Journal of
Risk and Financial Management

Article

The Greater Sustainability of Stablecoins Relative to Other Cryptocurrencies

Adi Wolfson [1,*], Gerard Khaladjan [2], Yotam Lurie [2] and Shlomo Mark [3]

[1] Green Processes Center, Sami Shamoon Collage of Engineering, Beer-Sheva 8410802, Israel
[2] Guilford Glazer Faculty of Business and Management, Ben-Gurion University of the Negev, Beer-Sheva 8410501, Israel; gerardkh@matrix.co.il (G.K.); yotam@bgu.ac.il (Y.L.)
[3] Software Engineering Department, Sami Shamoon Collage of Engineering, Beer-Sheva 8410802, Israel; marks@sce.ac.il
* Correspondence: adiw@sce.ac.il

Abstract: Cryptocurrencies are decentralized digital financial services that do not physically exist in the world of tangible products and goods, and therefore purportedly offer some positive environmental sustainability features. However, since they are based on blockchain technology, which requires a relatively large input of energy, their climatic impact is not benign. Furthermore, they are very volatile and characterized by low levels of transparency and control, thus creating some negative economic and social sustainability effects. Stablecoins, which are a pegged type of cryptocurrency, exhibit much less volatility and have higher levels of management and interoperability. This raises the following question: are stablecoins more sustainable compared to other cryptocurrencies? To explore this, a sustainability assessment was conducted, comparing cryptocurrencies and stablecoins across environmental, social, and economic dimensions while identifying the key characteristics of sustainability. It was found that stablecoins can mitigate the economic and social risks associated with cryptocurrencies and thus increase their overall sustainability. Moreover, since stablecoins are managed and governed to a greater extent, a key consideration in their development is the selection and implementation of more appropriate mechanisms that can reduce energy use and enhance sustainability. Finally, stablecoins offer more effective—and not just more efficient—solutions, based on value co-creation between several providers and a customer.

Keywords: cryptocurrencies; stablecoins; sustainability assessment

check for updates

Academic Editors: Thanasis Stengos, Cristian Tiu, Ole Jakob Bergfjord and Ramona Rupeika-Apoga

Received: 7 February 2025
Revised: 5 March 2025
Accepted: 12 March 2025
Published: 18 March 2025

Citation: Wolfson, A., Khaladjan, G., Lurie, Y., & Mark, S. (2025). The Greater Sustainability of Stablecoins Relative to Other Cryptocurrencies. *Journal of Risk and Financial Management*, *18*(3), 161. https://doi.org/10.3390/jrfm18030161

1. Introduction

The evolution of money has mirrored broader economic trends. For thousands of years, currencies, which replaced the barter system, were made from precious metals like gold and silver (Davies, 2010). Over time, paper money emerged, initially backed by gold reserves but later detached from any material worth. Today, fiat currencies operate on the trust in and credibility of the issuing states without material backing.

About three decades ago, the first digital currencies were launched. A digital currency is a currency-like asset that is managed, stored, and exchanged by computer systems (Zhong, 2022). E-Gold, which was introduced in 1996, allowed users to make payments in grams of gold, backed by gold coins stored in a safe deposit box (Mullan, 2016). PayPal, which was launched in 1998, supports online payments and replaced traditional money with electronic alternatives. In 2008, Satoshi Nakamoto introduced Bitcoin, a decentralized digital currency that addresses some of the weaknesses of traditional fiat and gold-based currencies (Nakamoto, 2008). Unlike traditional currencies, Bitcoin is a virtual currency that is not governed by any central authority such as a government or central bank and does not rely on intermediaries for issuance, settlement, or transaction validation (Vranken, 2017). Moreover, in contrast to previous digital currencies that were backed by materials, Bitcoin is a digital asset that exists solely in virtual space and employs cryptography to secure transactions, thus classifying it as a cryptocurrency.

This paper offers a conceptual approach to compare the sustainability of stablecoins and cryptocurrencies, assessing twelve sustainability indicators that have been previously proposed (Näf et al., 2021). The paper is organized in the following manner. Section 1 reviews the relevant literature on cryptocurrencies and stablecoins, highlighting their main differences and sustainability. Section 2 presents the research methodology, and Section 3 discusses the sustainability assessment of cryptocurrencies versus stablecoins with regard to general, environmental, social, and economic aspects. Then, we discuss the different value delivery modes both offer in relation to the value hierarchy and their implications for sustainability. In general, it was found that stablecoins are inherently more sustainable due to their higher stability, which minimizes fluctuations and disruptions while ensuring resilience, regulatory acceptance, and energy efficiency. Furthermore, stablecoins promote more sustainable value co-creation between providers and customers.

1.1. Cryptocurrencies

Cryptocurrencies are digital currencies that enable the transfer of value for various purposes, primarily payment for goods or services (Chohan, 2022; El Hajj & Farran, 2024). The uniqueness of these currencies is that their value is not determined by a real market value or by the decision of a central authority or institution, such as the World Bank, but rather, their value fluctuates based on market-driven factors, including supply and demand, market sentiment, and competition between various kinds of cryptocurrencies, as well as production costs (Kyriazis, 2021).

A cryptocurrency is distributed across a vast number of computers, which makes it almost impossible to counterfeit and prevents double-spending. Essentially, it is a system based on blockchain technology, which involves a large network of computers interconnected via the internet to form a kind of distributed ledger (Nakamoto, 2008; Swan, 2015). This makes it very difficult to hack, which would require breaching multiple computers in the network. It is therefore a highly effective system in terms of information security, thus enabling secure online payments (Mitawa & Bhambu, 2023). This structure also means that these currencies exist outside the control of governments and regulatory authorities (Jagtiani et al., 2021). Furthermore, the process does not involve banking institutions, eliminating the need for intermediaries (Yermack, 2017; Golosova & Romanovs, 2018). Finally, it creates a transparent and immutable record by grouping data into blocks, each linked to the previous one to form a secure chain.

In the case of blockchain-based cryptocurrencies, there are two main methods for verifying transactions and ensuring that the blockchain remains secure and accurate in the absence of a central authority: Proof of Work (PoW) and Proof of Stake (PoS) (Duong et al., 2018; Sheikh et al., 2018). In the former, miners use powerful computers to confirm transactions by solving complex puzzles, and the miner that solves it first adds a new block of transactions to the blockchain (Gervais et al., 2016). For this, the miner is rewarded with new cryptocurrency and transaction fees. In PoS, validators, which check transactions and propose new blocks, are selected based on how much cryptocurrency they hold (their "stake"), and if other validators agree that the block is correct, it is added to the blockchain (Saleh, 2021). This system consumes less energy than PoW, and validators are rewarded for participating. Finally, the blockchain technology used for cryptocurrencies operates through a series of interconnected processes. They begin when a user initiates a transaction, which is then broadcast to the network. Multiple transactions are collected into a pool of unconfirmed transactions. Then, either miners or validators—depending on the consensus mechanism used (PoW or PoS)—verify the legitimacy of the transactions.

Cryptocurrencies have a number of significant advantages over fiat currency (Bunjaku et al., 2017):

1. Decentralization: Cryptocurrencies are stored in a database that is distributed across numerous network nodes in different locations worldwide. This ensures the integrity of the stored data and prevents any single actor from altering a record of the database.
2. High security level: The currencies are very secure. Every transaction made through the blockchain network is secured through the mining process, and all miners must approve them based on an algorithm.
3. Protection from inflation: Most cryptocurrencies determine the maximum number of coins that can be produced at the time of the currency's launch. Therefore, as demand for them increases, their value rises, which can help stabilize the market and in the long run prevent inflation that would devalue the currency.

Cryptocurrencies also have a number of disadvantages:

1. Lack of regulation and oversight: This feature naturally attracts individuals who wish to conceal their actions, evade taxes, or commit various types of financial crime.
2. Lack of protection in case of fraud: The loss or theft of digital currencies leads to a complete loss of value because they are not insured, and there is no entity responsible for replacing them or compensating the customer.
3. Environmental impact: Mining cryptocurrencies requires enormous computing power, which results in the release of large amounts of greenhouse gasses and air pollutants into the atmosphere and uses large quantities of water.

1.2. Stablecoins

Stablecoins were developed in order to reduce the risk of cryptocurrencies while maintaining their benefits. They are a type of cryptocurrency designed to maintain a stable value relative to a specific asset (known as pegging), typically a fiat currency like the US dollar (USD) or some other assets such as gold (Mita et al., 2020). Pegging allows stablecoins to function effectively as a medium of exchange, a unit of account, and a store of value, provided the underlying asset retains its value over time. Unlike highly speculative and volatile cryptocurrencies, stablecoins are designed to combine the benefits of cryptocurrencies with the stability of traditional fiat currencies or other assets (Hoang & Baur, 2024).

Stablecoins differ as to how they maintain their value and whether they are governed by centralized or decentralized systems. In general, they can be classified into three main categories (Kahya et al., 2021):

1. Fiat or Asset-Backed Stablecoins (Srivisad & Wattanakoon, 2024): These are cryptocurrencies supported by reserves of fiat currency, such as the US dollar, or a commodity such as gold. These stablecoins are typically governed in a centralized manner, with reserves managed by a custodian or organization. Furthermore, for every stablecoin issued, an equivalent amount of fiat currency or the equivalent value in commodities is held in reserve by a central authority in order to ensure stability. Examples include Tether (USDT), USD Coin (USDC), and TrueUSD (TUSD).
2. Crypto-Backed Stablecoins (Feng et al., 2024): These are decentralized stablecoins that use other cryptocurrencies as collateral rather than fiat currency. These stablecoins are typically governed by smart contracts and community protocols, ensuring decentralized management. The cryptocurrencies used as collateral help support the

stablecoin's value. Examples include DAI, which is backed by a basket of cryptocurrencies, and USD.

3. Algorithmic Stablecoins (Clements, 2021): These are stablecoins that are not backed by any collateral. Instead, they use sophisticated algorithms and smart contracts, driven by external price feeds, to manage the supply of the stablecoin, increasing or decreasing it to stabilize its value. These mechanisms automate the process of minting and withdrawing coins from circulation in order to maintain price stability (Kahya et al., 2021). Governance is typically decentralized, with automatic adjustments managed by algorithms. Examples include Terra (LUNA) and Ampleforth (AMPL).

Sanz-Bas (2020, 2022) and Sanz-Bas et al. (2021) proposed an additional classification of stablecoins based on their ability to maintain long-term stability. He identified two main categories according to the strategy used to preserve their value over time: collateralized and non-collateralized stablecoins. Collateralized stablecoins rely on an issuing institution that ensures their market price maintains a 1:1 ratio with the value of a chosen reference asset. In contrast, non-collateralized stablecoins use an algorithm to regulate their supply and stabilize their price. However, Sanz-Bas concluded that designing non-collateralized stablecoins capable of sustaining a stable value over time is likely impossible.

1.3. The Main Differences Between Cryptocurrencies and Stablecoins

Stablecoins offer significant benefits but also create challenges (Kołodziejczyk & Jarno, 2020). They combine the advantages of digital currencies, such as speed and a low cost, with the stability of traditional currencies, making them useful for daily transactions and attractive for hedging against the volatility of other cryptocurrencies or traditional assets. However, their trust and transparency are critical issues (Al-Afeef et al., 2024), especially for fiat-backed stablecoins, where users rely on the issuing organization to hold the claimed reserves. Furthermore, algorithmic stablecoins may struggle to maintain stability and can be vulnerable to market manipulation or technical issues. Additionally, stablecoins are increasingly subject to regulatory scrutiny which is aimed at ensuring compliance with financial laws and standards.

Though both cryptocurrencies and stablecoins operate outside traditional financial frameworks by using blockchain technology, they each offer a different alternative to fiat currency. One main feature that differentiates them is the lower volatility of stablecoins (Al-Afeef et al., 2024). They also differ with respect to their function, management, and interoperability. Finally, each system has different advantages and disadvantages, and they may also differ in their economic, social, and environmental impacts.

1.4. The Sustainability of Cryptocurrencies

The concept of sustainability was defined in 1987 by the United Nations Brundtland Commission as the capacity of the present generation to meet its needs without compromising the ability of future generations to meet theirs (Brundtland, 1985). Expanding on this concept, the Triple Bottom Line (TBL) framework, introduced by John Elkington in 1999, encourages companies to evaluate their performance beyond financial metrics by also considering their environmental and social impacts (Elkington & Rowlands, 1999). This promotes a balance between economic success, environmental stewardship, and social justice. In other words, the concept of sustainability, as formulated over the years, encompasses a long-term perspective aimed at achieving enduring stability across three key dimensions: environmental, economic, and social (Wolfson et al., 2015). This approach is closely linked to decision-making processes that integrate both local and global factors, thus encompassing economic, social, and environmental responsibilities toward humanity and the preservation of the Earth. Yet, achieving this comprehensive approach necessitates a fundamental shift in human behavior.

Since the emergence of Bitcoin, several sustainability aspects of cryptocurrencies have been raised and discussed (Sahoo, 2017; Gulli, 2020). Decentralization, for instance, may create a positive social impact since it reduces the possibility of governments and banks interfering with the market; but, on the other hand, it may lead to a less controlled system. Security is also an important characteristic of cryptocurrencies, with positive economic and social effects. At the same time, cryptocurrencies may have a negative economic and social impact on national security by facilitating the illegal transaction of goods, by serving as a means of exchange on the darknet, and by providing a platform for current or new types of money laundering practices (Limba et al., 2019). Thus, the regulatory framework that will oversee cryptocurrencies is also an issue of importance (Dhali et al., 2023). The cryptocurrency market and the technology that supports it have also raised ethical issues, since they encourage addiction, especially among young people, and facilitate criminal activities. Moreover, cryptocurrencies also endanger long-term economic growth, which is a fundamental aspect of economic sustainability (Shin & Rice, 2022). The trajectory of some cryptocurrencies also disproportionately impacts poor and vulnerable communities where cryptocurrency producers and other actors take advantage of economic instabilities, weak regulation, and access to cheap energy and other resources (Howson & de Vries, 2022). Much of the debate has focused on the high energy use of cryptocurrencies, resulting in the emission of enormous amounts of greenhouse gasses (de Vries, 2018), which accelerate the climate crisis, and other pollutants that threaten public health.

As previously discussed, blockchain technology has the potential to lower the cost of financial services and contribute to a more equitable distribution of economic wealth. It also offers various societal benefits. However, its implementation still incurs significant costs. While cryptocurrencies do not require metal mining for coin production or cotton cultivation for paper money, the process of mining cryptocurrencies using blockchain technology demands substantial computational power. This, in turn, depends on the algorithm used to solve cryptographic problems, leading to high energy consumption. The increased reliance on fossil fuels for electricity generation results in significant emissions of air pollutants and greenhouse gasses, exacerbating the climate crisis (Egiyi & Ofoegbu, 2020).

Beyond energy consumption, cryptocurrencies and data centers also have a considerable water footprint (de Vries, 2018). This includes the amount of water required to cool data centers, which varies based on the efficiency of cooling systems and the regional climate. Other factors influencing water usage include hardware efficiency—as lower energy consumption reduces cooling requirements—the type of energy sources used for electricity generation, and the mining process itself.

In addition to energy and water consumption, the use of computers and data centers has broader environmental consequences. These include the extraction of resources required for the production of computers, server farms, and other infrastructure—from metals used in components to fossil fuels for plastic production—leading to wastewater discharge and air pollution. Furthermore, the growing volume of electronic waste generated by the industry has severe environmental implications.

For instance, in 2021, the cryptocurrency-related electricity consumption reached 236×10^6 megawatt hours (MWh), surpassing that of traditional transaction systems, despite cryptocurrencies accounting for less than 0.5% of global cashless financial transactions. In terms of water usage, cryptocurrencies have an annual consumption of 3670×10^6 cubic meters, more than double that of conventional currencies. Additionally, crypto-mining activities are estimated to generate approximately 139×10^6 tonnes of CO_2-equivalent (CO_2-eq) greenhouse gas emissions globally (Siddik et al., 2023). Bajra et al. (2024) further highlight that Proof-of-Work (PoW) cryptocurrencies generate approximately 0.86 metric tons of carbon emissions per transaction, significantly higher than Proof-of-Stake (PoS) transactions like Ethereum.

Finally, while stablecoins are designed to maintain a stable value relative to specific assets—thereby reducing the volatility of cryptocurrencies—the lack of standardized regulatory frameworks across jurisdictions creates regulatory uncertainty (Ferreira, 2021). This poses several risks to financial stability and might make stablecoins a less sustainable alternative. Additionally, inconsistencies in governmental approaches to reserves, transparency, and consumer protection further complicate their regulation. Moreover, stablecoins can contribute to financial instability by facilitating the buildup of leverage and liquidity mismatches in decentralized finance (MacDonald & Zhao, 2022). Without adequate oversight of the broader crypto ecosystem, these risks cannot be mitigated solely through stablecoin regulations.

2. Methods

Since the goal of this work was to compare the sustainability of cryptocurrencies in general with stablecoins in particular, a sustainability assessment of cryptocurrencies versus stablecoins was carried out using environmental, social, and economic categories. Then, the central characteristics of sustainability that distinguish stablecoins from all other cryptocurrencies were identified. Finally, both the value delivery model and the level that it reaches in the Data–Information–Knowledge–Intelligence–Wisdom (DIKIW) pyramid enhance sustainability.

The sustainability assessment followed Näf et al.'s (2021) survey, which defined requirements for sustainable cryptocurrencies that were clustered into 13 categories (Näf et al., 2021). These categories enable developers, administrators, and end users to assess the sustainability of the different alternatives. Based on these categories, the following twelve sustainability indicators were proposed to evaluate the sustainability of cryptocurrencies:

Technical indicators:

1. The foundation year, which measures the maturity and stability of a cryptocurrency.
2. The confirmation latency, which is the time required for transactions to be confirmed.
3. The transactions per second, which assesses the scalability of a cryptocurrency network.
4. The network size, which reflects the number of nodes in a cryptocurrency network.
5. The development activity, which measures ongoing development efforts for a cryptocurrency.

Economic indicators:

6. The market capitalization, reflecting the total value of a cryptocurrency.
7. The volatility, which is a measure of price fluctuations.
8. The transaction volume, which is the level of activity on a cryptocurrency network.
9. Transaction costs, which are the fees associated with transactions.

Social indicators:

10. The activity on social networks, which measures the level of public interest and support for a cryptocurrency.

Ecological/environmental indicators:

11. The total network energy consumption.
12. The energy consumption per transaction.

It is important to note that some of these indicators may have limitations or may not be directly correlated with sustainability.

3. Results

3.1. Sustainability Assessment of Cryptocurrencies Versus Stablecoins

A comparison of sustainability between cryptocurrencies in general and stablecoins in particular could be carried out using the aforementioned categories, with some modifications.

3.1.1. General Value Contribution to Sustainable Development

This is a general category that considers whether a cryptocurrency constitutes a practical solution that offers long-term, integrated economic, social, and environmental value, while maintaining a balance between the three sustainability dimensions. In this regard, it should be mentioned that using digital currencies instead of coins, bills, or cheques offers a service instead of a good, representing a shift from tangible to intangible value. In addition, cryptocurrencies operate outside traditional financial infrastructure, generating a number of benefits, such as faster settlement times, lower costs, and reduced operational complexity (Makarov & Schoar, 2022). As a result, the use of natural resources is more sustainable, though a specific life cycle assessment that compares direct and indirect material and energy use between the payment pathways should be performed. In addition, blockchain technology, which provides the infrastructure for cryptocurrencies, can promote sustainable practices given its decentralized nature, which creates a robust, documented, and transparent system (Ante et al., 2021). Finally, Davidson et al. (2018) argued that blockchains are not just digital financial instruments but institutional technology and a new way of coordinating economic activity, which will improve the productive efficiency of some economic operations and thus improve economic efficiency. Moreover, they appear to offer a new way of coordinating economic activity owing to the underlying technology possessing many institutional aspects of market capitalism itself. As a result, it may provide a more sustainable method for resource allocation and transaction processing, ultimately reducing costs and lowering pollution emissions.

Although both cryptocurrencies and stablecoins are based on the same technology, the fact that stablecoins are pegged to an asset reduces the volatility that characterizes cryptocurrencies, thus leading to a more stable and sustainable alternative (Mita et al., 2020). Moreover, unlike cryptocurrencies, which are a suitable store of wealth for the long term, stablecoins are well suited for payments and business settlements. In addition, the decentralized nature of cryptocurrencies means there is no controlling entity, creating a relatively high level of risk. The use of stablecoins makes this risk more manageable and therefore gives them an advantage with respect to sustainability (Arner et al., 2020). Furthermore, stablecoins offer an element of regulatory protection (Koemtzopoulos et al., 2025), thus protecting merchants and their customers and adding value for various stakeholders. Finally, stablecoins can operate across multiple blockchains, unlike a cryptocurrency which exists solely on its own network, making stablecoins more interoperable. Thus, they can be processed more efficiently, which translates into faster transaction confirmation times and a higher throughput and even less energy consumption and lower costs. In this regard, stablecoins, compared to other cryptocurrencies, offer not only a more efficient but also a more effective alternative. They go beyond merely optimizing transactions by reducing resource use, effort, the time taken, and emissions—focusing on process efficiency alone—and instead prioritize the quality of the transaction outcome, thereby adding greater social value. By utilizing resources in a way that ensures more reliable and stable transactions, stablecoins provide a more sustainable solution.

3.1.2. Environmental Sustainability

Environmental sustainability is achieved by preventing the negative impact of humans' activities on the environment (McKinnon et al., 2010). Essentially, it requires the responsible management of natural resources and the control of emissions from manmade processes in order to reduce the damage to ecosystems and thus maintain their ability to generate services and reduce the negative impact on public health. In addition, since cryptocurrencies in general, and stablecoins in particular, are designed to serve distinct purposes, their environmental sustainability may vary depending on their specific functions.

Efficient Use of Ecological Resources

This category calls for a cryptocurrency to consume as few resources as possible in order to generate its added value. As mentioned, one of the main criticisms of cryptocurrencies is that blockchain technologies require an energy-intensive mining process that exacerbates the climate crisis. Thus, the generation of this energy usually involves fossil fuels, which results in substantial emissions of air pollutants and greenhouse gasses. Furthermore, a large quantity of water is used for data center cooling, and even if energy is produced by renewable means, blockchain technology's infrastructure is built using large amounts of various metals, produced in highly polluting mines. Finally, the mining process also generates a level of e-waste as older systems are replaced, thus discharging toxic materials into the soil, water, and air. Numerous studies have highlighted the severe environmental damage caused by the enormous energy consumption required for cryptocurrency mining (Zohar, 2015; Vranken, 2017; de Vries, 2018; Truby et al., 2022; Goodkind et al., 2020; Stoll et al., 2019; Krause & Tolaymat, 2018; McCook, 2018; Clark & Greenley, 2019).

However, not all blockchain technologies are equally harmful to the environment. More sustainable alternatives exist that are characterized by significantly lower energy consumption and have a lower impact on global emissions. Given the vital role of blockchain technology in the economy and society, it is essential to differentiate between blockchain types based on their consensus protocols (Truby et al., 2022). For example, there is a growing shift towards environmentally friendly solutions such as Proof of Stake (PoS), which offers a more sustainable consensus mechanism relative to Proof of Work (PoW). Ethereum is at the forefront of this transition, moving away from PoW to reduce its environmental footprint.

Since both cryptocurrencies and stablecoins are based on the same technology and system, they require the same amount of energy and at first glance would appear to have the same environmental impact. However, since stablecoins are more managed and governed, there is the possibility of selecting and implementing more appropriate mechanisms during development in order to attain greater sustainability. Thus, stablecoins make it possible to shift away from the energy-intensive Proof of Work (PoW) protocol towards eco-friendly alternatives like Proof of Stake (PoS) or delegated Proof of Stake (DPoS), thus drastically reducing energy consumption.

3.1.3. Social Sustainability

Social sustainability means creating and maintaining societies that can thrive and continue to exist in a healthy, fair, and equal way (Colantonio, 2009). It is focused on improving quality of life and the promotion of social justice, education, health, safety, and gender equality, as well as the way in which different stakeholders co-create value.

1. Participative culture: This category relates to the ethics of the ecosystem in its treatment of the different stakeholders in the cryptocurrency network.
2. Adaptable coordinated governance: Despite the decentralized character of cryptocurrencies, coordinated innovation management, clear structures and processes, and transparent management will increase their sustainability.
3. Knowledge transfer: A cryptocurrency that is supported by knowledge transfer through concise documentation is clearly advantageous.

4. Protection of stakeholders: This involves safety instructions, stakeholder privacy, and data protection while at the same time reducing the risk to all users. The key social aspects of the cryptocurrency market center on safety and transparency, with the goal of preventing discrimination among stakeholders and mitigating harm to the population. This may be direct harm, as in the case of crime, or indirect harm, as in the case of fraud. Additionally, users seek stability in the decentralized market. Stablecoins—being less volatile and more controlled and hence more stable—offer a secure and regulated alternative to traditional cryptocurrencies, making them a more ethical and sustainable solution.

By reducing transaction costs, increasing financial accessibility, and expanding the variety and availability of financial services, stablecoins have the potential to foster economic growth for individual users, alleviate poverty, and reduce inequality. They can also promote economic stability in underserved regions and positively impact communities. Lastly, due to their higher level of regulation relative to cryptocurrencies, stablecoins are less likely to undermine national security or hinder the use of sanctions meant to advance national interests.

3.1.4. Economic Sustainability

Economic sustainability requires that investment and saving are based on sustainable technologies and practices that support long-term financial stability and growth while avoiding adverse social and environmental impacts (Doane & MacGillivray, 2001).

1. Long-term financial stability: Ensuring sustainable funding in the cryptocurrency market by means of a stable market position and low volatility protects stakeholders and promotes the use of cryptocurrencies as a means of payment.
2. Technical maturity: A more mature technological system offers a higher level of security and contributes to sustainability.
3. Technical performance: A powerful and scalable network capable of processing high transaction volumes in a short time with low fees enhances sustainability.
4. Legal compliance: Adherence to laws and ethical principles, alongside collaboration with legislators, ensures the long-term viability of cryptocurrencies.
5. Trustworthiness of developers and administrators: Developers and administrators must be reliable, refrain from illegal activities, and support the continued existence of the cryptocurrency.
6. Network security: A high degree of decentralization and robust protective mechanisms prevent network attacks and improve sustainability.
7. Established infrastructure: A comprehensive infrastructure ensures the easy and secure use of cryptocurrencies. Stablecoins, being less volatile and more usable in current markets, offer greater long-term financial stability and support economic growth. They are therefore more economically sustainable. However, stablecoins have not always achieved their promised stability. Instances of losing their pegs to reference assets (depegging) and the failures of algorithmic stablecoins highlight their limitations (Yujin et al., 2024). Stablecoins and cryptocurrencies are often subject to overlapping regulations. However, due to their pegged nature and closer ties to traditional finance, stablecoins face additional regulatory scrutiny that does not necessarily apply to other cryptocurrencies. Stablecoins often fall under specific regulatory frameworks aimed at addressing issues such as fraud, money laundering, and financial system stability. For instance, the *Financial Innovation and Technology for the 21st Century Act in the U.S.* (2023) established a regulatory framework in which the Securities and Exchange Commission (SEC) and the Commodity Futures Trading Commission (CFTC) oversee asset-backed tokens, while the Federal Reserve regulates bank-issued stablecoins. Similarly, under the *UK Financial Services and Markets Act*

(2023), stablecoins are classified as "systemic payment instruments" and are subject to oversight by the Financial Conduct Authority (FCA)—the primary financial regulatory body in the United Kingdom. This classification ensures stricter supervision regarding issuance, reserve management, consumer protection, and financial stability risks.

The three general types of stablecoins—fiat-backed, crypto-backed, and algorithmic—vary in their stability and, consequently, their sustainability (Asadov et al., 2023). Selecting the appropriate type of stablecoin is crucial for maximizing economic sustainability. Proper regulation could make stablecoins a widespread means of payment, reduce transaction costs, and enable faster, more efficient transactions. They may also contribute to stabilizing the economy in many nations.

Figure 1 summarizes the primary sustainability advantages of stablecoins over cryptocurrencies. The Venn diagram illustrates the overlap and connections between sustainability, cryptocurrencies, and stablecoins. Cryptocurrencies can promote sustainability by reducing reliance on traditional finance and enhancing transparency, while stablecoins—due to their greater stability, regulation, and integration capabilities—offer an even larger sustainability impact. At the center of this overlap lies the shared goal of contributing to a sustainable future.

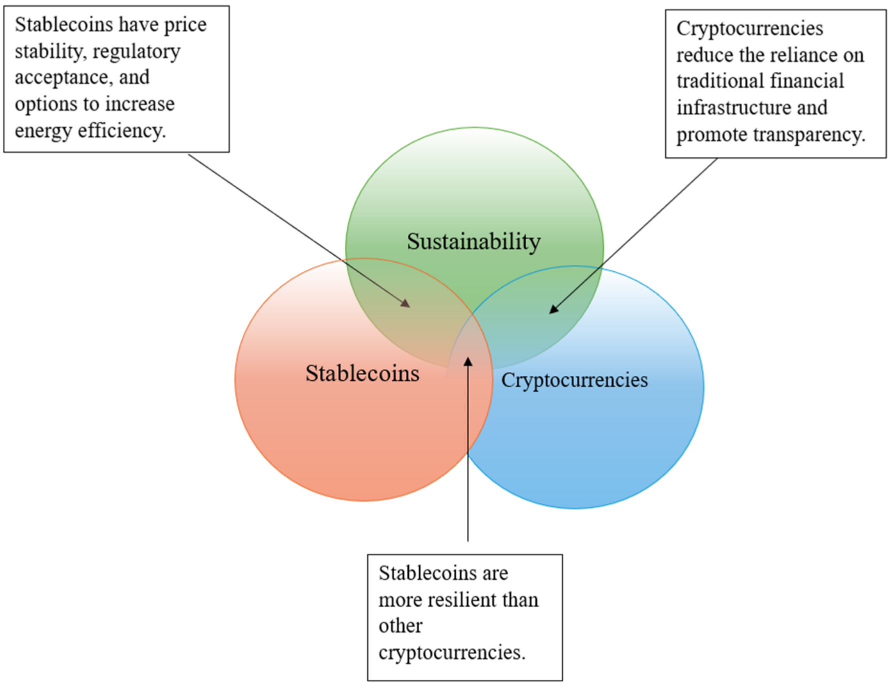

Figure 1. Venn diagram of sustainability, cryptocurrencies, and stablecoins—a conceptual framework.

As discussed above, stablecoins generally present fewer social and economic risks than cryptocurrencies, making them more reliable due to their price stability, regulatory acceptance, and even improved energy efficiency. Moreover, sustainability indicators are interconnected, meaning that progress in one area can generate additional benefits. For example, reducing energy consumption not only lowers the environmental impact but also decreases costs, while long-term financial stability enhances stakeholder protection.

However, sustainability assessments involve complex decision-making, where improvements in one aspect may come at the expense of another (Morrison-Saunders & Pope, 2013). Therefore, it is essential to consider trade-offs when making decisions aimed at improving environmental and socio-economic outcomes (Hahn et al., 2010).

Stablecoins using Proof of Stake (PoS) or centralized systems are generally more energy-efficient compared to Proof of Work (PoW)-based cryptocurrencies. However, centralization may compromise security, censorship resistance, and decentralization—

core principles of blockchain technology. Additionally, while stablecoins can enhance financial inclusion and offer stability in regions with volatile economies, the absence of a standardized regulatory framework creates uncertainty. This makes stablecoins vulnerable to liquidity risks, potential runs, and financial instability. Furthermore, although stablecoins aim to reduce volatility, their peg to fiat currencies relies on collateralization, which still exposes them to risks inherent in the traditional financial system and may limit efficient resource allocation.

3.2. A More Sustainable Solution

A cryptocurrency is a service providing intangible values like transactions and storage. Thus, it can be evaluated for sustainability, which in this context depends on nonphysical characteristics, such as the social and economic aspects of management and transparency. This is based on the value it creates, taking into consideration both the value delivery model and the level that it reaches. In this respect, the transition from a value-in-exchange model, where value is transferred from a supplier to a consumer, to a value-in-use model, where value is co-created by the provider and customer, results in greater sustainability (Vargo & Lusch, 2004). In addition, climbing up the Data–Information–Knowledge–Intelligence–Wisdom (DIKIW) pyramid (Ackoff, 1989) enhances sustainability.

Cryptocurrencies operate according to a simple value-in-exchange model (Figure 2a), where a supplier provides digital currency to a customer in return for payment. Stablecoins, on the other hand, involve the co-creation of value between the buyer and the supplier, thus adding attributes like stability and safety (Figure 2b). Generating stablecoins also requires collaboration among stakeholders (investors, traders, businesses, governments, etc.) and regulatory agencies, thus enhancing their sustainability.

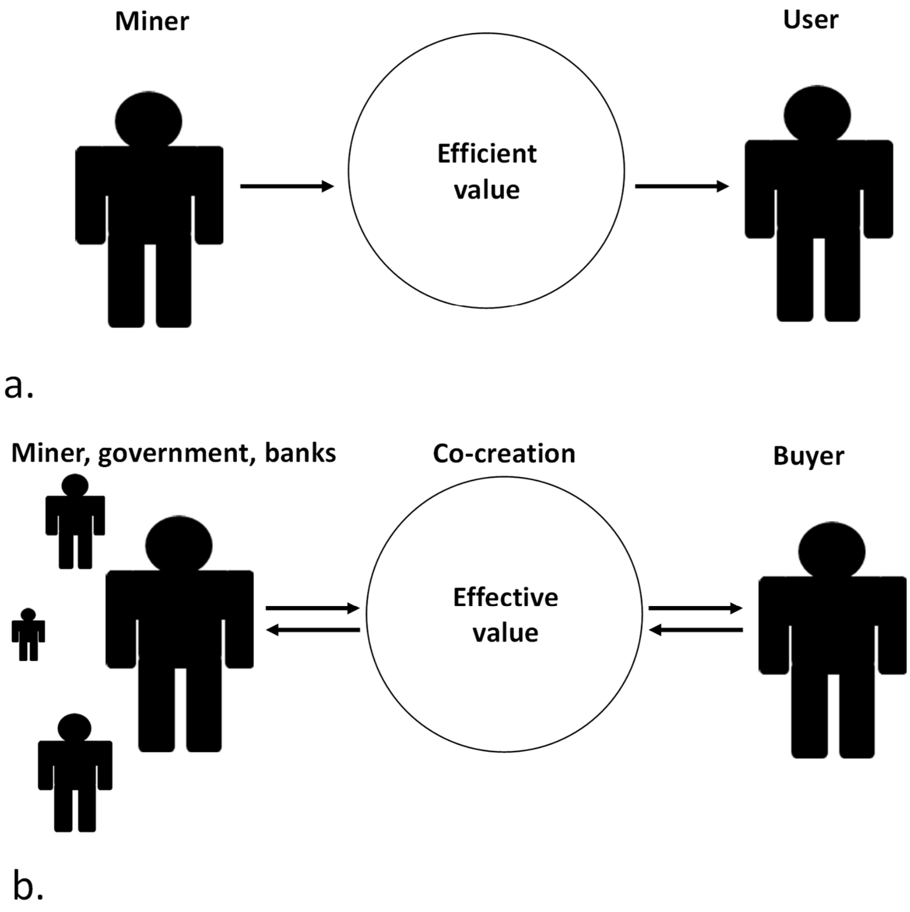

Figure 2. The service models of (**a**) cryptocurrencies and (**b**) stablecoins.

Comparing cryptocurrencies and stablecoins reveals that while raw data processing is similar for both, the value derived differs due to different target values. Stablecoins' stricter restrictions lead to the integration of economic and social considerations within their knowledge creation, yielding more effective and wise solutions. Wise values originate from raw data, which are processed into information and then into knowledge. This knowledge can drive intelligent solutions to improve efficiency and, ultimately, generate wisdom for more effective solutions. Wise values balance environmental, social, and economic considerations for short- and long-term benefits, positively impacting future generations (Wolfson, 2016).

4. Conclusions and Future Prospects

Stability, as an inherent characteristic of sustainability, focuses on maintaining operations over the long term in order to meet current social, economic, and environmental needs while preserving future generations' ability to do the same. Stability minimizes fluctuations and disruptions while ensuring resilience. Balancing the three dimensions of sustainability is equally essential. As such, stablecoins are inherently more sustainable.

Stablecoins mitigate the downside risks of cryptocurrency portfolios, making them more reliable as a medium of exchange and a store of value. Their sustainability surpasses that of traditional cryptocurrencies in terms of price stability, regulatory acceptance, and energy efficiency, depending on the underlying technology. Additionally, stablecoins rely on environmentally friendly blockchain approaches and emphasize value co-creation among providers and customers, offering long-term, stable digital coins that align with the Triple Bottom Line framework.

Author Contributions: Conceptualization: A.W., Y.L. and S.M.; investigation: G.K.; supervision: A.W., Y.L. and S.M.; writing—original draft: A.W. and S.M.; writing—review and editing: A.W., Y.L. and S.M. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Data sharing is not applicable.

Conflicts of Interest: The authors declare no conflicts of interest.

References

Ackoff, R. L. (1989). From data to wisdom. *Journal of Applied Systems Analysis*, *16*(1), 3–9.

Al-Afeef, M. A., Al-Smadi, R. W., & Al-Smadi, A. W. (2024). The role of stable coins in mitigating volatility in cryptocurrency markets. *International Journal of Applied Economics, Finance and Accounting*, *19*(1), 176–185. [CrossRef]

Ante, L., Fiedler, I., & Strehle, E. (2021). The impact of transparent money flows: Effects of stablecoin transfers on the returns and trading volume of Bitcoin. *Technological Forecasting and Social Change*, *170*, 120851. [CrossRef]

Arner, D. W., Auer, R., & Frost, J. (2020). *Stablecoins: Risks, potential and regulation*. Bank for International Settlements.

Asadov, A., Yildirim, R., & Masih, M. (2023). Toward greater stability in stablecoins: Empirical evidence from an analysis of precious metals. *Borsa Istanbul Review*, *23*(5), 1152–1172. [CrossRef]

Bajra, U. Q., Rogova, E., & Avdiaj, S. (2024). Cryptocurrency blockchain and its carbon footprint: Anticipating future challenges. *Technology in Society*, *77*, 102571. [CrossRef]

Brundtland, G. H. (1985). World commission on environment and development. *Environmental Policy and Law*, *14*(1), 26–30.

Bunjaku, F., Gjorgieva-Trajkovska, O., & Miteva-Kacarski, E. (2017). Cryptocurrencies–advantages and disadvantages. *Journal of Economics*, *2*(1), 31–39.

Chohan, U. W. (2022). *Cryptocurrencies: A brief thematic review*. Available online: https://ssrn.com/abstract=3024330 (accessed on 20 July 2024).

Clark, C. E., & Greenley, H. L. (2019). *Bitcoin, blockchain, and the energy sector*. Congressional Research Service.

Clements, R. (2021). *Built to fail: The inherent fragility of algorithmic stablecoins*. Available online: https://ssrn.com/abstract=3952045 (accessed on 20 July 2024).

Colantonio, A. (2009). Social sustainability: A review and critique of traditional versus emerging themes and assessment methods. In M. Horner, A. Price, J. Bebbington, & R. Emmanuel (Eds.), *SUE-Mot conference 2009: Second international conference on whole life urban sustainability and its assessment: Conference proceedings* (pp. 865–885). Loughborough University.

Davidson, S., De Filippi, P., & Potts, J. (2018). Blockchain and the economic institutions of capitalism. *Journal of Institutional Economics*, *14*(4), 639–658. [CrossRef]

Davies, G. (2010). *History of money*. University of Wales Press.

de Vries, A. (2018). Bitcoin's growing energy problem. *Joule*, *2*(5), 801–805. [CrossRef]

Dhali, M., Hassan, S., & Mehar, S. M. (2023). Cryptocurrency in the Darknet: Sustainability of the current national legislation. *International Journal of Law and Management*, *65*(3), 261–282. [CrossRef]

Doane, D., & MacGillivray, A. (2001). *Economic sustainability: The business of staying in business*. New Economics Foundation.

Duong, T., Chepurnoy, A., Fan, L., & Zhou, H. S. (2018, June 4). *Twinscoin: A cryptocurrency via proof-of-work and proof-of-stake*. Proceedings of the 2nd ACM Workshop on Blockchains, Cryptocurrencies, and Contracts (pp. 1–13), Incheon, Republic of Korea.

Egiyi, M. A., & Ofoegbu, G. N. (2020). Cryptocurrency and climate change: An overview. *International Journal of Mechanical Engineering and Technology (IJMET)*, *11*(3), 15–22.

El Hajj, M., & Farran, I. (2024). The cryptocurrencies in emerging markets: Enhancing financial inclusion and economic empowerment. *Journal of Risk and Financial Management*, *17*(10), 467. [CrossRef]

Elkington, J., & Rowlands, I. H. (1999). Cannibals with forks: The triple bottom line of 21st century business. *Alternatives Journal*, *25*(4), 42. [CrossRef]

Feng, Z., Mohanty, H., & Krishnamachari, B. (2024). Modeling and analysis of crypto-backed over-collateralized stable derivatives in DeFi. *Frontiers in Blockchain*, *7*, 1392812. [CrossRef]

Ferreira, A. (2021). The curious case of stablecoins-balancing risks and rewards? *Journal of International Economic Law*, *24*(4), 755–778. [CrossRef]

Financial Innovation and Technology for the 21st Century Act in the U.S. (2023). Available online: https://www.congress.gov/bill/118th-congress/house-bill/4763 (accessed on 20 July 2024).

Gervais, A., Karame, G. O., Wüst, K., Glynatsis, V., Ritzdorf, H., & Capkun, S. (2016, October 24–28). *On the security and performance of proof of work blockchains*. Proceedings of the 2016 ACM SIGSAC Conference on Computer and Communications Security (pp. 3–16), Vienna, Austria.

Golosova, J., & Romanovs, A. (2018, November 8–10). *The advantages and disadvantages of the blockchain technology*. 2018 IEEE 6th Workshop on Advances in Information, Electronic and Electrical Engineering (AIEEE) (pp. 1–6), Vilnius, Lithuania.

Goodkind, A. L., Jones, B. A., & Berrens, R. P. (2020). Cryptodamages: Monetary value estimates of the air pollution and human health impacts of cryptocurrency mining. *Energy Research & Social Science*, *59*, 101281.

Gulli, A. (2020). *(Un)sustainability of bitcoin mining*. Rutgers Computer & Tech.

Hahn, T., Figge, F., Pinkse, J., & Preuss, L. (2010). Trade-offs in corporate sustainability: You can't have your cake and eat it. *Business Strategy and the Environment*, *19*(4), 217–229. [CrossRef]

Hoang, L. T., & Baur, D. G. (2024). How stable are stablecoins? *The European Journal of Finance*, *30*(16), 1984–2000. [CrossRef]

Howson, P., & de Vries, A. (2022). Preying on the poor? Opportunities and challenges for tackling the social and environmental threats of cryptocurrencies for vulnerable and low-income communities. *Energy Research & Social Science*, *84*, 102394.

Jagtiani, J., Papaioannou, M., Tsetsekos, G., Dolson, E., & Milo, D. (2021). Cryptocurrencies: Regulatory perspectives and implications for investors. In *The palgrave handbook of technological finance* (pp. 161–186). Palgrave Macmillan.

Kahya, A., Krishnamachari, B., & Yun, S. (2021). Reducing the Volatility of Cryptocurrencies—A Survey of Stablecoins. *arXiv*, arXiv:2103.01340.

Koemtzopoulos, D., Zournatzidou, G., & Sariannidis, N. (2025). Can cryptocurrencies be green? The role of stablecoins toward a carbon footprint and sustainable ecosystem. *Sustainability*, *17*, 483. [CrossRef]

Kołodziejczyk, H., & Jarno, K. (2020). Stablecoin—The stable cryptocurrency. *Studia BAS*, *3*(63), 155–170. [CrossRef]

Krause, M. J., & Tolaymat, T. (2018). Quantification of energy and carbon costs for mining cryptocurrencies. *Nature Sustainability*, *1*(11), 711–718. [CrossRef]

Kyriazis, N. A. (2021). A survey on volatility fluctuations in the decentralized cryptocurrency financial assets. *Journal of Risk and Financial Management*, *14*(7), 293. [CrossRef]

Limba, T., Stankevičius, A., & Andrulevičius, A. (2019). Towards sustainable cryptocurrency: Risk mitigations from a perspective of national security. *Journal of Security and Sustainability Issues*, *9*(2), 375–389. [CrossRef]

MacDonald, C., & Zhao, L. (2022). *Stablecoins and their risks to financial stability* (Staff Discussion Paper 2022-20). Bank of Canada.

Makarov, I., & Schoar, A. (2022). Cryptocurrencies and decentralized finance (DeFi). *Brookings Papers on Economic Activity*, *2022*(1), 141–215. [CrossRef]

McCook, H. (2018). The cost & sustainability of Bitcoin. *A Monthly Bitcoin Journal*, 1–34.

McKinnon, A., Browne, M., Piecyk, M., & Whiteing, A. E. (2010). *Green logistics: Improving the environmental sustainability of logistics*. Chartered Institute of Logistics and Transport in the UK.

Mita, M., Ito, K., Ohsawa, S., & Tanaka, H. (2020). What is stablecoin?: A survey on its mechanism and potential as decentralized payment systems. *International Journal of Service and Knowledge Management*, *4*(2), 71–86.

Mitawa, A., & Bhambu, P. (2023). Safeguarding financial transaction with cryptocurrency. In *International conference on data science and applications* (pp. 361–368). Springer Nature Singapore.

Morrison-Saunders, A., & Pope, J. (2013). Conceptualising and managing trade-offs in sustainability assessment. *Environmental Impact Assessment Review*, *38*, 54–63. [CrossRef]

Mullan, P. C. (2016). E-gold. In *A history of digital currency in the United States: New technology in an unregulated market*. Springer Nature.

Nakamoto, S. (2008). *Bitcoin: A peer-to-peer electronic cash system*. Available online: https://bitcoin.org/bitcoin.pdf (accessed on 20 July 2024).

Näf, M., Keller, T., & Seiler, R. (2021, January 5). *Proposal of a methodology for the sustainability assessment of cryptocurrencies*. Proceedings of the 54th Hawaii International Conference on System Sciences (pp. 5617–5626), Kauai, HI, USA.

Sahoo, P. K. (2017). Bitcoin as digital money: Its growth and future sustainability. *Theoretical & Applied Economics*, *24*(4), 53–64.

Saleh, F. (2021). Blockchain without waste: Proof-of-stake. *The Review of Financial Studies*, *34*(3), 1156–1190. [CrossRef]

Sanz-Bas, D. (2020). Hayek and the cryptocurrency revolution. *Iberian Journal of the History of Economic Thought*, *7*, 15–28. [CrossRef]

Sanz-Bas, D. (2022). Las profecías de Hayek sobre las criptomonedas. In *Digitalización de empresas y economía: Tendencias actuales* (pp. 28–39). Dykinson eBook.

Sanz-Bas, D., Del Rosal, C., Náñez Alonso, S. L., & Echarte Fernández, M. Á. (2021). Cryptocurrencies and fraudulent transactions: Risks, practices, and legislation for their prevention in Europe and Spain. *Laws*, *10*(3), 57. [CrossRef]

Sheikh, H., Azmathullah, R. M., & Rizwan, F. (2018). Proof-of-work vs proof-of-stake: A comparative analysis and an approach to blockchain consensus mechanism. *International Journal for Research in Applied Science & Engineering Technology*, *6*(12), 786–791.

Shin, D., & Rice, J. (2022). Cryptocurrency: A panacea for economic growth and sustainability? A critical review of crypto innovation. *Telematics and Informatics*, *71*(1), 101830. [CrossRef]

Siddik, M. A. B., Amaya, M., & Marston, L. T. (2023). The water and carbon footprint of cryptocurrencies and conventional currencies. *Journal of Cleaner Production*, *411*, 137268. [CrossRef]

Srivisad, N., & Wattanakoon, P. (2024). *Assessing price stability in fiat-backed stablecoins: Implications for financial regulation and market dynamics*. Available online: https://ssrn.com/abstract=4977810 (accessed on 24 July 2024).

Stoll, C., Klaaßen, L., & Gallersdörfer, U. (2019). The carbon footprint of bitcoin. *Joule*, *3*(7), 1647–1661. [CrossRef]

Swan, M. (2015). *Blockchain: Blueprint for a new economy*. O'Reilly Media, Inc.

Truby, J., Brown, R. D., Dahdal, A., & Ibrahim, I. (2022). Blockchain, climate damage, and death: Policy interventions to reduce the carbon emissions, mortality, and net-zero implications of non-fungible tokens and Bitcoin. *Energy Research & Social Science*, *88*, 102499.

UK Financial Services and Markets Act. (2023). Available online: https://www.legislation.gov.uk/ukpga/2021/22/contents (accessed on 24 July 2024).

Vargo, S. L., & Lusch, R. F. (2004). Evolving to a New Dominant Logic for Marketing. *Journal of Marketing*, *68*, 1–17. [CrossRef]

Vranken, H. (2017). Sustainability of bitcoin and blockchains. *Current Opinion in Environmental Sustainability*, *28*, 1–9. [CrossRef]

Wolfson, A. (2016). *Sustainable service*. Business Expert Press.

Wolfson, A., Mark, S., Martin, P. M., & Tavor, D. (2015). Sustainability and Service. In *Sustainability through service* (pp. 31–48). Springer.

Yermack, D. (2017). Corporate governance and blockchains. *Review of Finance*, *21*(1), 7–31. [CrossRef]

Yujin, K., Kornrapat, P., Kaihua, Q., Ariah, K. M., Philipp, J., Christine, P., Arthur, G., & Dawn, S. (2024, May 27–31). *What drives the (in)stability of a stablecoin?* 2024 IEEE International Conference on Blockchain and Cryptocurrency (ICBC) (pp. 316–324), Dublin, Ireland.

Zhong, Y. (2022). *Review on digital currency* (pp. 585–590). Atlantis Press.

Zohar, A. (2015). Bitcoin: Under the hood. *Communications of the ACM*, *58*(9), 104–113.