A theoretical concept of cryptocurrencies employing proof of socially beneficial work

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Abstract

We propose a theoretical concept of cryptocurrencies employing proof of socially beneficial work, which have the potential to become a major source of funding for nonprofit organizations aiming at benefiting society. New tokens of these cryptocurrencies would be issued only based on work that has already been conducted, with demonstrated and easily quantifiable positive results. We theorize that such cryptocurrencies will emerge and be progressively utilized to fund socially beneficial work without increasing indebtedness or inflation in the countries where the tokens are minted. Moreover, we theorize that such cryptocurrencies will be more successful than cryptocurrencies employing traditional proof schemes, of which the most common are proof of work and proof of stake. Since our theorizing proposes, for the first time, the idea of cryptocurrencies employing proof of socially beneficial work, it is also aimed at spurring interest in this idea.

KEYWORDS: Cryptocurrencies, Mining, Minting, Proof of Work, Proof of Stake, Proof of Socially Beneficial Work

JEL Classification: G10; G11

1. Introduction

While there has been increasing interest in the use of cryptocurrencies to benefit society (Breidbach & Tana, 2021; Liu et al., 2022), most of the existing initiatives rely on structures that may be too rigid, lack transparency, or support consensus-building approaches that are too limited to fully achieve their societal goals (Leafscore, 2022). A prominent example is the SolarCoin project, which has promised to issue 1 Solarcoin for every Megawatt hour generated from solar technology. It is very difficult to find any information on SolarCoin from major cryptocurrency exchanges, let alone any discussion about who generates electricity from solar technology and who receives the new tokens (a.k.a. coins). Perhaps because of this and related limitations, the cryptocurrency exchange Coinbase (Kathiravan et al., 2019) suggests that SolarCoin: has been in existence since 2014; the market value of each token has reached a peak of $2.64 in 2018; and its market value has collapsed since, having dropped below $0.01 at the time of this writing.

We believe that cryptocurrencies hold great promise in terms of their potential to benefit society. Moreover, cryptocurrencies could provide a solution to a major monetary problem that has been plaguing countries (Bommer, Milevoj, & Rana, 2023), particularly since 2020. Countries have been having to increasingly issue debt to fund social benefits, particular retirement benefits (Bixby, 2020; Eisner & Pieper, 1984; Fair, 2012). The greater the debt-to-GDP ratio of countries, the higher are the yields expected by lenders (i.e., holders of that debt), leading to further increases in the countries' debt loads and additional deterioration in debt-to-GDP ratios (Hsing, 2015; Poghosyan, 2014). To control these yields, countries' central banks have been progressively relying on becoming major lenders to their own governments, by issuing new currency and decreasing the supply of government debt securities (Blinder, 2010; Fawley & Neely, 2013). This leads to an erosion in the value of those countries' currencies, causing consumer price inflation (Christensen & Gillan, forthcoming; Picault

et al., forthcoming). When many countries do this in a synchronized way, a somewhat contradictory state of affairs develops. More desirable currencies, such as the U.S. dollar, gain value against other currencies, even as holders of those currencies lose purchasing power with respect to basic products and services consumed in their own countries.

We develop a theoretical concept of cryptocurrencies employing proof of socially beneficial work, where new tokens are created based on work that has already been completed and that has had demonstrable societal benefits – e.g., health improvement achievements among the low-income residents of a city. We theorize that such cryptocurrencies will emerge and be progressively utilized to fund socially beneficial work in countries without increasing those countries' indebtedness, and also that such cryptocurrencies will be utilized to expand the monetary base of those countries without causing inflation. Additionally, we theorize that such cryptocurrencies will be more successful than cryptocurrencies employing traditional proof schemes that have no inherent benefit to society, of which the most common are proof of work and proof of stake. Since our theorizing proposes, for the first time, the idea of cryptocurrencies employing proof of socially beneficial work, it is also aimed at spurring interest in this idea.

Before examining the specific theoretical concepts around PoSBW cryptocurrencies, it is important to understand the philosophical orientation that motivate and shape this approach, grounded in the principles of effective altruism.

2. Philosophical orientation: Software-driven effective altruism

The aftermath of the financial crisis of 2008 (Acharya & Richardson, 2009) has seen the growth of a new social movement and approach to philanthropy called effective altruism (Gabriel, 2017). This social movement encourages individuals and organizations to make altruism a central part of their existence and do as much good as possible in ways that leverage their specific expertise and

resources. Peter Singer and William MacAskill have been notable among philosophers in their contribution to popularizing the underlying ideas of effective altruism (Benatar & Singer, 2000; MacAskill, 2017).

Individuals and organizations whose expertise and resources are related to software development can practice a genre of effective altruism, which we refer to here as software-driven effective altruism, by creating software infrastructures that provide the basis on which socially beneficial activities may take place. These software infrastructures are envisioned as being explicitly designed to benefit society. Arguably, one prominent example of this is Wikipedia (Kock et al., 2016), which is one of the projects of the nonprofit organization Wikimedia Foundation.

The new modality of cryptocurrencies that we discuss in this paper, cryptocurrencies employing proof of socially beneficial work, can be seen as implementations of software-driven effective altruism. We argue later in this paper that while a blockchain (Lacity & Van Hoek, 2021; Lumineau et al., 2021; Mattke et al., 2019; Murray et al., 2021; Renwick & Gleasure, 2021; Rossi et al., 2019) is a critical and central component of these implementations, a better analog to what we foresee is in fact Wikipedia, because of its extensive reliance on discussion and highly transparent fact-based consensus building. We envision this consensus building as necessary for minting of new cryptocurrency tokens.

3. Countries' social benefits and indebtedness

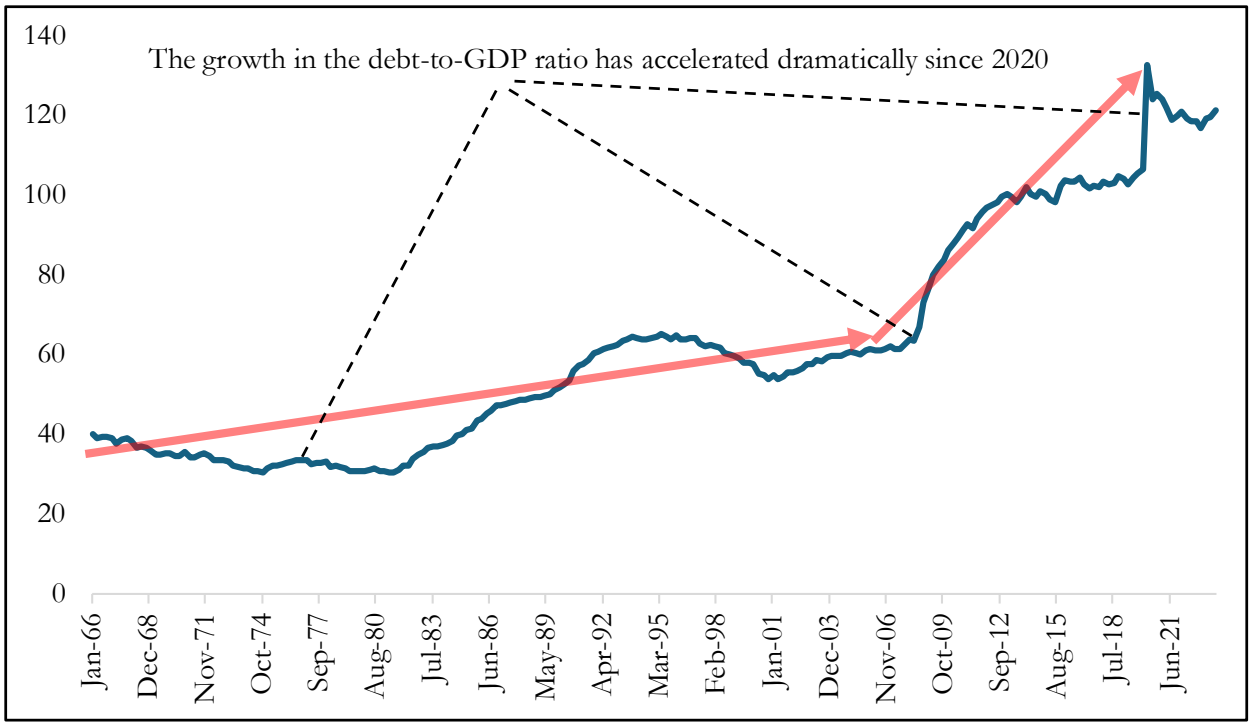
As populations age, countries have to increasingly rely on issuing central government debt to cover social benefits that have been promised to its senior citizens. That debt is issued in each country's own currency, which tends to place countries with strong currencies in a better position to issue and manage their debt. Nevertheless, excessive indebtedness plagues countries with both weak and strong currencies. The social benefits include retirement income and subsidies for medical care

received in retirement (Chernew et al., 2010). One notable example of this is Japan, with a debt-to-GDP ratio of 266 percent, based on data from 2021. Other examples are the U.S., with a ratio of 137 percent; and Canada, with a ratio of 118 percent.

Retirement income and subsidies for medical care received in retirement are not the only social benefits that must be provided by countries, even though they account for the heaviest burden on the growth of many countries' indebtedness. Other social benefits include unemployment income, whose demand tends to increase during recessions, as unemployment rates rise; fully-funded basic education services, usually provided to children; emergency healthcare to pre-retirement individuals; housing subsidies, particularly for lower-income families; and disability benefits; among others.

A combination of population ageing and the COVID recession has placed unexpected pressure on countries to provide social benefits to degrees that appear to be beyond their capacity to grow their economies. As a result, debt-to-GDP ratios have been rising dramatically since 2020. Figure 1 illustrates this growth in debt-to-GDP in the U.S., based on data from the Office of Management and Budget at The White House.

Figure 1: Growth in debt-to-GDP in the U.S.



Notes: X axis = time in months; Y axis = debt-to-GDP in percentage points; graph adapted from Tradingeconomics.com; underlying data from the U.S. Office of Management and Budget at The White House.

Central government debt is typically issued in a country's own currency. This ensures that the country will always be able to pay that debt, because the country can always issue (or print) more of its currency. This expansion of the monetary base in the country creates more supply of its currency. If this increase in supply is not met by a corresponding growth in the demand for the currency, the currency will lose its value (Alexandrov et al., 2021; Batarseh, 2021). As it will be shown in the following section, this is hard to avoid, even in a country with a large economy and dominant currency as the U.S.

4. Central banks and money supply

Central government debt levels tend to rise as countries face increasing obligations to fund social benefits, notably retirement income and healthcare costs for an aging population. The market

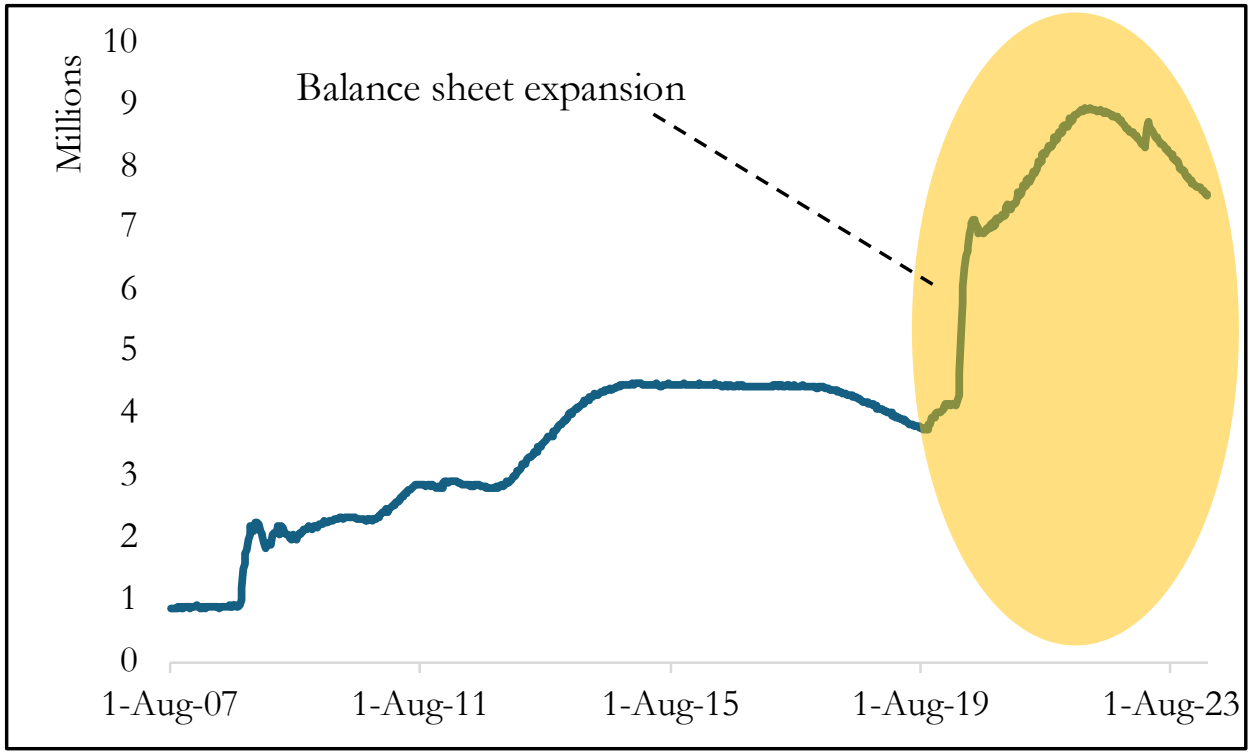
dynamics of supply and demand for this debt influence the yields lenders demand, with higher debt levels generally leading to higher required yields. For example, the yield for 10-year Treasury notes was a little over 3 percent in late June 2022. Lenders can also recover their initial investment by trading government debt before maturity, which tends to be a more speculative and risky activity than holding the debt until its contracted end date. This creates a self-reinforcing cycle where greater debt issuance to service the obligations exacerbates the debt burden itself through higher interest costs. Attempting to ease this cycle, central banks have resorted to monetizing government debt by issuing new currency, which can potentially cause inflation and devaluation of the domestic currency if taken too far. These interlinked challenges of rising debt, compounding interest costs, and potential currency debasement highlight the context and motivations for exploring alternative funding mechanisms like the proposed PoSBW cryptocurrency solution.

The more debt a country's government issues, as a proportion of its GDP, the more debt it tends to owe beyond its capacity to grow its economy. Therefore, other things being equal, the greater the debt-to-GDP level of a country, the higher are the yields expected by lenders (Hsing, 2015; Poghosyan, 2014). Higher government debt yields tend to lead to higher borrowing costs paid by the citizens of a country, as well as organizations operating in that country. For example, interest rates on mortgages in the U.S. are highly correlated to the yields on 10-year Treasury notes. These higher borrowing costs further reduce a country's capacity to grow its economy, which leads to more debt issuance, in a vicious cycle. Without new debt issuance, the economy may contract, leading to massive unemployment.

In attempts to avoid the vicious cycle above, it has become ever more common for central banks to monetize their countries debt, essentially acting as lenders to their own government (Blinder, 2010; Fawley & Neely, 2013). Central banks do that by issuing new currency, or new money, and transferring it to their governments. Their governments can then spend that money. Generally, the

central banks do not have the authority to spend money directly, and are primarily restricted to lend money. The debt securities (e.g., 10-year Treasury notes) are held in the central bank's balance sheet, leading to its expansion. Figure 2 shows the growth over time in the balance sheet of the U.S. Federal Reserve. Like the debt-to-GDP ratio for the U.S., the balance sheet of the U.S. Federal Reserve has been rising dramatically since 2020.

Figure 2: Growth in the balance sheet of the U.S. Federal Reserve



Notes: X axis = time in months; Y axis = millions of dollars (e.g., 8M = 8 trillion U.S. dollars); graph adapted from Federalreserve.gov; underlying data from the U.S. Federal Reserve System.

This monetization of a country's government debt by its own central bank, when taken beyond a certain point, leads to inflation (Christensen & Gillan, forthcoming; Picault et al., forthcoming). In the U.S., inflation grew from almost zero percent in early 2020 to a historically very high 9.1 percent in July 2022, coinciding with the massive growth in the balance sheet of the U.S. Federal Reserve. Inflation can be even more problematic than unemployment, because it affects a much wider proportion of a country's population.

For example, in a country with a population of 100 million and a workforce of 50 million, a 10 percent unemployment rate will negatively affect the employment status of approximately 5 million people. A 10 percent rate of inflation, on the other hand, will negatively affect the lives of close to 100 million people – directly, e.g., employed middle class workers; and indirectly, e.g., their dependents. In this sense, inflation can be seen as a very regressive form of taxation, which directly or indirectly affects virtually all people in a country in a negative way.

5. Economic theories related cryptocurrencies and monetary policy

The PoSBW cryptocurrency concept intersects with several established economic theories across different schools of thought. It aligns with the *Austrian Business Cycle Theory* (ABCT), which suggests that central bank interventions in the money supply led to boom-bust cycles in the economy (Von Mises, 2002; Rangeley, 2018). Dong, Xu, and Zhang (2022) show that the collapse of Bitcoin bubbles can improve social welfare by reducing distortion-driven real investment, which aligns with ABCT's critiques. By providing a decentralized system for monetary expansion based on verified socially beneficial work rather than sovereign debt, PoSBW could potentially mitigate the distortions caused by central banks. The concept also aligns with the *Quantity Theory of Money*, as PoSBW's predetermined and quantifiable minting schedule tied to the cost of completed achievements could make it a hedge against inflationary pressures from central banks expanding the money supply unbacked (Friedman, 1963; Su et al., 2020).

Additionally, the PoSBW model engages with concepts from *New Keynesian Economics* by introducing novel monetary policy mechanisms like programmable money supply adjustments based on real-world data about socioeconomic impact (Barrdear & Kumhof, 2022; Keister & Monnet, 2022). It also aligns with *Market Monetarism*, which emphasizes the importance of stable monetary growth for macroeconomic stability. PoSBW's consensus-based and transparent token issuance

could be viewed as a viable decentralized tool for achieving this goal (Sumner, 2015; Hofmann, 2020). Theories in *Institutional Economics* highlighting the role of regulatory frameworks are highly relevant (North, 1990), as PoSBW's alignment with governments' socioeconomic goals could potentially benefit from supportive regulations.

Moreover, concepts from *Behavioral Economics* around investor sentiment, herd behavior, and speculative bubbles (Kahneman & Tversky, 1979; Biais et al., 2019) are applicable to PoSBW. Its transparent value-anchoring based on quantifiable socioeconomic achievements could reduce the volatility and rampant speculation that plague existing cryptocurrencies like Bitcoin (Chuen et al., 2017; Ilk et al., 2021; Hendershott et al., 2021). Thus, the PoSBW concept substantively engages with and builds upon multiple long-standing economic theories across domains like monetary policy, institutional analysis, and behavioral finance, while proposing an innovative approach to cryptocurrency design and implementation.

Building upon these economic foundations, we now introduce our core concept of cryptocurrencies employing proof of socially beneficial work.

6. Cryptocurrencies employing proof of socially beneficial work

Cryptocurrencies, like Bitcoin and Ether, have been primarily used as a store of value, for speculation, and for illegal activities (Almeida & Gonçalves, 2023; Chuen et al., 2017; Ilk et al., 2021; Hendershott et al., 2021; Kang et al., 2022; Nizzoli et al., 2020; Li & Whinston, 2020). In early 2022, only an insignificant proportion of all legal business-to-consumer and business-to-business trade was conducted with cryptocurrencies, even though the total market value of all cryptocurrencies went from $774 billion to $2.2 trillion in the previous year (Newmyer, 2022). For comparison, the total M2 money supply in the U.S. was a little over $21 trillion; this M2 money supply includes money in circulation, bank deposits, and money market account balances (Haug & Tam, 2007).

So, the market value of all cryptocurrencies was approximately 10 percent of the total M2 money supply in the U.S. at the end of 2021, when the U.S. made up 25 percent of the world economy. This shows that cryptocurrencies have the potential to grow and support business-to-consumer and business-to-business trade in many countries, presumably as long as they are not in conflict with the socially beneficial missions of the governments of those countries. For example, if a cryptocurrency's adoption grows to the point of significantly reducing demand for a country's own currency, the resulting monetary inflation (i.e., loss of value by the country's own currency) would negatively impact the country's ability to support its retirees.

Nevertheless, the emergence of one or more cryptocurrencies that could be widely used to support business-to-consumer and business-to-business transactions, like the U.S. dollar and other country currencies do, would potentially provide a solution to the vicious cycle discussed in the previous section. Central government debt would not have to be issued for more money to go into circulation, and thus neither debt-to-GDP levels nor central bank balance sheets would have to grow.

In general, the main mission of governments is to benefit society in their countries. Existing cryptocurrencies do not seem to directly benefit society, and arguably harm society in some respects, which places them at odds with governmental goals. Cryptocurrencies that employ computationally intensive proof of work (PoW) schemes for mining arguably harm the environment, due to the increasing energy consumption needed (Clark, Lahiani, & Mefteh-Wali, 2023; Kharif, 2021; Zhang et al., 2023). For this reason, early in 2022 a regulator from the European Union recommended that computationally intensive PoW mechanisms be banned (Bateman, 2022).

The most widely used alternative to PoW schemes are proof of stake (PoS) schemes. In PoS schemes, mining (or minting) relies on consensus validation by participants selected in proportion to the quantity of those participants' holdings in the cryptocurrency being mined (Chandler, 2022).

There are no computationally intensive problems to solve in PoS schemes, and thus much less energy consumption is required. Nevertheless, PoS schemes provide no clear direct benefit to society; nor do they have a clear anchor to support new currency issuance, making that issuance rather arbitrary. We argue here that if a cryptocurrency could drive the provision of direct benefits to society as part of its mining or minting, that would significantly enhance the cryptocurrency's social and government appeal, and also afford a better alignment between the cryptocurrency and a country government's societal goals. Moreover, the value of the new currency issued would be anchored on the value of the socially beneficial work in the country where the cryptocurrency is being issued.

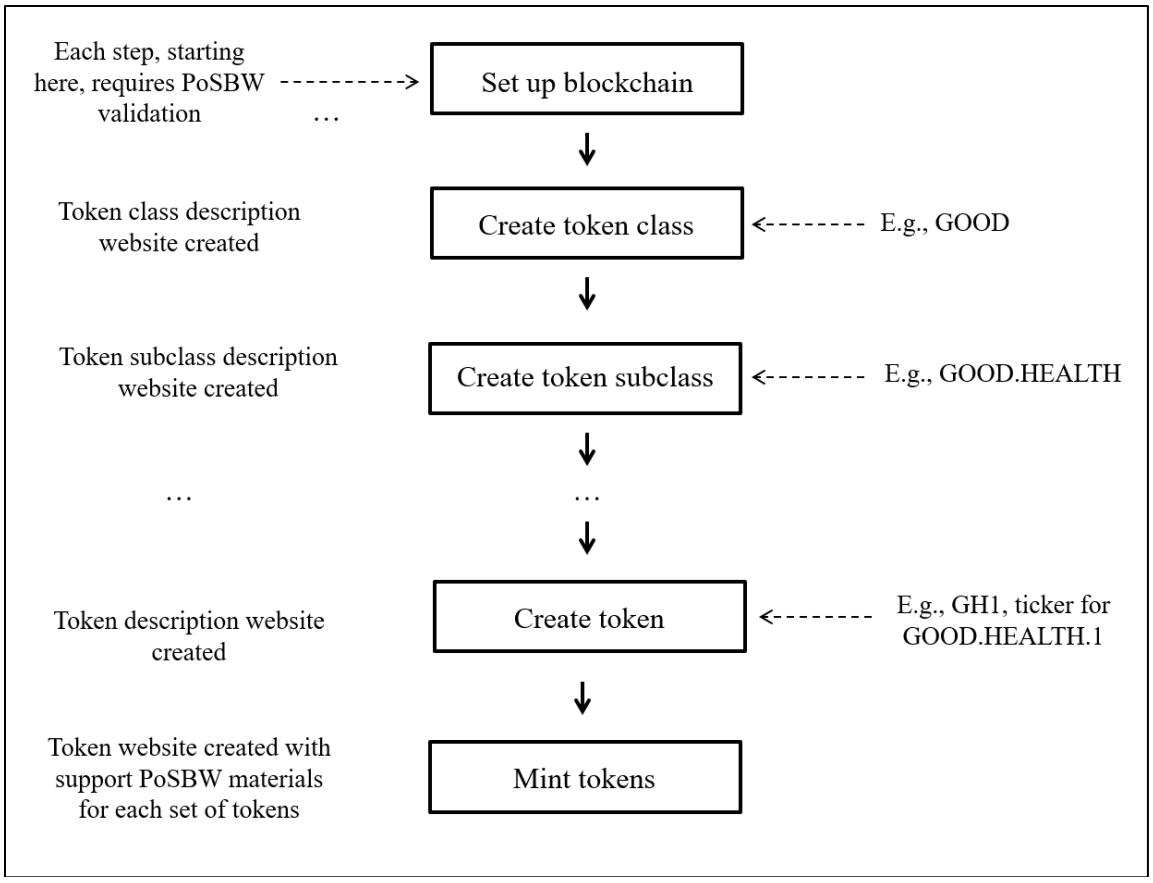
It is our contention that what we refer to as socially beneficial cryptocurrencies can fill this gap. These are cryptocurrencies employing what we call proof of socially beneficial work (PoSBW) for mining (or token minting), which would employ a combination of PoW and PoS schemes. Here, new money would be issued by validation of PoSBW (e.g., provision of shelter to the homeless, reduction in childhood diabetes) by participants selected in proportion to their quantity of holdings in the associated cryptocurrency. We would expect society to favor this type of cryptocurrency and supporting government regulation to ensue.

7. The structure of a cryptocurrency employing PoSBW

Figure 3 lays out the conceptual structure involving the initial creation and token minting, and subsequent minting of additional tokens, of a cryptocurrency employing PoSBW. While a blockchain (Lacity & Van Hoek, 2021; Lumineau et al., 2021; Mattke et al., 2019; Murray et al., 2021; Rossi et al., 2019) is a critical and central component of this structure, a better analog to what we foresee is arguably Wikipedia, because of its extensive reliance on discussion and highly transparent fact-based consensus building (Kock et al., 2016). Existing blockchains, notably Ethereum, allow for

discussions and shared governance (see, e.g.: Ajiboye, 2022), but in a much more limited way. The first step is to set up the blockchain for a PoSBW cryptocurrency, based on what would be analogous to a new instance of Wikipedia that would serve as a discussion and consensus building structure for PoSBW cryptocurrencies.

Figure 3: The structure of a cryptocurrency employing PoSBW



We envision the volunteer organization behind the creation of the blockchain for each new PoSBW cryptocurrency to be a nonprofit organization such as the Wikimedia Foundation, of which Wikipedia is one project. The new blockchain for the cryptocurrency employing PoSBW could be an entirely new blockchain or a fork of an existing blockchain. An example of the former is Solana; and of the latter is Bitcoin Cash, which is a fork of Bitcoin. As is common, the term "token" would be used to refer, in a general sense, to the cryptocurrency supported by a new blockchain. Issuing new

transferrable money would be achieved through the process of minting new tokens of the cryptocurrency.

The validation process involved in the setting up of the new blockchain would be similar to the validation processes for the next steps and would be analogous to the discussion associated with whether or not to keep new Wikipedia articles that are created by editors. New Wikipedia articles often undergo deletion discussions, where editors in good standing vote on whether to keep or delete the article and provide a rationale for their vote – this often includes links to sites outside Wikipedia. The result of the discussion is then summarized by a senior editor. For example, the result could be to keep the article and archive the discussion, to delete it and archive the discussion (in case the article is created again later), or to continue the discussion. A similar process would be associated with the decision to set up the new blockchain for the cryptocurrency employing PoSBW, and subsequently to mint tokens.

If the decision is to set up the new blockchain, the next step is to create a token class, which is a software object class of which the token will be an instance. For example, the class could be called GOOD, which would be the parent class of the subclass HEALTH, which in turn would be the parent of other subclasses that are progressively more specific. A token would be an instance of a subclass, typically the final subclass in the hierarchical sequence of subclasses. A health-related example would be GOOD.HEALTH.1; examples in other areas would be CLEAN.AIR.1, CLEAN.AIR.2, GREEN.ENERGY.1, and LOW.CRIME.1.

For the health-related example GOOD.HEALTH.1, we could have a financial market ticker GH1, referring to health improvement achievements in the city of Curitiba, Brazil. The last step would be the minting of tokens associated with a specific health improvement achievement, such as the reduction in the incidence of juvenile diabetes from 30 to 17 percent among low-income families

in the city, achieved through the work of a charitable organization that coordinates the work of volunteer health professionals.

The class creation, subclasses creation, instantiated token creation, and minting action would each be implemented after a consensus discussion and vote, where the weight of the votes would be proportional to the number of tokens each voter holds in the blockchain. The number of tokens to be minted (e.g., 100,000) would be proposed by a blockchain participant, in the example above on behalf of the charitable organization that coordinates the work of volunteer health professionals. If the consensus were to be in favor of the minting of the 100,000 tokens, a proportion of the minted tokens would then be transferred to the proposing blockchain participant, the charitable organization (who could be the same as the proponent), and each of the participants in the consensus discussion and vote.

Websites would have to be created for each of the steps, laying out the reasons for the creation of the various elements – e.g., why health improvement in the city of Curitiba, Brazil, would be worthy of funding via the new PoSBW cryptocurrency; and why a proportion of the 100,000 tokens should be given for the reduction in the incidence of juvenile diabetes among low-income families in the city. The websites would contain links to supporting materials that are publicly available in other websites, which would then serve as a basis for the various consensus discussions and votes. Once the classes and subclasses were established, multiple proposals for minting tokens could be put forth for achievements by the same charitable organization, as long as credible evidence was made available that provided proof of the achievements.

Having outlined the envisioned structure and processes of PoSBW cryptocurrencies, we now formally present our key theoretical propositions regarding their potential emergence and impact.

8. Theoretical propositions

A central problem that underlies the usefulness of PoSBW cryptocurrencies is that, as a country's population ages, the country has to increasingly rely on issuing central government debt to cover social benefits that have been promised to its senior citizens. Notably, the social benefits include retirement income and subsidies for medical care received in retirement, which are at the time of this writing the main contributors to the growth in debt-to-GDP in the U.S. and many other developed countries.

We believe that it is unavoidable that PoSBW cryptocurrencies will emerge, and be progressively utilized to fund socially beneficial work. This will likely include work that is beneficial to senior citizens. A key advantage of PoSBW cryptocurrencies in this respect is that they will fund socially beneficial work in countries without increasing those countries' indebtedness. This is formalized in our theoretical model through the social funding proposition, stated below.

Social funding proposition. *PoSBW cryptocurrencies will emerge and be progressively utilized to fund socially beneficial work in countries without increasing those countries' indebtedness.*

Another fundamental problem that underlies the usefulness of PoSBW cryptocurrencies is that, as a country's government debt is monetized by its own central bank beyond a certain point, monetary inflation tends to ensue. This inflation is essentially a loss of purchasing power in the country's currency as a result of the oversupply of that currency. As noted earlier with respect to the U.S., inflation grew from almost zero percent in early 2020 to a historically very high 9.1 percent in June 2022; this coincided with the massive growth in the balance sheet of the U.S. Federal Reserve. Expansion of the monetary base of countries without causing inflation is proposed as a useful aspect of PoSBW cryptocurrencies, which is formalized in our theoretical model through the monetary expansion proposition, stated below.

Monetary expansion proposition. *PoSBW cryptocurrencies will emerge and be increasingly utilized to expand the monetary base of countries without causing inflation in those countries' main currencies.*

One could argue that stablecoins could be successfully used to expand a country's monetary base without causing inflation. However, if a stablecoin is backed by a country's currency (Łęt et al., 2023), the country's monetary base would have to expand proportionally to the growth in the amount of the stablecoin in circulation. If not, as in the case of the stablecoin Tether, one could argue that the stablecoin's representation of stability is fraudulent, leading to government prosecution (Lopatto, 2021). A variation of this limitation is likely to plague stablecoins that are backed by commodities (Cai Xue & Zhou, 2024), such as gold and silver, for similar reasons.

Algorithmic stablecoins promise to maintain a 1-to-1 correspondence with a currency, notably the U.S. dollar, in an algorithmic way and without having to be backed by a country's currency. The idea has proved to be quite problematic, as exemplified by the TerraUSD algorithmic stablecoin (Miller, 2022, p. 1): "This week's undoing of the TerraUSD algorithmic stablecoin and its sister token Luna has ramifications for all of crypto. […] The rapid collapse of a once-popular pair of cryptocurrencies sent a ripple effect across the industry, contributing to plummeting coin prices that wiped hundreds of billions of market value from the digital-asset market (Bouteska et al., 2024) and stoked worries over the potential fragility of digital-asset ventures."

Monetary expansion via cryptocurrency would require transaction speeds comparable with those of credit and debit cards and stability in the value of the cryptocurrency. It is reasonable to assume that the former requirement is easily achievable by PoSBW cryptocurrencies, given their consensus-based token minting process, and the fact that PoSBW cryptocurrencies can be based on blockchains that are designed to facilitate fast transactions – e.g., the blockchain underlying the cryptocurrency XRP, developed by Ripple Labs (Reiff, 2022). This assumption is grounded in the inherent efficiency of blockchain technology, particularly when leveraging consensus mechanisms

designed for rapid transaction processing. By utilizing consensus algorithms that prioritize speed and scalability, PoSBW networks can facilitate swift validation and confirmation of transactions, akin to the processes observed in established cryptocurrencies like XRP. Furthermore, the decentralized nature of PoSBW consensus protocols fosters a distributed network of validators, enhancing efficiency and resilience while minimizing bottlenecks that could impede transaction speeds.

The latter requirement, stability in the value of the cryptocurrency, comes from the fact that PoSBW cryptocurrencies mint tokens based on socially beneficial achievements whose cost is quantifiable – preventing speculation and thus reducing volatility in the cryptocurrency's value. The cost of each achievement is likely to be closely tied to the number of tokens minted and the actual or expected value of the tokens in the country's currency or a dominant reserve currency like the U.S. dollar. For example, let us assume that each token is worth 2 U.S. dollars in our previous scenario where the health improvement achievement was the reduction in the incidence of juvenile diabetes from 30 to 17 percent among low-income families. If the minting proponent assumes that $100,000 is a fair reward to the charitable organization, for the achievement, then the proposal may be to mint 100,000 tokens, half of which (i.e., 50,000 tokens) would go to the charitable organization. This type of scenario, where token worth is highly transparent, would discourage speculators willing to buy tokens for capital appreciation only.

Given the above discussion, it is reasonable to expect that PoSBW cryptocurrencies will emerge and be more successful than cryptocurrencies employing traditional proof schemes, of which the most common are proof of work (PoW) or proof of stake (PoS). Their focus on social benefits that have already occurred and are quantified in their country's currency should make PoSBW cryptocurrencies closely aligned with the goals of the central governments of the countries in which they will be created and used, making them benefit the most from government regulation among all

existing cryptocurrencies (Griffith & Clancey-Shang, 2023). This is formalized in our theoretical model through the social proof proposition, stated below.

Social proof proposition. *PoSBW cryptocurrencies will emerge and be more successful than cryptocurrencies employing traditional proof schemes, of which the most common are proof of work (PoW) or proof of stake (PoS).*

Success, as envisioned in the social proof proposition, is to be measured by speed of adoption and general public perceptions about PoSBW cryptocurrencies, even as they exist together with other cryptocurrencies that employ traditional proof schemes (Carvalho et al., 2020; Wade & Shan, 2020). Public perceptions are influenced by a greater number of positive use cases covered by the media than negative ones. An example of negative use case, at least in its initial stages, is the Bitcoin experiment conducted in the country of El Salvador, whose status in 2022 was quite discouraging (Sigalos, 2022, p. 1): "The government's Bitcoin investment has been cut in half, Bitcoin adoption nationwide isn't really taking off, and the country needs a lot of cash, fast, to meet its upcoming debt payments of more than $1 billion in the next year."

In addition to the arguments presented above, it is also reasonable to contend that the likely stability in the value of PoSBW cryptocurrencies is inherent in the non-speculative nature of these cryptocurrencies and their focus on consensus about social benefits. Since most PoSBW cryptocurrency stakeholders would fundamentally want to benefit society, it is likely that PoSBW cryptocurrency stability will be part of their discussions, given that instability may be beneficial to speculators but not to society as a whole. This makes PoSBW cryptocurrencies fundamentally different from highly speculative cryptocurrencies like Bitcoin.

To further illustrate the potential implications of our theoretical propositions, we present the following simulation examining the impact of adopting a PoSBW cryptocurrency from the perspective of the US Federal Government.

9. Simulation

Table 1 shows the results of a simulation we conducted from the perspective of the US Federal Government receiving tokens to pay for social benefits (e.g., Medicare payments) that it would have provided to the US population. This simulation assumes the minting of a little over $100 billion worth of tokens per year to fund social benefits provided by the US Federal Government to the US population. The simulation also assumes that the tokens will have a yearly appreciation in value that will match an inflation rate of 2 percent, plus will have an added appreciation represented by a "popularity" rate. This latter "popularity" appreciation rate refers to a willingness among individuals and organizations to possess the tokens, due to voluntary promotion by organizations (e.g., the US Federal Government itself) and individuals (e.g., celebrities).

Table 1: Simulation

Year	**US Federal tokens owned (amount in USD)**	**Proponents' tokens owned (amount in USD)**	**Others' tokens owned (amount in USD)**	**Token/USD exchange rate**
1	0	0	0	1.0000
2	$114,514,334,514	$10,920,000,000	$10,920,000,000	1.0920
3	$343,511,017,891	$24,946,346,880	$24,946,346,880	1.1925
4	$762,443,906,253	$45,506,108,560	$45,506,108,560	1.3022
5	$1,466,346,424,867	$78,928,042,908	$78,928,042,908	1.4220
6	$2,580,332,311,511	$138,086,724,017	$138,086,724,017	1.5528
7	$4,657,144,665,903	$251,103,031,550	$251,103,031,550	1.6956
8	$8,589,172,445,156	$483,470,948,658	$483,470,948,658	1.8516
9	$16,618,410,130,556	$997,798,156,395	$997,798,156,395	2.0220
10	$34,477,077,026,609	$2,225,242,289,465	$2,225,242,289,465	2.2080

Notes: US Federal debt = $34 trillion, as of this writing. US Federal token owned (amount in US dollars) in Year 10 would be greater than the entire US Federal debt.

The simulation assumes that approximately 10 percent of the tokens issued would be owned by the proponents of the token issued and other participating in the related discussions, which could be individuals of the public or organizations in the US or other countries. Additionally, the simulation assumes that approximately 10 percent of the tokens issued would be owned by

organizations providing the infrastructure for the discussions (e.g., the blockchain and structured discussion web sites), which could be organizations based on the US or other countries.

As we can see, the amount in tokens owned by US Federal Government, in US dollars, would be a little over $34 trillion in Year 10. This amount, $34 trillion, is approximately the entire US Federal debt at the time of this writing. In other words, our simulation suggests that the new cryptocurrency employing PoSBW could potentially wipe out the entire US Federal Government's debt. This was achieved in the simulation by setting the "popularity" appreciation rate at 7.2 percent, which led to an exchange rate of only 2.2 dollars per token in Year 10. This appreciation rate of 7.2 percent is rather modest considering the impact that certain celebrities (e.g., Elon Musk, who supported Dogecoin) may have on the willingness by the public and organizations to hold the tokens.

While an exchange rate of 2.2 is not exactly a rate of 1, which would be the rate expected for a stablecoin, the exchange rate of 2.2 is the result of a rather gradual 10-year progression starting from 1. This is a rather slow progression upwards would be, in our view, necessary to stimulate the desire by individuals and organizations to own the new cryptocurrency employing PoSBW. This progression would be very much unlike the volatile massive increases and decreases seen so far with most other non-stable cryptocurrencies. This relatively low volatility would be a precondition for the tokens to be used as currency, without the need for US dollars to be issued to "guarantee" them

10. Mitigating the risk of overconcentration

While our proposal assumes a high level of coordination and participation from various stakeholders, including nonprofit organizations, developers, and community members, achieving such initiatives would require additional guidelines and infrastructure to further enhance decentralization and prevent excessive concentration of power. Proposed measures include implementing voting caps or limits on individual or group voting power, regardless of token

holdings. Moreover, strategies like incentivizing broad token distribution through airdrops or introducing mechanisms for gradual token redistribution can foster a more equitable power distribution. Establishing transparent governance rules and guidelines that prioritize accountability and democratic decision-making processes is of essence.

Ultimately, PoSBW's overarching goal is to advance societal welfare by funding socially beneficial initiatives and expanding the monetary base without triggering inflation. This focus, combined with the consensus-building process, holds promise in mitigating the risk of overconcentration and fostering a fairer distribution of power and resources across the PoSBW ecosystem.

11. Valuation approaches

Our premise of tying token minting to quantifiable costs of socially beneficial achievements aims to provide an objective anchor to stabilize the cryptocurrency's value. However, we believe that measuring the full costs and valuation of such benefits, including potential externalities, is an arduous endeavor requiring careful consideration. In these sections, we propose a multi-faceted valuation approach that combines different perspectives.

Firstly, we suggest employing a direct cost valuation method. This would involve considering the direct costs incurred, such as labor costs of volunteers, materials, and other inputs required for the socially beneficial undertaking. However, we acknowledge that this approach alone may not capture the full extent of the societal impact. Secondly, in addition to direct costs, a market-based valuation approach could be employed to estimate the broader benefits to society, including externalities. This could involve techniques such as contingent valuation methods, which have been used to estimate the value of non-market goods and services (Brookshire & Crocker, 1981; Perni, Barreiro-Hurlé, & Martínez-Paz, 2021).

Lastly, given the subjective nature of valuing societal benefits, it is crucial to involve the broader community in the valuation process. Ultimately, the token minting process would be subject to open discussion and consensus-building by stakeholders, similar to Wikipedia. This democratic process allows for diverse perspectives and contextual factors to be considered. Furthermore, we propose the establishment of an independent oversight body or committee responsible for developing and implementing robust valuation guidelines, ensuring transparency, and mitigating potential biases or conflicts of interest. We recognize that no single valuation method is perfect, and a combination of approaches is likely needed. The specifics would depend on the nature of the socially beneficial work and the community's consensus. Additionally, we propose establishing a framework for empirical case studies and sharing of best practices as PoSBW cryptocurrencies are implemented. This would allow for continuous refinement and adaptation of valuation methodologies based on real-world experiences.

12. Discussion

To be testable, a theoretical concept must be falsifiable. Since all of the three propositions in our concept predict the emergence of PoSBW cryptocurrencies; if no such cryptocurrencies were to emerge, then our concept would be proven wrong. The social funding proposition predicts that PoSBW cryptocurrencies will be utilized to fund socially beneficial work in countries without increasing those countries' indebtedness. If PoSBW cryptocurrencies emerged and were used to fund socially beneficial work, but led to economic problems (e.g., the collapse of financial institutions seen in 2008) and thus government bailouts that increased those countries' indebtedness, then our concept would be proven wrong. The social funding proposition could be empirically tested by examining cases where PoSBW cryptocurrencies are adopted and analyzing if they indeed

funded socially beneficial work without increasing government debt levels, using measures like government debt-to-GDP ratios before and after PoSBW adoption as quantitative evidence.

The monetary expansion proposition predicts that PoSBW cryptocurrencies will be utilized to expand the monetary base of countries without causing inflation in those countries' main currencies. If PoSBW cryptocurrencies emerged and were used to expand the monetary base of countries, but caused inflation in those countries' main currencies, then our concept would be proven wrong. Here, studying the adoption of PoSBW cryptocurrencies that demonstrably expand a country's monetary base, with data on inflation rates in the country's traditional currency serving as a key indicator of whether such monetary expansion occurred without causing inflation.

Finally, the social proof proposition predicts that PoSBW cryptocurrencies will be more successful than cryptocurrencies employing traditional proof schemes. If success, measured by speed of adoption and general public perceptions about PoSBW cryptocurrencies, were to be lower than that of cryptocurrencies employing traditional proof schemes (e.g., Bitcoin and Ether), then our concept would be proven wrong. As for this proposition, potential empirical tests may include analysis of adoption rates, trading volumes, media sentiment analysis comparing coverage of PoSBW versus traditional cryptocurrencies over time, as well as public perception surveys.

It should be stressed that the social proof proposition predicts greater success of PoSBW cryptocurrencies over traditional cryptocurrencies like Bitcoin and Ether, but it does not preclude the use of the blockchains underlying Bitcoin and Ether to support the more successful PoSBW cryptocurrencies. Moreover, the proposition does not preclude the possibility of the emergence of more successful PoSBW cryptocurrencies as forks of Bitcoin or Ether either; with those blockchains augmented by a Wikipedia-like infrastructure to support proposals, related discussions, and consensus building.

How does the emergence of central bank digital currencies (CBDCs) fit with our concept of PoSBW cryptocurrencies? CBDCs are analogous to stablecoins but handled in a much more centralized way (Daly, 2022). A CBDC would be issued by a country's central bank, without the intermediation of commercial banks, which could conceivably allow central banks to credit funds directly to individuals in times of need (such as a pandemic). With respect to our theoretical framework, the problem here is that this would expand the monetary base of countries while at the same time causing inflation in those countries' main currencies. In this sense, it does not solve one of the fundamental problems that fiat currencies face, namely monetary inflation. Also, it is questionable that countries' governments, particularly in democracies, would be in favor of allowing government spending decisions to be made by central bank administrators instead of elected officials.

13. Conclusion

We have argued in this paper that cryptocurrencies have to potential to greatly benefit society. Specifically, we have argued that they can provide a solution to a major monetary problem faced by countries. That problem is characterized by countries having to progressively issue more and more debt, through government bonds (a.k.a. treasuries), to fund social benefits in general and retirement benefits in particular. As their debt-to-GDP ratios deteriorate, bond holders demand increasingly higher interest rates, which further deteriorate debt-to-GDP ratios. To slow this deterioration, countries' central banks have become major lenders to their own countries, by issuing new currency, leading to devaluation of those countries' currencies and thus consumer price inflation.

In the preceding sections we have proposed a theoretical concept of cryptocurrencies employing proof of socially beneficial work. New tokens of these cryptocurrencies would be issued only based on socially beneficial work that has already been conducted, with demonstrated and easily

quantifiable positive results. We theorized that such cryptocurrencies would emerge and be increasingly utilized to fund socially beneficial work without increasing indebtedness or inflation in the countries where the tokens are minted. Moreover, we theorized that cryptocurrencies employing proof of socially beneficial work will be more successful than cryptocurrencies employing traditional proof schemes, of which the most common are proof of work and proof of stake. If follows from our discussion that such cryptocurrencies have the potential become a major source of funding for nonprofit organizations aiming at benefiting society. Because our theorizing proposes, for the first time, the idea of cryptocurrencies employing proof of socially beneficial work, this theorizing can also be seen as aimed at spurring interest in this arguably highly promising idea.

While our paper presents a compelling argument for the potential benefits of cryptocurrencies employing proof of socially beneficial work, it is important to recognize certain limitations that do not detract from the validity of our propositions but rather offer opportunities for further exploration. For instance, empirical validation of our proposed framework is indeed important for validating its effectiveness in real-world scenarios. By conducting empirical studies, scholars can assess the actual impact of cryptocurrencies employing proof of socially beneficial work on societal welfare, economic stability, and financial inclusion. Moreover, investigating the relationship between PoSBW cryptocurrencies and (ir)rational behavior among participants within the cryptocurrency ecosystem can shed light on the psychological factors influencing their adoption and usage.

References

Acharya, V. V., & Richardson, M. (2009). Causes of the financial crisis. *Critical Review*, 21(2), 195-210.

Ajiboye, T. (2022, July 1). Ethereum successfully implements Gray Glacier hard fork to extend difficulty bomb by 700,000 blocks. *Coinspeaker*. https://www.coinspeaker.com/ethereum-gray-glacier-hard-fork-extend-difficulty-bomb/

Almeida, J., & Gonçalves, T. C. (2023). A systematic literature review of investor behavior in the cryptocurrency markets. *Journal of Behavioral and Experimental Finance*, *37*, 100785.

Alexandrov, D. G., Valinurova, L. S., Kostromin, P. A., Zenkina, E. V., & Egorov, V. G. (2021). Metrics for Assessing the Effect of Household Income and the Money Supply on Inflation. *Montenegrin Journal of Economics*, 17(4), 147-154.

Batarseh, A. (2021). The nature of the relationship between the money supply and inflation in the Jordanian economy (1980–2019). *Banks and Bank Systems*, 16(2), 38.

Bateman, T. (2022, January 19). Ban proof of work crypto mining to save energy, EU regulator says. *Euronews*. https://www.euronews.com/next/2022/01/19/eu-regulator-calls-for-a-ban-on-proof-of-work-bitcoin-mining-to-save-renewable-energy

Bixby, R. L. (2020). Impacts of aging on the federal budget and economy: A cross-cutting challenge. *Public Policy & Aging Report*, 30(2), 46-51.

Blinder, A. S. (2010). Quantitative easing: Entrance and exit strategies. *Federal Reserve Bank of St. Louis Review*, 92(6), 465-479.

Bommer, W. H., Milevoj, E., & Rana, S. (2023). The intention to use cryptocurrency: A meta-analysis of what we know. *Emerging Markets Review*, *55*, 100962.

Bouteska, A., Abedin, M. Z., Hajek, P., & Yuan, K. (2024). Cryptocurrency price forecasting–A comparative analysis of ensemble learning and deep learning methods. *International Review of Financial Analysis*, *92*, 103055.

Breidbach, C. F., & Tana, S. (2021). Betting on Bitcoin: How social collectives shape cryptocurrency markets. *Journal of Business Research*, 122, 311-320.

Brookshire, D. S., & Crocker, T. D. (1981). The advantages of contingent valuation methods for benefit-cost analysis. *Public choice*, 36(2), 235-252.

Cai, C. W., Xue, R., & Zhou, B. (2024). Cryptocurrency puzzles: A comprehensive review and re-introduction. *Journal of Accounting Literature*, *46*(1), 26-50.

Carvalho, A., Sambhara, C., & Young, P. (2020). What the history of linux says about the future of Cryptocurrencies. *Communications of the Association for Information Systems*, 46(2), 18–29.

Chandler, S. (2022, January 22). Proof of stake vs. proof of work: Key differences between these methods of verifying cryptocurrency transactions. *Business Insider*. https://www.businessinsider.com/personal-finance/proof-of-stake-vs-proof-of-work

Chernew, M. E., Baicker, K., & Hsu, J. (2010). The specter of financial Armageddon - health care and federal debt in the United States. *The New England Journal of Medicine*, 362(13), 1166.

Chuen, D. L. K., Guo, L., & Wang, Y. (2017). Cryptocurrency: A new investment opportunity? *The Journal of Alternative Investments*, 20(3), 16-40.

Christensen, J. H., & Gillan, J. M. (forthcoming). Does quantitative easing affect market liquidity? *Journal of Banking & Finance*.

Clark, E., Lahiani, A., & Mefteh-Wali, S. (2023). Cryptocurrency return predictability: What is the role of the environment?. *Technological Forecasting and Social Change*, *189*, 122350.

Daly, L. (2022, June 28). What is central bank digital currency (CBDC)? *The Motley Fool*. https://www.fool.com/investing/stock-market/market-sectors/financials/cryptocurrency-stocks/central-bank-digital-currency/

Eisner, R., & Pieper, P. J. (1984). A new view of the federal debt and budget deficits. *The American Economic Review*, 74(1), 11-29.
Fair, R. C. (2012). What it takes to solve the US government deficit problem. *Contemporary Economic Policy*, 30(4), 618-628.
Fawley, B. W., & Neely, C. J. (2013). Four stories of quantitative easing. *Federal Reserve Bank of St. Louis Review*, 95(1), 51-88.
Gabriel, I. (2017). Effective altruism and its critics. *Journal of Applied Philosophy*, 34(4), 457-473.
Griffith, T., & Clancey-Shang, D. (2023). Cryptocurrency regulation and market quality. *Journal of International Financial Markets, Institutions and Money*, *84*, 101744.
Haug, A. A., & Tam, J. (2007). A closer look at long-run US money demand: Linear or nonlinear error-correction with M0, M1, or M2? *Economic Inquiry*, 45(2), 363-376.
Hendershott, T., Zhang, X., Zhao, J. L., & Zheng, Z. (2021). FinTech as a game changer: Overview of research frontiers. *Information Systems Research*, 32(1), 1-17.
Hsing, Y. (2015). Determinants of the government bond yield in Spain: a loanable funds model. *International Journal of Financial Studies*, 3(3), 342-350.
Ilk, N., Shang, G., Fan, S., & Zhao, J. L. (2021). Stability of transaction fees in bitcoin: A supply and demand perspective. *MIS Quarterly*, 45(2), 563-592.
Kang, H. J., Lee, S. G., & Park, S. Y. (2022). Information efficiency in the cryptocurrency market: The efficient-market hypothesis. *Journal of Computer Information Systems*, 62(3), 622-631.
Kathiravan, C., Selvam, M., Maniam, B., Venkateswar, S., Gayathri, J., & Pavithran, A. (2019). Effect of weather on cryptocurrency index: Evidences from coinbase index. *International Journal of Financial Research*, 10(4), 108-118.
Kharif, O. (2021, November 30). Bye-bye, miners! How Ethereum's big change will work. *The Washington Post*. https://www.washingtonpost.com/business/bye-bye-miners-how-ethereums-big-change-will-work/2021/11/30/234cabda-5201-11ec-83d2-d9dab0e23b7e_story.html
Kock, N., Jung, Y., & Syn, T. (2016). Wikipedia and e-collaboration research: opportunities and challenges. *International Journal of e-Collaboration*, 12(2), 1-8.
Lacity, M. C., & Van Hoek, R. (2021). How Walmart Canada used blockchain technology to reimagine freight invoice processing. *MIS Quarterly Executive*, 20(3), 219-233.
Leafscore (2022). The 28 most sustainable cryptocurrencies for 2022. *Leafscore*. https://www.leafscore.com/blog/the-9-most-sustainable-cryptocurrencies-for-2021/
Łęt, B., Sobański, K., Świder, W., & Włosik, K. (2023). What drives the popularity of stablecoins? Measuring the frequency dynamics of connectedness between volatile and stable cryptocurrencies. *Technological Forecasting and Social Change*, 189, 122318.
Li, X., & Whinston, A. B. (2020). Analyzing cryptocurrencies. *Information Systems Frontiers*, 22(1), 17-22.
Liu, Y., Tsyvinski, A., & Wu, X. (2022). Common risk factors in cryptocurrency. *The Journal of Finance*, 77(2), 1133-1177.
Lopatto, E. (2021, August 16). The Tether controversy, explained: How stable are stablecoins? *The Verge*. https://www.theverge.com/22620464/tether-backing-cryptocurrency-stablecoin
Lumineau, F., Wang, W., & Schilke, O. (2021). Blockchain governance—A new way of organizing collaborations? *Organization Science*, 32(2), 500-521.
MacAskill, W. (2017). Effective altruism: Introduction. *Essays in Philosophy*, 18(1), 1-5.
Mattke, J., Hund, A., Maier, C., & Weitzel, T. (2019). How an enterprise blockchain application in the US Pharmaceuticals supply chain is saving lives. *MIS Quarterly Executive*, 18(4), 246-261.

Miller, H. (2022, May 13). Terra $45 billion face plant creates crowd of crypto losers. *Bloomberg News*. https://www.bloomberg.com/news/articles/2022-05-14/terra-s-45-billion-face-plant-creates-a-crowd-of-crypto-losers

Murray, A., Kuban, S., Josefy, M., & Anderson, J. (2021). Contracting in the smart era: The implications of blockchain and decentralized autonomous organizations for contracting and corporate governance. *Academy of Management Perspectives*, 35(4), 622-641.

Newmyer, T. (2022, January 12). Cryptocurrency is suddenly everywhere — except in the cash register. *The Washington Post*. https://www.washingtonpost.com/business/2022/01/12/crypto-versus-cash/

Nizzoli, L., Tardelli, S., Avvenuti, M., Cresci, S., Tesconi, M., & Ferrara, E. (2020). Charting the landscape of online cryptocurrency manipulation. *IEEE Access*, 8(1), 113230-113245.

Perni, Á., Barreiro-Hurlé, J., & Martínez-Paz, J. M. (2021). Contingent valuation estimates for environmental goods: Validity and reliability. *Ecological Economics*, 189, 107144.

Picault, M., Pinter, J., & Renault, T. (2022). Media sentiment on monetary policy: Determinants and relevance for inflation expectations. *Journal of International Money and Finance*.

Poghosyan, T. (2014). Long-run and short-run determinants of sovereign bond yields in advanced economies. *Economic Systems*, 38(1), 100-114.

Reiff, N. (2022, May 2). Bitcoin vs. Ripple: What's the difference? *Investopedia*. https://www.investopedia.com/tech/whats-difference-between-bitcoin-and-ripple/

Renwick, R., & Gleasure, R. (2021). Those who control the code control the rules: How different perspectives of privacy are being written into the code of blockchain systems. *Journal of Information Technology*, 36(1), 16-38.

Rossi, M., Mueller-Bloch, C., Thatcher, J. B., & Beck, R. (2019). Blockchain research in information systems: Current trends and an inclusive future research agenda. *Journal of the Association for Information Systems*, 20(9), 1390-1405.

Sigalos, M. (2022, June 25). El Salvador's $425 million bitcoin experiment isn't saving the country's finances. *CNBC Crypto World*. https://www.cnbc.com/2022/06/25/el-salvador-bitcoin-experiment-not-saving-countrys-finances.html

Benatar, S. R., & Singer, P. A. (2000). A new look at international research ethics. *The BMJ*, 321(7264), 824-826.

Wade, M., & Shan, J. (2020). Covid-19 has accelerated digital transformation, but may have made it harder not easier. *MIS Quarterly Executive*, 19(3), 213-220.

Zhang, D., Chen, X. H., Lau, C. K. M., & Xu, B. (2023). Implications of cryptocurrency energy usage on climate change. *Technological Forecasting and Social Change*, 187, 122219.