, 2019 would have ended not with a total supply of 820,876,415 Tezos tokens, but with one additional block and 16 additional tokens, for a year-end supply of 820,876,431.

Similarly, on several occasions Jarrett missed an opportunity to create tokens by endorsing a block. On July 8, for example, he missed the opportunity to endorse the block that is now part of the blockchain at height 512,973. It is possible to endorse a valid block that does not end up as part of the blockchain; the purpose of endorsements is to establish a consensus around one and only one valid block, so that stakers can move ahead with adding subsequent blocks. In Jarrett's case, several missed endorsements over the course of a week in July led him to suspect a problem with his internet. He added two Wi-Fi connections to back up his ethernet connection, and the problem went away. Jarrett Decl. ¶ 18. Whatever the cause, on July 8 block 512,973 was added to the blockchain without his endorsement,

leaving Jarrett – and the universe – with two fewer Tezos tokens than otherwise would now exist.[32]

IV. Applicable Law

With this background on the mechanics and economics of Tezos in place, we can now address the possibility that Jarrett's new tokens are items of income enumerated under section 61 or are otherwise taxable under the Internal Revenue Code.

A. Reward Tokens Are Not Interest or Dividends

As should now be clear, reward tokens are not interest or dividends under section 61(a)(4) or (a)(7). Although no corporation or other entity created or issued Jarrett's new tokens (for he created them himself), it is helpful to establish why the analogy to taxable distributions of property does not support the taxation of new tokens as income. Tezos block rewards do bear a superficial resemblance to stock dividends, but the analogy fails completely. In fact, the example of stock dividends shows why Tezos tokens *cannot* be fairly taxed as income at their FMV on the date acquired, because doing so would result in an impermissible tax on the taxpayer's capital.

Reward tokens are not distributions and therefore cannot be taxed like dividends. The stockholder who receives a taxable stock distribution does not create that stock; the company does. But if Congress were inspired to tax Tezos reward tokens the way taxable stock dividends are taxed under IRC section 301 – that is, if Congress decided to tax reward tokens as a "distribution of property [to a cryptocurrency stakeholder] with respect to its [stake in the cryptocurrency network]," to quote from section 301(a) – then Jarrett would not have $9,407 in gross income. He would have zero gross income, because section 301(c) accounts for our concern, which is that only *gains* should be subject to tax.

By definition, dividends are paid out of a corporation's earnings and profits, *see* IRC section 316(a), and only dividends are gross income under section 301(c)(1). Tezos has no earnings or profits, so the new tokens would not be gross income. Under section 301(c)(2), all of Jarrett's new tokens would be "applied against and reduce the adjusted basis of [Jarrett's stake in Tezos]." From a fairness perspective, taxing Jarrett's tokens as income is wrong because some – indeed, most – of the tokens' value is appropriately viewed as a return of Jarrett's own capital. The example of section 301 does

[32] In 2019, 289,205 endorsement opportunities were missed. Also in 2019, on 13,145 occasions, the baker first in line failed to add a block to the blockchain, in each case causing the block time to be longer than the minimum of 60 seconds.

not undermine this concern, it validates it. *See Taxation of Block Rewards* at 956-958.

Despite section 301(c)'s express concern for the fair taxation of distributions, it is true that a dividend under section 316(a) can look like a return of the investor's capital. When a share purchased at $10 on Monday drops to $8 after a $2 dividend is paid on Tuesday, the unlucky or inattentive shareholder has $2 of taxable gross income. But this quirk of tax policy does nothing to justify taxing new Tezos tokens as income. New tokens never convey earnings and profits. And, taxing an apparent return of capital as though it were income would not be an exception limited to "occasional instances," as it is with dividend taxation. *United States v. Phellis*, 257 U.S. 156, 171 (1921). Rather, overtaxation would be the rule: day in and day out, Jarrett's new tokens would be subject to tax at a valuation in excess of his true gain. *See Taxation of Block Rewards* at 765.

B. Reward Tokens Are Not Compensation for Services under Section 61(a)(1).

The final enumerated category of gross income that could appear to include reward tokens is section 61(a)(1)'s "[c]ompensation for services." As the account of Jarrett's new tokens should make clear, no person and no entity paid these tokens to Jarrett as compensation for his help maintaining the network. The Tezos blockchain is not a corporation or any kind of entity for tax purposes. The importance of this point goes deeper than just the observation that "Tezos" is incapable of signing Form 1099s. The whole point of decentralized block and token creation is to prevent any such entity from establishing control over blocks and tokens. The fact that Jarrett's new tokens cannot be matched to an equivalent expense in some other ledger is a clue that the tokens are not compensation. But whether or not gross income from compensation for services always involves a corresponding accounting entry or some form of spending on the part of an identifiable other party – and clearly there is no such party here – the relevant fact is that Jarrett created the tokens.

Cryptocurrency is new and unusual, so it is worth pausing to examine why tokens might look like taxable compensation. At first glance, a staker who helps maintain the Tezos network can look a lot like the office tech admin who helps maintain a company's computer network. The tech admin receives compensation – probably in dollars, but it would not matter if it were in Tezos tokens – so perhaps the staker's new tokens are also compensation for services.

The analogy is flawed, because the apparent purpose of the economic activity is not what matters. What matters is whether the taxpayer creates the property or receives it from somewhere else. As shown, Jarrett did not

receive his tokens from another party, and the fact that the creation of these tokens also served a public good (i.e., a functioning Tezos network) does not transform them into compensation.

Often, the most salient "purpose" of efforts to create property is the property itself, and the wealth it brings. Artists create art, farmers grow wheat. But farmers also perform the service of irrigating their fields. Their most immediate reward – wheat – is not income, even though a farmhand who takes home wheat in lieu of dollars for *his* irrigation services does indeed receive taxable compensation under section 61(a)(1).[33]

The social good that comes from creating property is most commonly associated with the property's sale: collectors enjoy their new art and consumers get to eat. But taxpayers are not taxed on creating social goods, they're taxed on their income. The hunter who kills coyotes does not have income at the pelts' FMV on the date they are taken. His actual purpose is irrelevant. It does not matter if he hunts to protect his neighbor's chickens or simply to increase his wealth. The apparent social purpose of his activity is similarly irrelevant. If the Utah legislature offers a $50 bounty on coyotes in a Mule Deer Protection Act, one might well say the hunter performs the service of maintaining the state's deer population.[34] But this does not render the pelts compensation for services under section 61(a)(1). The same applies to Jarrett's maintenance of the Tezos network in the course of creating his new tokens.

Jarrett could not have created his tokens if other stakers were not also busy creating their own. This is how public cryptocurrencies work, and it is also why they work.[35] But this does not mean those other stakers or other token holders created Jarrett's 8,876 tokens or somehow paid those tokens to Jarrett as compensation. Jarrett was the first to own them. Creators need not be Robinson Crusoes to escape having their new property characterized as compensation or a distribution from a source. Some measure of social cooperation is generally required for the creation of new property, but

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[33] Unless he is keeping a share of his production as a sharecropper, in which case the wheat is not yet income to either him or the farm's owner. The current regulation, in section 1.61-4, traces to an early Treasury Decision which established the commonsense policy that a farmer's crops would not be rendered gross income simply because the crops passed through the hands of a sharecropper tenant as opposed to a farm employee: "Income from farm products and crop-share rentals to be included in the return of income for the year in which sold or exchanged for money or a money equivalent." Treas. Decision 2153, 17 Treas. Dec. Int. Rev. 1, 101 (1915).

[34] https://www.sltrib.com/news/environment/2018/06/30/want-get-cash-killing/.

[35] This is not to say that other kinds of digital tokens cannot be created without such decentralization, and of course the creation of such tokens is also not a taxable event. *See Taxation of Block Rewards* at 962, for a discussion of Ripple's XRP digital tokens, all 100 billion of which were created by a single entity.

civilization does not render all productive activity a partnership or a barter relationship.

Farms may rely on a water supply without which no crops could be produced. Whether the stream is maintained by a distant sovereign or through local farmers' agreement to share the burden, this "but for" cause of each farmer's crops does not render those crops compensation or any kind of taxable distribution. And unlike farmers jointly maintaining a stream, Tezos stakers do not cooperate with each other in a traditional sense. As the explanation of Jarrett's new tokens was intended to show, stakers do not work together to create tokens; they compete. And as shown by the explanation of signature verification, stakers do not even trust one another; they verify. Jarrett's 8,876 tokens are not compensation under section 61(a)(1) .

C. Taxpayer-Created Property Has Never Been Income

Because no express provision of section 61 or any other statute reaches Jarrett's tokens,[36] they are his gross income in 2019 only if they constitute income under the catch-all clause.

New Tezos tokens – like whittled tokens, Great American novels, wild truffles, coyote pelts, and so on – are not income to their first owner. But adducing rationales is easier than grounding the result in law. We suspect many whittled tokens and first novels will never find a buyer; half of all discovered truffles are not fit for sale; the pelt might be worth nothing if it fails the predator control coordinator's inspection. For the 8,876 tokens at issue, the valuation concerns are especially stark. Jarrett's gains were just a fraction of the tokens' cash value on the dates they were acquired, and determining which valuation to use would require a policy decision. There is also the problem of taxpayer liquidity and the considerable inconvenience of marking those tokens to market as they are acquired. These valuation and practical concerns may help explain the "universal understanding"[37] that taxpayer-created property is not taxable until sold. But the proof requires a bit more work.

The few tax provisions that touch on the matter do not establish the rule; they assume it. For example, the regulations will indeed protect farmers and miners from having their animals, vegetables, and minerals taxed as

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[36] Jarrett's 8,876 tokens are not prizes or awards under IRC section 74(a) and Treas. Reg. section 1.74-1(a)(1), and are not "[g]ains derived from dealings in property" under section 61(a)(3) or a "[d]istributive share of partnership gross income" under section 61(a)(12). The treasure trove regulation, Treas. Reg. section 1.61-14, was addressed above.

[37] Lawrence A. Zelenak & Martin J. McMahon, Jr., *Taxing Baseballs and Other Found Property*, 84 Tax Notes 1299, 1306 (Aug. 30, 1999).

income under section 61(a) prior to their sale. But these regulations' evident purpose is to establish what costs are *deductible* – or more to the point, are not deductible – in the calculation of gross income. The reason the regulations inform us that new calves and wheat and bauxite are not yet income is that the announced starting point for calculating gross income is "cash and the value of merchandise or other property received during the taxable year from [sales]" (farming; Treas. Reg. section 1.61-4) or "total sales" (mining; Treas. Reg. section 1.61-3). These regulations, in other words, are COGS provisions, and a deduction for the cost of goods *sold* is predicated on a *sale*.[38] It has always been this way. In 1913, the inaugural Form 1040 advised taxpayers that:

> The farmer, in computing the net income from his farm for his annual return, shall include all moneys received for produce and animals sold, . . . and he shall deduct therefrom the sums actually paid as purchase money for the animals sold or slaughtered during the year.
>
> When animals were raised by the owner and are sold or slaughtered he shall not deduct their value as expenses or loss. He may deduct the amount of money actually paid as expense for producing any farm products, live stock, etc.[39]

Where cost of goods sold is not a consideration in the calculation of gross income from created or discovered property, we should not be surprised to find the law silent on the requirement of a sale.[40]

D. The Catch-All Clause Has Never Reached Taxpayer-Created Property

"[G]ross income means all income from whatever source derived," so Jarrett's tokens are taxable in 2019 if they are income derived from a source.

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[38] *See also Taxation of Block Rewards* at 964 (example of the uniform capitalization rules, IRC section 263A).

[39] IRS Form 1040 for 1913, p. 4, instruction 11, irs.gov/pub/irs-prior/f1040--1913.pdf. The current regulation is similar, framed in terms of gross rather than net income. Treas. Reg. section 1.61-4. Early regulations also acknowledged one obvious reason why taxpayer-created property should not be valued on the date it is created: "When farm products are held for favorable market prices, no deduction on account of shrinkage in weight or physical value . . . shall be allowed." Treas. Reg. 33 (rev.), Art. 4, ¶ 31 (1918).

[40] *See Alpenglow Botanicals, LLC v. United States*, 894 F.3d 1187, 1199 (10th Cir. 2018) ("To ensure taxation of *income* rather than sales, the 'cost of goods sold' is a mandatory exclusion from the calculation of a taxpayer's gross income."). Jarrett does not claim that his creation of tez implicates COGS. The constitutional requirement that COGS be deductible *before* arriving at gross income, combined with the definition of COGS in terms of *sales*, may suggest a shortcut to the conclusion that created property is not income until sold, in particular for property for which there is a COGS.

IRC section 61(a). As it was in *Glenshaw Glass*, "[o]ur question is one of statutory construction." 348 U.S. at 429. The catch-all clause, by its text, fails to reach property created by the taxpayer. It fails because the required relationship between income (or its recipient) and the income's source is not present. Typically, income derives from the taxpayer's labor or property, and this will be the case if and when Jarrett realizes income or a taxable gain from his reward tokens. But that income is not – and cannot be – the same as that labor or property; it will be derived from that source.

"Derived from a source" informs the meaning of "income," which itself means something that has come in. "Derived from" establishes that the source and the income cannot be one and the same thing. The accepted meanings of "source" have evolved since 1913, but "from whatever source derived" remains part of the statute. *See* section 61(a). Prior to the 16th Amendment, income that derived from one's property – or put another way, rents and profits whose source was one's capital – could not be taxed by Congress due to the Constitution's prohibition on unapportioned direct taxes on property. *Pollock v. Farmers' Loan & Trust Co.*, 158 U.S. 601 (1895). The amendment removed this source restriction:

> The Congress shall have power to lay and collect taxes on incomes, from whatever source derived, without apportionment among the several States, and without regard to any census or enumeration.

U.S. Const. amend. XVI.

Soon, "the gain derived from capital, from labor, or from both combined" emerged as an early and concise definition of the income taxed under the post-amendment revenue acts. *Eisner v. Macomber*, 252 U.S. 189, 207 (1920) (quoting *Stratton's Indep., Ltd. v. Howbert*, 231 U.S. 399, 415 (1913)). Consider wages, the prototypical gain derived from labor. Labor – the source – is not itself income. Such gain does not become taxable as the labor is expended, but rather as the labor is in fact "sold": that is, as wages are paid or accrued. The immediate fruits of one's labor are not (yet) income, whether they take the form of new property created for one's employer, or new property created for oneself. Employee-created property is not income; the employee's income, derived from his labor, comes in as wages. Taxpayer-created property likewise is not income; the taxpayer's income, derived from his labor and capital, comes in from sales.

Imputed income – here meaning taxpayer gains from services provided to oneself or from property created and consumed by oneself – is not included in gross income. But if imputed income from self-created property *were* included in gross income, it is nonetheless clear that such income would be

realized at the time of the property's consumption, not the time of its creation.[41]

E. After *Glenshaw Glass*, the Catch-All Clause Still Does Not Reach Jarrett's 8,876 New Tokens

This explains why taxpayer-created property is not income under the statute under a *Macomber* interpretation of income, but what about under *Glenshaw Glass*? The early concern for the contours of *income* would be eclipsed by an emphasis on the *sources* of income reached by the statute. Income need not derive from the taxpayer's capital and/or labor, or even from a catalog of enumerated sources. Rather, *Glenshaw Glass* clarified that "income derived from any source whatever" would mean gains derived from *any* source. *Glenshaw Glass*, 348 U.S. at 429 (1955) (interpreting a predecessor to today's section 61(a)).

But this evolution does not change our result. If "any source" could mean "any source or no source at all," and if income means nothing more than gain, then perhaps Jarrett's tokens would be reached by the statute. But this is not what the Court held. Glenshaw Glass Company's windfall came in the form of cash, and that cash had certainly "come in" from somewhere – another company. The Court seemed to agree that the punitive damages award derived from the culpable conduct of that other company, *see id.* at 429, which is to say the income derived from *someone's* (culpable) labor. Or perhaps – as the court below had suggested – the payment derived from the sovereign and its decision to punish bad behavior. *Commissioner v. Glenshaw Glass Co.*, 211 F.2d 928, 933 (3d Cir. 1954). Whatever the case, the payment was derived from a source.

The Court in *Glenshaw Glass* therefore had no occasion to decide that "derived from [a] source" was text that could be ignored entirely. 348 U.S at 431 ("*Here we have* instances of undeniable accessions to wealth, clearly realized, and over which the taxpayers have complete dominion.") (emphasis added). Whatever the possible meanings of "source" in the statute, the requirement of *a* source survives *Glenshaw Glass*, and this requirement

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[41] *Morris v. Commissioner*, 9 B.T.A. 1273, 1278 (1928) ("Products of a farm consumed by the operator thereof and his family do not appear to come within any of the categories of income enumerated in the taxing statutes and the administrative regulations of the Commissioner. . . . If products of a farm consumed thereon are income to the producer, it would seem to follow that the rental value of the farmer's home, the gratuitous services of his wife and children, and the value of the power derived from draft animals owned by the farmer and used without cost should also be so considered. It is obvious that such items are comparable to the rental value of a private residence, which has never been regarded as income or as a factor in the determination of tax liability.")

continues to exclude taxpayer-created property from income as it has since the first revenue act in 1913.

As explained above, if the source is Jarrett's labor and capital, no income is derived from that source until the reward tokens are sold or exchanged. On this meaning of source, if Jarrett's tokens were income then the statute's requirement that income be "derived from a source" would not be met.

On the other hand, source could merely refer to the origin or nature of the taxpayer's receipts. This meaning is illustrated by the 14 items now listed in section 61(a) and is suggested by the Court's observation that "Congress applied no limitations as to the source of taxable receipts." *Glenshaw Glass*, 348 U.S. at 429. Applying this meaning to our case, "income derived from a source" would simply require receipts that come in from somewhere. Anywhere will do, but to give the words meaning, it must be somewhere *else*. Jarrett's receipts – that is, his reward tokens – would come from Jarrett, because Jarrett created them. The source and the recipient would be one and the same. Payments one makes to oneself are not income under section 61(a).

F. Income from Jarrett's 8,876 Tokens Has Not Been "Realized"

That Jarrett's 8,876 tokens are not income derived from a source pursuant to section 61(a) is also evident from the realization requirement preserved in *Glenshaw Glass*. As Professor Joseph Dodge has noted in a discussion of the "obscure" realization-of-income (as distinct from realization-of-*gain*) doctrine, "[i]n the case of self-created property, income is not realized until the self-created objects are sold."[42] The realization requirement originates in the text's admonition that income must be "derived from" somewhere. As Dodge explains the special case of taxpayer-created property:

> 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. Even the pure performing of services for wages or fees does not give rise to realized income until the wages are received or

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[42] Joseph M. Dodge, *Accessions to Wealth, Realization of Gross Income, and Dominion and Control: Applying the "Claim of Right Doctrine" to Found Objects, Including Record-Setting Baseballs*, 5 Fla. Tax Rev. 685, 688 (2000).

> accrued. The high labor component of self-created inventory (perhaps) results in a higher accounting profit, but the ratio of profit to accounting cost has nothing to do with when profit 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.

5 Fla. Tax Rev. 685, 697 (2000) (footnotes omitted).

Elsewhere, Dodge maintains that "the self-creation of an asset is not an 'accession,'" one of the requirements recognized by *Glenshaw Glass*: "One does not 'accede' to one's own labor or the fruits thereof."[43] The requirements of an accession to wealth, realization, and a gain derived from a source all lead to the same conclusion: the 8,876 tokens Jarrett created in 2019 are not yet taxable under section 61(a).

G. Property That Is Not Income Is Not Taxable Under the 16th Amendment

Congress's options for taxing cryptocurrency reward tokens need not be examined in order to grant Jarrett's request for refund. But it is helpful to see why a statute that did tax the 8,876 tokens at issue could be problematic, if only for further assurance that section 61(a)'s catch-all clause cannot be stretched to reach Jarrett's reward tokens.

In short, Jarrett's 8,876 tokens might not be among the "incomes, from whatever source derived" rendered taxable by the 16th Amendment. If they are not – for example, if they are simply his property or his inventory and no different from the 98,554 tokens he purchased during 2019, or if such a provision would be a tax on Jarrett's capital – then Congress's power to tax them might not be traceable to the 16th Amendment. Congress may tax anything, but unless blessed by the 16th Amendment a direct tax on property must be apportioned among the states according to population. U.S. Const. Art. I, Sec. 9, Cl. 4; *Nat'l Fed'n of Indep. Bus. v. Sebelius*, 567 U.S. 519, 571 (2012), *Pollock*, 158 U.S. at 618, *Macomber*, 252 U.S at 219. A tax that might be subject to apportionment under Article I, Section 9 of the Constitution should not be lightly inferred from a catch-all provision of a statute that in

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[43] Joseph M. Dodge, *The Fair Tax: The Personal Realization Income Tax*, 19 Fla. Tax Rev. 522, 544 n.60 (2016).

the history of the federal income tax has never been applied to taxpayer-created property.

V. Technology Considerations

The temptation to tax new cryptocurrency units as income arises from tokens' money-like qualities. But some of these qualities are products of convention, not necessity. Computer code is flexible, and it is helpful to note how a system of scarce, decentralized digital value could be designed differently.

For example, if Congress did insist on taxing new tokens as income, there is a relatively simple way for stakers to continue to create blocks, as required for network security, while confounding attempts to tax stakers on an exaggerated statement of their gain. Instead of stakers creating new tokens, non-stakers would have some of their existing tokens burned. Stakers would still garner an increased share of the token supply. But, with no new tokens to show for it, there would be no realization events to trigger the taxation of stakers' gains. *See Taxation of Block Rewards* at 769-70 (example of "Burn Coin"). Further, if burned tokens are viewed as non-stakers' costs for using the network without helping with its maintenance, non-stakers could then deduct their value as a business expense (at least those organized as a business).

Even more creative strategies could be devised if new tokens were deemed distributions. Like Burn Coin, a "Landoni Coin" would burn non-stakers' tokens. In addition, however, to avoid deflation, all holders would continuously receive new tokens in fixed proportion to their account balance. Since "[t]he proportional interest of each [stake]holder remains the same" (*Macomber*, 252 U.S. at 203; *see also* IRC section 305(a)), these pro rata "distributions" would not be taxable income. Importantly, Tezos itself could adopt the Landoni Coin model, which arguably better aligns the form of its incentives to their underlying economic substance.

Similarly, a stake in a cryptocurrency network could be expressed not in tokens but as a percentage of the network. Those who help maintain the network will see their percentages rise, while those who do not will see their percentages fall. Current law is not well-equipped to tax gains from such a cryptocurrency on an annual basis. In principle, however, it is possible. Leaving aside its constitutionality and practicability, under a Haig-Simons approach, stakers' gains could be taxed annually, and the statement of stakers' gains would indeed be accurate. Of course, non-stakers would also be taxed fairly, as their losses due to dilution would be recognized annually, the same as stakers' gains. *See Taxation of Block Rewards* at 770-71 (example of "Haig-Simons Coin").

The Haig-Simons approach highlights another key fact about the economics of Tezos. Stakers' gains from staking are equal to non-stakers' losses from not staking, due to dilution. *See Taxation of Block Rewards* at 766. In our case, Jarrett's true economic gain is balanced by some non-stakers' economic loss. Under Haig-Simons, year-end gains and losses from staking are a wash. Under our realization-based system, however, the non-staker's loss will not be realized until that non-staker sells or exchanges her tokens. Accordingly, there is no strong argument for expediting the taxation of Jarrett's new tokens, even if the income from those tokens were first adjusted to reflect Jarrett's true economic gain. In contrast, Congress does have an argument for expediting the taxation of corporate earnings and profits. One reason Congress has chosen to tax most non-pro-rata stock dividends is to prevent the tax-sheltered accumulation of E&P within corporations. *See Taxation of Block Rewards* at 957.

Haig-Simons is one way to treat stakers and non-stakers equally. The other way, of course, is simply to recognize that new tokens are not income. Stakers' gains from new tokens, like their gains from purchased tokens and like non-stakers' losses from dilution, will be fairly taxed at the time of sale.

VI. Practical Considerations

As just shown, cryptocurrency incentive mechanisms could be designed in response to tax policy. It appears that this has yet to happen, at least among cryptocurrencies that currently exist. Indeed, if reward tokens are their creators' income, existing cryptocurrencies might seem designed to create compliance headaches for all concerned. And as proof-of-stake technologists invent new solutions to increase the speed, reliability, and capacity of networks, compliance could become even more of a challenge.

Tezos is relatively simple and straightforward. New tez are created each minute, but for security reasons new tokens remain frozen and subject to forfeiture until, after five complete cycles, they are unfrozen and become spendable. This reduces the number of potential taxable events considerably. Still, every Tezos staker would be required to account for more than 100 taxable events each year. This also assumes, unrealistically, that each taxpayer's reward tokens accumulate in just one account. In fact, a single taxpayer may have a number of accounts, each one requiring a separate accounting. Joshua Jarrett kept immaculate records and presents an easy case. Still, recording even a couple hundred block reward transactions and matching them to historical market data is not necessarily an easy task.

Tezos is not the only proof-of-stake cryptocurrency, and more are on their way. The developers of Ethereum – the largest cryptocurrency network after Bitcoin, both in terms of total token value and the number of token holders in the United States – are currently planning a switch from proof of

work to proof of stake. And new technologies promise to introduce even more complications.

One example will help prove the point. Cosmos, like Tezos and the planned "Ethereum 2.0," is a proof-of-stake cryptocurrency network. Cosmos began operation in March 2019, and at the end of 2019 about 250 million of its native tokens, called Atoms, existed on the network.[44] Like Tezos, Cosmos is maintained by those who own its tokens, and new tokens are created as new blocks are added to the blockchain. Currently, Cosmos aims for an annual token creation rate of about seven percent, so we can predict that about 267.5 million Atoms will exist at the end of 2020. About 37,000 new Atoms, therefore, are created each day.

A prominent feature of Cosmos is that each new block becomes "final" – that is, a permanent part of the Cosmos blockchain – almost as soon as it is proposed by Cosmos' equivalent of a baker. For our purposes, this means that new Atoms (unlike new tez) need not be frozen for a period of time for security reasons.

Unlike Tezos, *every* Cosmos staker can participate in validating *each* new block – this is what makes instant finality possible. A new block is added to the Cosmos blockchain about each 6.5 seconds. This means that about 13,000 times a day, most Cosmos stakers create new Atoms. More precisely, 13,000 times a day each staker creates a very, very small fraction of an Atom. One Atom currently costs about $3.65. Each six and a half seconds a Cosmos token holder staking 1,000 Atoms can expect to create approximately 0.0000171289 Atoms, with a dollar value of approximately $0.0000625206.

"Approximately" is used here advisedly, because it turns out this is hard to check. Using the example of Jarrett's preparation of his 2019 Tezos records,[45] one might suppose a Cosmos staker could simply create a spreadsheet with 4,855,015 rows for the potential 4,855,015 taxable events occurring during a tax year.[46] After multiplying each quantity of reward token by the then-market price, the dollar figures could then be summed to arrive at a total for the tokens' FMV.

This is not possible, and not just because an Excel worksheet maxes out at one million rows of data. It is not possible because Cosmos does not record or even calculate this data as the blocks tick by. It is simply too much data to manage; Cosmos is designed to allow millions of token holders to help validate blocks. And the method Cosmos uses to economize on processing and

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[44] For facts in this section, *see* Declaration of Robert Witoff.

[45] *See* Jarrett Declaration and its Exhibit A, detailing 210 block reward entries.

[46] (365.25*24*60*60)/6.5 = 4,855,015.

storing data turns out to be quite inconvenient for precise tax accounting – *if* reward tokens are income at the time created or "received."

Cosmos stakers' block rewards are always immediately accessible. Stakers own and control their new tokens as soon as they are created with each block. But, moving these accumulated reward tokens – for example, to sell them, or to store them in a different digital wallet – requires an action on the part of the staker. And here is the twist: The number of accumulated reward tokens is not even calculated until such a request is made. And, when it is calculated, the result is a single number which accounts for all the tokens that the staker created since the previous calculation. In short, Cosmos simply does not provide a way to establish such tokens' FMV on the day (much less the 6.5-second interval) they became the property of the staker that created them.[47]

After the detailed account of Tezos, this fact about Cosmos might sound surprising or odd, but it shouldn't. Taxpayers never know what they've got until it gets counted. Ranchers don't know how many calves they have until they are gathered for spring branding. Even this roundup isn't mandated by the tax collector, because typically with taxpayer-created property the count that matters comes at the property's sale, which is the only time the value of the property is incontrovertibly "realized." The truly remarkable feature of cryptocurrencies is that so much historical data concerning the genesis of reward tokens is available in the first place.[48] No doubt this feature of Bitcoin and Tezos (but less so Cosmos) contributes to the sense that such tokens are akin to dollars for tax purposes.

With Cosmos, one option is to throw up our hands and find a taxable event only when a staker elects to move his or her reward tokens. But for obvious reasons, this is tantamount to conceding taxpayer control over income realization. Ultimately, this is the correct approach, but not due to any quirks of Cosmos' design or the justifiable fear of compliance challenges.

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[47] Third parties have begun to develop tools that provide estimates of accumulated Cosmos reward tokens, as well as methods to reconstruct and estimate the past accumulation and value of reward tokens. An example of an estimate of the reward tokens accumulated by a Cosmos staker can be viewed at https://www.mintscan.io/account/cosmos1cj7u0wpe45j0udnsy306sna7peah054upxtkzk. The figure for "Reward" is an estimate of the Atoms that will be available when the staker requests the reward tokens to be moved.

[48] Jarrett does not challenge the taxation of his 8,876 tokens on the grounds that their historical FMV cannot be determined. But while on the subject of tax practicalities, this problem should be noted. Not all cryptocurrency tokens have a genuine and liquid market to convert them into the dollars required to pay tax, and not all marketplaces are accessible to all token holders. In many cases, the existence of a price paid for a cryptocurrency token on a certain day on some or another marketplace does not actually establish that a staker could have sold tokens on that day and at that price.

It is the correct approach because new Atoms, like new tez, are property created by stakers and are therefore properly taxed at the time of their sale.

VII. Conclusion

Taxpayer Joshua Jarrett owns Tezos cryptocurrency tokens and participates in the maintenance of the Tezos network. He hopes that the value of the network increases over time as more people understand its features and the value of acquiring and using its tokens. He uses the network for the options it offers to store value, make payments, and for other emerging uses; he plans to use it for business applications of his own.

By staking, Jarrett participates in Tezos in a way he views as a prerequisite for further projects on the network. Staking also reduces his cost of holding tokens and using the network. Because some token holders did not participate in staking during 2019, his participation resulted in a net gain. As it turned out, his share in the network increased at a rate of 0.65 percent. His increased stake is reflected in the 8,876 new tokens he created in 2019, but during that period the total token supply increased at almost the same rate. The sum of the tokens' dollar value on the relevant dates, $9,407, bears little relation to Jarrett's true gain. On the most rigorous accounting method, his true gain was just 16 percent of this figure, or $1,458.

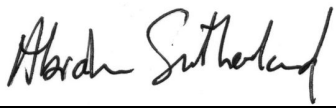
Section 61(a)'s catch-all clause neither requires nor permits such overtaxation. As it has for the last century, taxpayer-created property remains outside the reach of the gross income statute. Like tokens acquired by purchase, gains from reward tokens will be fairly taxed at the time of their sale or exchange.

Jarrett respectfully requests the Service's acknowledgment that, because Jarrett is responsible for the creation of the 8,876 tokens at issue and taxpayer-created property is not income under section 61(a), these tokens are not his gross income in 2019.

Dated: July 31, 2020

Respectfully Submitted,

Counsel for taxpayer



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Dilution and True Economic Gain From Cryptocurrency Block Rewards

by Mattia Landoni and Abraham Sutherland

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In this article, Landoni and Sutherland quantify the potential for overtaxation of a real-world taxpayer holding cryptocurrency tokens.

The views expressed in this article are those of the authors and do not necessarily represent those of the Federal Reserve Bank of Boston or the Federal Reserve System.

Dilution is the loss experienced by incumbent owners upon the creation of new ownership units (such as shares or tokens). Although many ad hoc patches to the U.S. tax code typically provide incumbents with some form of tax allowance for their loss, there appears to be no unified theory of accounting for dilution — for tax or any other purposes. When additions to one's balance from newly created units are viewed as an income realization event, whereas dilution is not, net income is systematically overstated. The resulting overtaxation could be a serious hurdle to the adoption of proof-of-stake cryptocurrencies, which rely on token creation by incumbent owners as an integral part of network maintenance. In this article we quantify the potential for overtaxation — defined herein as the excess of taxable income under a strict realization approach over true economic income — for a real-world taxpayer holding cryptocurrency tokens.

Our example taxpayer is a Tezos staker — a token holder who acquires new Tezos cryptocurrency tokens by participating in the maintenance of the Tezos network. We present the pros and cons of different methods of accounting for dilution when the cryptocurrency's aggregate network value, the taxpayer's ownership balance, and the rate at which dilution happens are all time-varying. We conclude that the acquisition of those tokens should not be an income realization event, although any of the methods we propose would be preferable to an approach of strict realization that ignores dilution entirely. Tax policy aside, the methods we develop to quantify the economic value lost to dilution are independently interesting to investors and other finance and accounting practitioners.

I. Definition of Income

The total change in wealth caused by ownership of an asset ($\Delta Wealth$) is:

$$\Delta Wealth = Distributions + Capital\ Appreciation \quad (1),$$

when capital appreciation is defined as the change in the asset's value and can be positive or negative.

Different operational definitions of income imply that different components of the change in wealth are included in current income. Under the most comprehensive definition, known as Haig-Simons income, both components are included. Under a "strict realization" principle, income includes distributions only, for the rest will be realized if and when the asset share is sold.

The U.S. income tax is not based on a strict realization principle, however, and taxpayers are often allowed to deduct reductions in the value of their investments (with a corresponding reduction in the tax basis) when these are reasonably certain

to have happened and are easy to quantify. The most obvious example is depreciation. If a business buys a car, it does not have to wait until the car is sold to a scrap yard to recognize an expense.

A less obvious example of a reduction in value is dilution. When owning a *share* of an asset, the capital appreciation is split into two components: the change in the value of the whole asset (prorated by the taxpayer's initial share), and dilution, defined as the current asset value times the change in the fraction owned that occurs because of the creation of additional shares independent of the taxpayer's purchases and sales:

$$\Delta Wealth = Distributions + Change\ in\ Asset\ Value - Dilution \quad (2)$$

Like depreciation, in many cases dilution results in an immediate explicit or implicit deduction for the taxpayer. Unlike depreciation, however, dilution is not a formally recognized taxable event and its treatment is determined on a case-by-case basis. For instance, for stock compensation, the corporation receives an offsetting deduction that indirectly benefits the shareholders being diluted. For a pro rata stock dividend, the distribution goes untaxed because it is automatically and exactly offset by dilution.

Cryptocurrencies consist of several tokens (units of accounting) in a network. If one accepts the uncontroversial premise that the value of a cryptocurrency network does not depend on the exact number of tokens it contains, then the creation of new cryptocurrency units results in dilution. Unlike random fluctuations in network value, which can give rise to both capital gains and losses, this dilution is sure to happen and sure to be detrimental to the taxpayer's wealth.[1]

As noted, dilution is fully and automatically accounted for under a Haig-Simons conception of income. Alternatively, dilution need not be accounted for if the acquisition of newly created tokens is not a realization event, as the combined effect will be accounted for at the time of sale. This is the position taken by one of us[2] on the grounds that new tokens are created by the taxpayer, and taxpayer-created property is not income under U.S. tax law. Under this approach, the true economic gains from both newly created tokens and purchased tokens will be accurately established, and can be taxed, at the time of those tokens' sale. However, if new tokens are viewed as distributions (despite not being distributed by anyone) and are taxed in the year in which they are acquired, current law does not provide a way for the taxpayer being diluted by those tokens to obtain a corresponding deduction.

In what follows we demonstrate that there is no one perfect method to account for this dilution. Accordingly, we propose three candidate methods, each with its own strengths and weaknesses. We then compare the results with an option for the tax treatment of block rewards that would disregard dilution. In 2014 IRS guidance stated that "mined" cryptocurrency tokens (such as bitcoins) are gross income at the tokens' fair market value on the date received.[3] This is a policy of strict realization because it fails to account for dilution. We call this policy of strict realization the cash value approach.

Our comparison is based on a specific cryptocurrency, Tezos, and we analyze both a stylized example (to build intuition) and a real-world example of a specific taxpayer. Dilution explains why the cash value approach systematically overstates taxpayer gain and is not desirable as a matter of tax policy. Our proposals therefore provide options for accounting for dilution, to make a realization-based annual tax fair. Each option results from a different but defensible approach to quantifying the economic value lost to dilution.

Because no one option is clearly superior, and because of the accounting complexity introduced by each option, we conclude that our results

[1] The best analogy is perhaps with buildings, for which depreciation is allowed, even though over time buildings experience both certain physical depreciation and uncertain financial appreciation with uncertain net effect. In this regard, the increase in a cryptocurrency's network value is highly uncertain: Mattia Landoni and Gina C. Pieters, "Taxing Blockchain Forks," 3(2) *Stan. J. Blockchain L. Pol'y* 197-227 (2020), showing that most newly launched cryptocurrencies experience large declines in market price and ultimately fade away.

[2] Abraham Sutherland, "Cryptocurrency Economics and the Taxation of Block Rewards," *Tax Notes Federal*, Nov. 4, 2019, p. 749; and Sutherland, "Cryptocurrency Economics and the Taxation of Block Rewards, Part 2," *Tax Notes Federal*, Nov. 11, 2019, p. 953 (hereinafter "Taxation of Block Rewards").

[3] Notice 2014-21, 2014-16 IRB 938, Q-8.

buttress arguments against a policy of annual taxation of reward tokens.

The lack of an obviously dominant option also implies that our discussion is independently interesting to investors in any assets subject to dilution. The accounting methods we develop suggest ways of decomposing investment returns into appreciation and dilution, and to produce consistent financial reporting of business income from cryptocurrency holdings.

II. Accounting for New Tokens

The aforementioned article presents a simple model for establishing true gains and losses from proof-of-stake cryptocurrency block rewards in light of dilution.[4] That model is based on two key variables which illustrate the consequences of ignoring dilution. The first is the rate at which new tokens are added to the network: the token creation rate. The second is the percentage of the total supply of tokens that participate in network maintenance through staking: the staking rate.[5] The model also excludes any changes in asset value, defined as the aggregate value of all tokens in the network. Later, we begin with this simplified model but then elaborate it to account for complications introduced when three parameters, held static in the simple model, are relaxed to account for their variance over time.

Tezos block rewards are the result of "staking" one's tokens (either directly, or through delegation), and staking is required to maintain the Tezos network. Tezos tokens have a readily verifiable market value and, as noted, one option, the cash value approach, is to include reward tokens in gross income at their FMV on the date acquired. Tezos tokens are property for tax purposes while taxes must be paid in dollars, and dollars are also the unit of account for most accounting purposes.

Tezos token holders are eligible to create new reward tokens proportionate to their holding, that is, to their ownership share in the network. If all token holders stake their tokens and receive pro rata block rewards, everyone's share would remain constant because block rewards would exactly make up for dilution. Then it would make sense to treat block rewards like pro rata stock dividends and exclude them from income. In this simplest case, when the staking rate is 100 percent, the token creation rate doesn't matter. Whether each holder's token balance increases by 10 percent or 1,000 percent, none experiences any gain and there should not be any income subjected to tax.

If some token holders do not participate in staking and therefore do not receive block rewards, then these "non-stakers" will see their share in the network decrease. If we know the token creation rate, then we know the effect of dilution on those who do not stake their tokens. The dilution rate is found from the reciprocal of the rate of increase of tokens in circulation. If the total supply of a cryptocurrency's tokens increases by 50 percent over the course of a tax year, every non-staker will see his share in that supply decrease by one third; if the creation rate is 10 percent, the dilution is 9.09 percent.[6]

The token creation rate is not enough, however, to establish stakers' gains from staking. Gains — both nominal and real — depend on the staking rate. Dilution affects stakers and non-stakers equally, but the extent to which stakers offset dilution through new tokens depends on how many stakers share in those tokens.[7]

We can use numbers drawn from Tezos to illustrate this simple model. In 2019 the total supply of Tezos tokens increased by about 5 percent, and so non-stakers' dilution was approximately 4.8 percent.[8] The staking rate varied over the course of the year, but averaged roughly 70 percent. Because the new tokens are divided among stakers, using these rough figures a Tezos staker would end the year with 0.05/0.7 =

[4] "Taxation of Block Rewards," *supra* note 2, at 760-771. The article also presents an overview of how a public cryptocurrency works, at 753-755, and a detailed explanation of how Tezos works, at 755-759.

[5] In "Taxation of Block Rewards," *supra* note 2, the term "validation participation rate" is used to describe what is here called simply "staking rate."

[6] (1 - (1/1.5)) = 33.33 percent; (1 - (1/1.1)) = 9.09 percent; *see* "Taxation of Block Rewards," *supra* note 2, at 764.

[7] Non-stakers' losses to dilution are equal to stakers' total net gains from staking. For this reason, stakers' gains can be viewed as a redistribution from non-stakers. *See* "Taxation of Block Rewards," *supra* note 2, at 764-765.

[8] Namely, the number of tokens increased from 781,346,794 to 820,876,415, a 5.06 percent increase. For a token holder who maintained a constant number of tokens throughout this period, this results in a 4.82 percent (= 1 - 1/(1.0506)) decrease in the share of total tokens.

7.14 percent more tokens. Accounting for the 5 percent new tokens, however, the true economic gain would be just (1 + 0.0714)/(1 + 0.05) = 2.04 percent.

This simple model is adequate to explain why the cash value approach overstates gain from staking. Under the cash value approach, the tax authorities treat the 7.14 percent new tokens as income, overstating the true gain by 250 percent.

Among other shortcomings, this model does not address the dollar value of Tezos tokens. There is no reason to suppose that the value of a single token, expressed in dollars, will remain constant as new tokens are added to the supply. The more reasonable assumption for a basic model is that the total network value remains constant, so that income is a function of distributions and dilution but not changes in asset value. This was the approach taken in "Taxation of Block Rewards." Assuming the value of the Tezos network holds constant, with 5 percent more tokens, at the end of the year the dollar value of a single token will be 95.24 percent what it was to start the year. With a 70 percent staking rate, a 5 percent token creation rate, and a constant network value, under the cash value approach stakers will show income of 6.97 percent of their initial share in the network.[9]

In real life, nothing remains constant. First, the value of the network expressed in dollars fluctuates — sometimes wildly. Second, the staking rate (and thus the dilution rate) varies over time; in 2019 it ranged between about 62 percent and 77 percent. (Note that, for a token holder who participates in validation, a higher number means less economic gain). Moreover, in practice reward tokens are not received in strict proportion to the tokens staked, especially over shorter periods of time.[10] Finally, stakers' balances change over time, as tokens are purchased or sold and as reward tokens are added to the balance.

Accordingly, a method of accounting for dilution must account for these three complications:

1. the taxpayer's balance is time-varying;
2. the rate of dilution is time-varying; and
3. the value of the network is time-varying.

The first complication is just a matter of using the appropriate accounting technique, explained in the next section. The second complication can be dealt with by using the measured rate of dilution. The third complication is the challenging one, because there is not one correct way of handling it.

We can think of at least three defensible methods. None is philosophically superior in terms of being "closer" to the concept of "true" economic income, but the methods require different inputs and therefore have different strengths and weaknesses.

Suppose on January 1 a taxpayer buys 600 Tezos tokens at a price of $0.42 per token (or $252 total). The total supply of Tezos at that time was 10,000. Next, suppose that on December 31 the total supply of Tezos rose to 15,000 and the token price rose to $0.50. What is the cost of the dilution sustained by the taxpayer?

A. Method 1: Depletion

While on January 1 the taxpayer owned 600/10,000 = 6 percent of the total cryptocurrency network, on December 31 she owns 600/15,000 = 4 percent, or one-third less. For this reason, the taxpayer takes a depletion charge equal to one-third of the tax basis of her investment, or[11]:

$$\textit{Depletion} = 252\ \left(1 - \frac{10{,}000}{15{,}000}\right) = 252 \cdot \frac{1}{3} = 84. \qquad (3)$$

The advantage of this method is that it does not require a market price and it is instead entirely based on transactions that happened in the past. The only data requirement is the total number of tokens outstanding at two points in time. Moreover, it is *consistent*: The depletion deduction is guaranteed to be less than the tax basis. Because

[9] (0.05 * ((1 + (1/(0.05 + 1)))/2))/0.7 = 0.0697. *See* "Taxation of Block Rewards," *supra* note 2, at 766-767.

[10] For example, opportunities to validate blocks are assigned at random; opportunities to create or endorse blocks can be missed; and delegators may agree to share a portion of their apportionment with those — the delegates — who operate the computer hardware and software that convert staked tokens into a stream of newly created tokens. For a detailed explanation of how Tezos works, see "Taxation of Block Rewards," *supra* note 2, at 755-758.

[11] Even though the accounting concept of depreciation is more widely known, the method we propose is more similar to cost depletion (*see, e.g.*, Internal Revenue Manual section 4.41.1, "Oil and Gas Handbook"): in Equation (3), the deduction is based on the estimated drop in one's ownership share and not on the passage of time.

of this consistency property, this method is suited for financial reporting to shareholders by a business that owns tokens.[12] Disregarding dilution altogether, as in the cash value method, would result in overstated business income, potentially distorting management compensation or shareholder perception of value. On the other hand, accounting for dilution using an inconsistent method could result in the business holding the tokens at negative book value, also an undesirable result.

B. Method 2: Market-Based

The market capitalization of Tezos went from $4,200 ($0.42 x 10,000) to $7,500 ($0.50 x 15,000), a 79 percent increase in network value, while the taxpayer's position went from $252 to $300 (a 19 percent return). The difference in return (79 percent - 19 percent = 60 percent of $252, or $150) must be mathematically caused by dilution. Equivalently, if the taxpayer had owned 6 percent of all Tezos in circulation on December 31, her position would have been worth $450 (6 percent x 15,000 x $0.50). Because her position is only worth $300, the value lost to dilution is $150 ($450 - $300).

This method is more complex, as it requires additional information: the price of Tezos at two points in time, in addition to the number of tokens outstanding. The main advantage of this method is that it is *accurate*: Unlike the depletion method, this definition captures the true economic cost of dilution under FMV (or Haig-Simons) accounting, that is, the third term in equation (2). For this reason, this method is suited for any business purposes that require measuring the true economic cost of dilution, such as performance attribution in an investment portfolio.

Unlike the depletion method, moreover, this method is not consistent. In the extreme, if on December 31 the price of Tezos rises to $1 (twice the previously assumed value), the value lost to dilution is $300 (2 x $150), more than the original cost basis of $252, resulting in negative book value. This problem happens precisely because this method allows the taxpayer to deduct the full market value cost of dilution without requiring her to first realize the market value of her unrealized capital gains (that is, it uses the Haig-Simons approach on the "minus" side but not on the "plus" side).

A less obvious consequence of this inconsistency is that the greater the unrealized capital gain, the greater the taxpayer's deduction is! Thus, a higher Haig-Simons income (a larger increase in market value of wealth) results in a lower taxable income. For this reason, this method would likely be deemed too favorable to the taxpayer and thus unacceptable as a method of determining taxable income.

C. Method 3: Imputed Dilution

The prior two methods highlight an apparently unsolvable trade-off between consistency and accuracy. On one hand, the market value of rewards is counted as current income, and thus it seems appropriate to offset it using the market-value cost of dilution. On the other hand, the market-value cost of dilution can be greater than the combined value of income from rewards and the taxpayer's basis in the original tokens. Accounting for tokens at FMV (that is, setting taxable income equal to Haig-Simons income) solves the trade-off but creates well-known problems, which is why the taxation of unrealized gains and losses on an FMV basis has found very limited application in real-world tax systems.[13]

A potential solution to this conundrum is to directly adjust rewards for an imputed cost of dilution. In our example, the total supply of tokens grows in a year by 50 percent (from 10,000 to 15,000). Our taxpayer begins the year with 600 tokens and would have to acquire 300 additional

[12]To the best of our understanding, the recommended treatment of block rewards under current U.S. generally accepted accounting principles closely resembles the cash-value approach to taxation. The Association of International CPAs considers tokens "intangible assets with indefinite life" ("Accounting for and Auditing of Digital Assets" (2019)). Under this treatment, rewards would be included in net income at market value whereas unrealized gains and losses, including those caused by dilution, would not be recorded. If, instead, the business were allowed to hold the tokens as "trading" securities (*see, e.g.*, Financial Accounting Standards Board, topic 320), it could then use FMV accounting (essentially, the Haig-Simons definition of income) and our argument would not apply.

[13]The only instance the authors are aware of is Italy's short-lived experiment in the late 1990s. For an account, see Julian Alworth, Giampaolo Arachi, and Rony Hamaui, "What's Come to Perfection Perishes: Adjusting Capital Gains Taxation in Italy," 56(1) *Nat'l Tax J.* 197-219 (2003).

tokens to maintain her proportionate share in the network. In practice, however, she may receive more than 300 tokens if other token holders choose not to participate in validation. For instance, suppose that 75 percent of tokens participate in validation (that is, the staking rate is 75 percent). In that case, our taxpayer should expect to receive 5,000 * 600/(10,000 * 0.75) = 400 tokens. Of these, 300 (75 percent of all tokens received) compensate the taxpayer for dilution, and the remaining 100 (25 percent) constitute a transfer from non-validators to validators, that is, income.

While the explanation is somewhat complicated, the resulting math is very simple. Under this proposal, taxable income is calculated as:

$$\textit{Taxable Income} = \textit{FMV of Tokens Acquired} \cdot (1 - \textit{Validation Rate}). \quad (4)$$

This method has two main advantages, both deriving from the fact that it does not affect the tax basis of, nor does it require any knowledge of, existing tokens, and income is defined at the level of individual reward transactions. First, as will be clear in the following section, this method greatly simplifies accounting. Second, while it is an approximate method, it does come close to solving the apparently unsolvable trade-off between accuracy and consistency, as it roughly captures *only the realized portion* of the FMV cost of dilution.

This resolution, however, comes at the cost of generality because it embeds knowledge specific to the Tezos network. This is a high cost: While the concept of staking rate exists in some form for most proof-of-stake cryptocurrencies (that is, those cryptocurrencies for which network maintenance is performed by token owners, and thus dilution accounting is most relevant), the rule proposed here is not guaranteed to be easily applicable to every existing and future cryptocurrency. Thus, the greater simplicity in accounting is offset by a greater complexity in regulation — namely, the potential for having as many distinct practical implementations of this method as there are cryptocurrencies.[14]

Also, the loss of generality is with respect to the taxpayer's behavior as well. The imputed dilution method essentially assumes that the taxpayer engages in staking directly and without pause throughout the entire tax reporting period. A taxpayer who stakes intermittently or delegates to others could plausibly earn less than necessary to keep up with the creation of new tokens. For this taxpayer, the true net income from holding Tezos is negative, but taxable income is positive. This happens because the taxpayer only gets an allowance for dilution when staking but gets diluted all the time.

III. A Stylized Example

Methods 1 and 2 isolate the losses from dilution regardless of whether token holders stake their tokens. If annual taxation is predicated on the receipt of reward tokens as a realization event, the more important case involves the token holder who stakes his tokens and as a result acquires reward tokens during the year.

Suppose that after having purchased 600 tokens on January 1, our taxpayer acquires 140 Tezos reward tokens on May 26 when the total supply is 12,000 and the price is 0.5, and then another 260 reward tokens on October 19 when the total supply is 14,000 and the price is 0.6. The next table shows that cumulative reward income as of December 31 is $226, if rewards are measured at their FMV on the date received (that is, the cash value approach). What is the total "true" income, net of dilution?

[14] In Tezos, for example, the staking rate that determines a staker's potential to create new tokens is determined at t_1, tokens are created at t_2, and they remain subject to forfeiture until they are released to the full control of the staker at t_3. By design, the elapsed time between t_1 and t_3 varies randomly between approximately 31 and 35 days. For ease of accounting, our imputed dilution method uses the staking rate as of the date the new tokens are actually acquired. A more accurate method tailored to Tezos would use the staking rate at t_1, or even at a time in a fixed relation to t_3 (*e.g.*, 30 days before).

Table 1

		XTZ				USD		
Date	XTZ: USD	Supply	Balance	Award	Purch.	Balance	Award	(Cum.)
1/1	0.42	10,000	600		600	252.00		0.00
5/26	0.50	12,000	740	140		370.00	70.00	70.00
10/19	0.60	14,000	1000	260		600.00	156.00	226.00
12/31	0.50	15,000	1000			500.00	0.00	**226.00**

Because the total supply of Tezos tokens changes at every reward transaction, any dilution allowance must be calculated upon every transaction starting from the previous transaction. For reporting purposes, the resulting income figures can be aggregated at arbitrary frequency.[15]

This section does not deal with the imputed dilution method. Because the cost of dilution is calculated on a per-transaction and not on a per-period basis, there is no need to worry about time-varying balances.

A. Depletion Method

For instance, on May 26 we calculate depletion for the first time just one instant before the balance changes for the first time. Depletion is calculated as the original tax basis (252) times the relative change in share. The preexisting tokens used to be the entirety of the tokens (10,000/10,000), whereas now they are only five-sixths (10,000/12,000), resulting in a one-sixth drop in share:

$$Depletions_{5/26} = 252\left(1 - \frac{10{,}000}{12{,}000}\right) = 252 \cdot \frac{1}{6} = 42. \quad (5)$$

The total new book value on May 26 after the reward transaction is then calculated as the remaining book value of the initial Tezos tokens (252 - 42) plus the new book value of the reward tokens (0.5 * 140):

$$Book\ Value_{5/26} = 252 - 42 + (0.5 \cdot 140) = 280. \quad (6)$$

On October 19, upon recording a new transaction, once again we take stock of the intervening depletion:

$$Depletion_{10/19} = 280\left(1 - \frac{12{,}000}{14{,}000}\right) = 280 \cdot \frac{1}{7} = 40. \quad (7)$$

And so forth. Note that depletion could be computed more frequently and regardless of transactions, but it has to be computed at least upon every transaction, that is, every time the number of tokens changes.

The results are summarized in Table 2, which shows that true income calculated this way is $117.60. Therefore, compared with this method, taxing reward income without any dilution allowances results in taxable income that is 92 percent greater.

B. Market Value Method

Up to May 26, the taxpayer's return has been 19 percent (price increase from $0.42 to $0.50). In the same period, however, the market capitalization of the network has increased from $4,200 to $6,000, a 42.9 percent increase. In the absence of dilution, the taxpayer would have realized an additional return of $60, or 23.8 percent (42.9 percent - 19 percent) of her initial investment of $252.

$$MV\ Dilution_{5/26} = 252\left(\frac{6{,}000 - 4{,}200}{4{,}200} - \frac{0.5 - 0.42}{0.42}\right) =$$

$$252 \cdot (42.9\% - 19.0\%) = 252 \cdot 23.8\% = 60.00. \quad (8)$$

Once again, the procedure is repeated at every transaction. On May 26, after receiving the first reward, the taxpayer's Tezos position is worth $370. On October 19, before receiving the second reward, the position has experienced a return of 20 percent (price increase from $0.50 to $0.60),

[15] Cryptocurrency ledgers typically update at a much higher frequency than that required by tax reporting. Approximately each minute a new block of transactions and up to 80 new Tezos tokens are added to the Tezos blockchain; there were 509,356 new blocks added during the 525,600 minutes of 2019. However, new reward tokens are initially frozen for security reasons, and are unfrozen (become spendable) about once every three days.

Table 2

	Depletion Method (USD)			
Date	BV	Depletion	Net Income	(Cum.)
1/1	252.00			0.00
5/26	280.00	-42.00	28.00	28.00
10/19	396.00	-40.00	116.00	144.00
12/31		-26.40	-26.40	**117.60**

Table 3

	Market Value Method (USD)					
Date	Ret%	Mkt Cap	Mkt Cap Ret %	MV Dilution	Net Inc.	(Cum.)
1/1		4,200				0.00
5/26	19.0%	6,000	42.9%	-60.00	10.00	10.00
10/19	20.0%	8,400	40.0%	-74.00	82.00	92.00
12/31	-16.7%	7,500	-10.7%	-35.71	-35.71	**56.29**

while market value has increased by 40 percent. The loss to dilution is therefore:

$$MV\ Dilution_{10/19} = 370 \left(\frac{8{,}400 - 6{,}000}{6{,}000} - \frac{0.60 - 0.50}{0.50} \right) =$$

$$370 \cdot (40.0\% - 20.0\%) = 370 \cdot 20.0\% = 74.00. \quad (9)$$

And so forth. The results are summarized in Table 3, which shows that true income calculated this way is $56.29. Therefore, compared with this method, taxing reward income without any dilution allowances results in taxable income that is 302 percent greater.

IV. Real-World Example

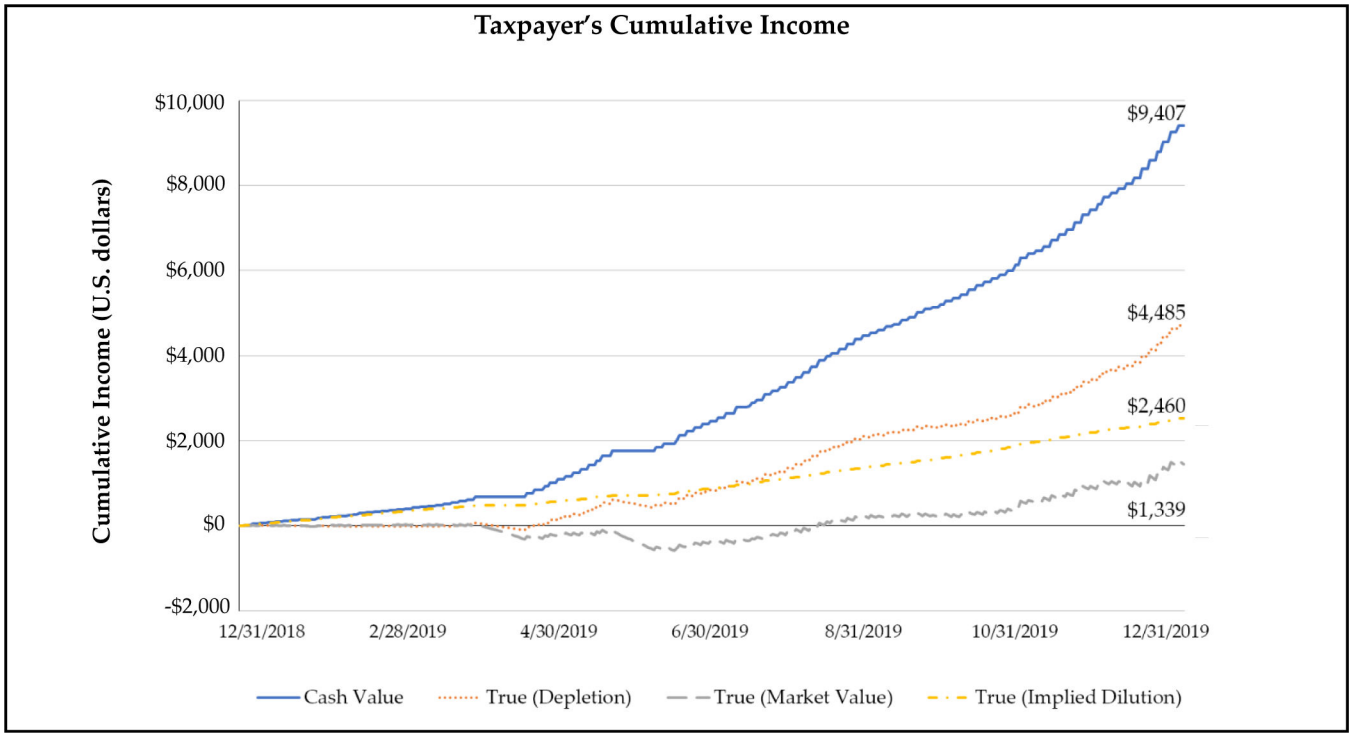
We now apply these methods to a real taxpayer's participation in the Tezos network and compute the taxpayer's total taxable income for 2019.

We use four methods:

1. The "cash value method" (include rewards in gross income at their FMV on the date received, with no deductions for dilution).
2. The "market value method" (dilution allowance based on market value of dilution loss).
3. The "depletion method" (dilution allowance based on fraction of initial investment).
4. The "imputed dilution method" (taxable income is computed already net of dilution allowance as the portion of reward tokens' FMV that exceeds the rewards expected in a 100 percent staking scenario).

This taxpayer staked his Tezos tokens throughout 2019, initially by delegating them to others, and later by delegating them to himself and directly operating a computer running the Tezos software that validated transactions. His initial balance on January 1, 2019, was 102,708 tokens. On several occasions during the year, he added to his staking balance through purchases of tokens. These purchases totaled 98,554 tokens. On two occasions he reduced his staking balance, selling a total of 460 tokens. During 2019 the taxpayer acquired 8,876 tokens as a result of staking; these tokens were added to his balance on more than 100 different days. His token balance at the close of 2019 was 209,678.

The total supply of Tezos on January 1, 2019, was 781,346,794. During 2019, the supply



increased by 39,529,621 tokens or 5.06 percent,[16] and at the end of the year the total supply was 820,876,415. The market price of a single token began the year at $0.49 and trended upward, ending the year at $1.32, an increase of 169 percent. The value of the total token supply started the year at $356,735,257 and ended the year at $1,085,198,621, an increase of 182 percent.

The taxpayer's 8,876 reward tokens, after adjusting for reward tokens as well as deposits and withdrawals over the course of the year, reflect an annual increase in tokens caused by staking of 5.74 percent.[17] The taxpayer reported the gains from his reward tokens by establishing their FMV on the date they became spendable.

The chart above reports the taxpayer's cumulative income under each of the three methods.[18] The outcomes are very different, but under any definition of true economic income the cash value approach drawn from the 2014 IRS guidance results in a substantial overstatement of taxpayer income and results in overtaxation.

Note that the "depletion" method is sensitive to the tax basis of the existing position on January 1. To show how the result differs, we provide four different assumptions for the tax basis:

- zero basis (as if the taxpayer had, for example, obtained the tokens for free) — a lower bound;
- basis = market value of tokens on January 1, 2019 (as if they had been bought on that date — a reasonable approximation of the situation of most taxpayers);
- basis = $4.46/token (all-time high — a practical upper bound); or
- basis = $10/token (an arbitrarily high number — a theoretical quasi-upper bound).

The results are reported in the following table, in which "income overstatement" is calculated as (taxable income under cash value method - taxable income under depletion method) / absolute value of taxable income under depletion method.

[16] 39,529,621 is the net total Tezos tokens created in 2019. A total of 39,648,280 tokens were created as block rewards, but a total of 118,658 tokens were burned (or destroyed) as security measures.

[17] This figure is computed as the taxpayer's Tezos-denominated time-weighted return.

[18] A sample of the data and our calculations is shown in the appendix.

Table 4

Rationale	Basis on 1/1/2019 (USD)	Income Overstatement
Most conservative	$0	32.90%
Market value	$46,886	93.18%
$4.46 per token	$458,079	162.59%
$10 per token	$1,027,084	116.74%

While the result is sensitive to the assumption, the estimated income overstatement is at a minimum 32.9 percent.

V. Conclusion

In this article we have examined three methods to account for dilution in proof-of-stake cryptocurrencies. The creation of new tokens ("block rewards") is often used as a device to encourage network maintenance and always results in dilution. Quantifying the economic effect of dilution is important for proof-of-stake cryptocurrencies in particular, as their networks are maintained by token owners as opposed to third-party miners. Therefore, to participate in network maintenance and obtain block rewards, one must suffer dilution as well. If block rewards are taxed as realized income, without a way to quantify the effect of dilution, cryptocurrency owners are likely to suffer from overtaxation.

Our methods attempt to reconcile the underlying economics of block rewards and dilution with a realization-based system. This turns out to be a formidable challenge. We propose a depletion method, which is consistent — that is, it never results in a depletion allowance greater than the cryptocurrency's initial cost basis — but inaccurate, as it does not measure the true market value cost of dilution. Next we propose a market-based method, which is accurate but inconsistent. Finally, we propose an imputed dilution method which is simple and offers a practical compromise between accuracy and consistency, but at the cost of generality — that is, it only works under specific assumptions.

It is therefore natural to conclude that instead of allowing proof-of-stake validators to realize the value of their dilution, it is simpler and fairer to allow them not to realize the value of their block rewards until sold.

Aside from tax, the methods we develop can be useful for valuation and management of cryptocurrency portfolios and inventories. The depletion method is suitable for reporting under delegated management, when realization matters and consistency matters more than correctness. The market-value method is likely more useful for cryptocurrency valuation and portfolio management, when total income (realized plus unrealized) matters. While in that context FMV accounting is both easy and best, our method is still useful to decompose investment performance into rewards, dilution, and actual asset appreciation.

VI. Appendix: Data Excerpt and Calculations

Table 5

Date	XTZ ($)	# Tokens	Rewards (XTZ)	Rewards (USD)	Rewards (USD, Cum.)
1/1/2019	0.4805	781,457,300	0.00	0.00	0.00
1/2/2019	0.4738	781,564,265	44.12	21.20	21.20
1/3/2019	0.4785	781,673,212	0.00	0.00	21.20
1/4/2019	0.4714	781,780,984	0.00	0.00	21.20
1/5/2019	0.4781	781,889,615	44.14	20.81	42.01
1/6/2019	0.4794	782,000,032	0.00	0.00	42.01
1/7/2019	0.4753	782,110,563	0.00	0.00	42.01
1/8/2019	0.4702	782,218,411	44.16	20.99	63.00
...					
12/24/2019	1.5138	820,104,596	0.00	0.00	9,027.49
12/25/2019	1.3758	820,215,207	0.00	0.00	9,027.49
12/26/2019	1.4010	820,324,794	166.35	228.87	9,256.36
12/27/2019	1.3629	820,436,878	0.00	0.00	9,256.36
12/28/2019	1.3249	820,549,859	0.00	0.00	9,256.36
12/29/2019	1.3260	820,662,081	113.34	150.16	9,406.52
12/30/2019	1.3029	820,773,664	0.00	0.00	9,406.52
12/31/2019	1.3220	820,876,415	0.00	0.00	9,406.52

Table 6

Cum. USD	Depletion		Market Value		Imputed dilution
Date	Depletion	Income	MV Dilution	Income	Income
1/1/2019	6.63	-6.63	6.98	-6.98	0.00
1/2/2019	13.05	8.15	13.64	7.26	16.83
1/3/2019	19.58	1.62	20.49	0.41	16.83
1/4/2019	26.05	-4.85	27.17	-6.27	16.83
1/5/2019	32.56	9.45	34.00	8.01	33.22
1/6/2019	39.18	2.83	40.96	1.05	33.22
1/7/2019	45.81	-3.80	47.86	-5.86	33.22
1/8/2019	52.27	10.73	54.53	8.24	49.44
...					
12/24/2019	4,542.81	4,484.68	7,726.91	1,339.40	2,460.33

Table 6 *(Continued)*

Cum. USD	Depletion		Market Value		Imputed dilution
Date	Depletion	Income	MV Dilution	Income	Income
12/25/2019	4,563.02	4,464.47	7,765.77	1,300.55	2,460.33
12/26/2019	4,583.05	4,673.31	7,804.97	1,494.41	2,498.30
12/27/2019	4,603.56	4,652.80	7,843.99	1,455.38	2,498.30
12/28/2019	4,624.22	4,632.14	7,882.23	1,417.15	2,498.30
12/29/2019	4,644.74	4,761.78	7,920.23	1,529.43	2,524.14
12/30/2019	4,665.16	4,741.36	7,957.38	1,492.29	2,524.14
12/31/2019	4,683.96	4,722.56	7,992.08	1,457.58	2,524.14

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