Unfolding Hyper-Sovereignty: A Preliminary Examination of Decentralized Autonomous Organizations (DAOs) through Definitional Properties

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Abstract: This article delves into the emergence of Decentralized Autonomous Organizations (DAOs), which operate via rules set in smart contracts on blockchain networks. Unlike traditional organizations, DAOs are a collective of individuals coordinating online, without centralized authority, driven by a common algorithmic rule set to attain mutual objectives. Although DAOs are pioneering and hold immense potential as a catalyst for economic productivity and innovation, they remain in their nascent stages. The technology underpinning DAOs also opens avenues for multidisciplinary research, exploring its economic, legal, political, and social implications.

1. Introduction

Decentralized Autonomous Organizations (DAOs) represent a transformative approach to organizational structure, built upon the principles of decentralization and automation. At their core, DAOs are mission-driven collectives that coordinate using rules enforced by a blockchain. The term "decentralized" is derived from its foundation on a blockchain, which devolves decision-making power to stakeholders rather than traditional management hierarchies. The "autonomous" aspect refers to the organization's reliance on smart contracts—programmatic agreements that, once set in motion on a public blockchain, execute tasks under specific conditions without human intervention. DAOs reimagine the way projects are financed, communities are governed, and value is distributed. Refusing the conventional hierarchical models, DAOs harness Web3 technology, combined with progressive governance and incentive structures, to allocate decision-making and financial benefits. This structure enables global collaborations among individuals without entrusting a single leader with operational or financial control. The absence of centralized figures like CEOs ensures transparent and tamper-proof financial operations. To facilitate active participation, DAOs issue tokens reflecting individual contributions, investments, or participation levels. These token holders can then propose ideas, cast votes, and engage in the collective decision-making process. This article seeks to present a comprehensive overview of DAOs, highlighting the paradigm shift they introduce to organizational frameworks. We'll delve into emerging research challenges, legal considerations, avenues for optimization, and the potential for mainstream adoption of this model. Our insights are rooted in an in-depth analysis of the operational behaviors and patterns of DAOs with the highest Total Value Locked (TVL). By systematically studying these entities, we offer

valuable perspectives on the evolving landscape of blockchain-centric organizational models.

2. Decentralized Autonomous Organizations: An Overview

Within the realm of organization theory, a considerable body of literature explores various forms of decentralized organizations. The modern understanding of DAOs has its origins in the earlier idea of a Decentralized Autonomous Corporation (DAC). This notion surfaced shortly after the birth of Bitcoin [1]. Initially, mentions of the DAC concept were chiefly among cryptocurrency enthusiasts, using "decentralized" and "distributed" interchangeably when describing autonomous corporations. It was only in 2013 that the terminology achieved widespread attention, primarily through the works of Vitalik Buterin, co-founder of Bitcoin Magazine [2]. The ongoing academic exploration of DAOs, albeit still in its nascent stages, extends across varied disciplines. Numerous scholarly articles investigate blockchain technology as the foundational layer for pioneering blockchain-centric business models. These models span from decentralized finance applications [3, 4] to market-driven platforms, such as prediction markets [5]. These platforms operate as decentralized units with automated governance [6, 7]. Importantly, a DAO isn't limited to a particular business model or organizational archetype. It symbolizes a flexible concept suitable for diverse functions, ranging from crowdfunding to educational platforms or fully automated decision-making mechanisms [8]. Governance researchers have recently embarked on a journey to uncover the potential of blockchain technology, and organizations driven by smart contracts. Their studies examine the viability of open and distributed governance frameworks [9–12] and pinpoint challenges inherent in these structures [13–19]. A burgeoning interest exists at the nexus of economic and legal theories regarding DAOs, with a segment of research honing in on the legal aspects of DAOs [20–24]. By its very definition, a DAO is a digital-based entity that operates devoid of centralized control. Orchestrated by rules set on a public blockchain, its paramount aim is to coordinate members towards a collective goal. Central to a DAO's ethos is the idea of automated governance, refusing traditional human hierarchies. DAOs boast several advantages, including scalability, diminished operational expenses, adaptability, and enhanced computer security. They operate outside established legal paradigms, presenting an "alegal" organizational mold. Yet, with these merits come challenges, such as:

- Ambiguous legal standing and definition.
- Code-based operation vulnerabilities.
- Issues stemming from consensus mechanisms.
- Governance challenges, namely responsibility, transparency, and decision-making.

A hallmark of DAOs is their intrinsic transparency. Contrary to conventional firms that release sporadic financial summaries, every DAO transaction is continuously available on the blockchain, providing instantaneous insights and potentially curtailing illicit activities. DAOs are adept at quickly adapting to the needs of members and market impediments. Generally, DAO governance is shaped by the governance tokens held by its participants. Voting processes might differ, with some DAOs venturing into groundbreaking techniques like quadratic voting. Unlike legacy businesses entrenched within the legal boundaries and infrastructure of nation-states, DAOs primarily function on blockchains. Though they stand independent of nation-state legal systems, select jurisdictions, such as Wyoming and Vermont, have initiated recognition of DAOs to ease interactions with conventional economic players. In its essence, DAOs introduce an innovative methodology for project funding, community governance, and value distribution. Harnessing Web3 tech and progressive governance structures, DAOs disperse decision-making power and monetary rewards based on criteria such as engagement, input, and investment [25].

3. A Historical Overview of DAOs from a Societal Perspective

Throughout historical periods, human coordination has often been anchored to foundational layers that

facilitate trust and establish norms. One can liken these foundational layers to operating systems that underlie economic and political institutions. Historically, religious beliefs and practices served as an initial layer, providing a framework for societal governance. However, this model was generally effective only within communities sharing the same beliefs and practices, limiting its capacity for broader societal integration. Using pre-Reformation Europe as an illustrative example, the religious layer, predominantly represented by the Catholic Church, exhibited certain limitations. The church's governance structure often necessitated significant financial and ritualistic commitments from its followers. Furthermore, there were instances when the Church's authority superseded that of political or economic entities, potentially introducing unpredictability into socio-economic systems. Subsequent to this religious layer, the emergence of nation-states introduced a secular foundational layer accompanied by a legal framework. This evolution facilitated the establishment and governance of various economic entities, such as corporations. However, with increasing societal complexity, this nation-state-based layer presented challenges, particularly its intrinsic geographical focus. According to Rees-Mogg and Davidson [26], such geocentric systems could inherently prioritize domestic interests over global ones, posing challenges for a globally integrated digital economy. Historical trends indicate that when a foundational layer faces limitations, newer layers or systems emerge to address contemporary challenges. While the prior system might not disappear entirely, it often operates in conjunction with or in support of the newer layer. This analysis leads to a proposition for further exploration: Could blockchain technology and DAOs potentially serve as a contemporary layer, better equipped to interface with the digital global economy?

4. What is the purpose and potential of a DAO?

Decentralized Autonomous Organizations have emerged as an alternative governance structure in the digital realm. Unlike traditional organizations which often operate within hierarchical frameworks, DAOs employ a more transparent decision-making process. While many conventional business organizations utilize a centralized decision-making model, DAOs propose a different approach. In a traditional model, decisions can often be made by a select group, potentially limiting transparency and inclusivity. This has raised concerns in some quarters about clarity in organizational changes, financial transparency, and the alignment of interests between decision-makers and stakeholders [27]. On the other hand, DAOs operate on the basis of predetermined rules encoded in algorithms. Here, the trust among participants isn't placed in individual actors but in the code that governs the organization's operations. One highlighted benefit of this structure is its potential to address the Principal-Agent dilemma. In traditional settings, agents, such as CEOs, might make decisions that aren't always in line with the broader interests of stakeholders. DAOs attempt to mitigate this by fostering community governance where stakeholders rely on encoded rules rather than individual agents. In essence, this model aims to distribute organizational power more evenly among its members, minimizing the role of intermediaries. However, like all governance models, DAOs aren't without challenges. Ensuring appropriate compensation, delineating responsibilities, and matching community needs can be complex. Coordination through platforms like Discord or Telegram may not always be seamless. Furthermore, some DAOs have faced issues related to plutocracy, vote manipulation, and voter fatigue, among others [28]. Delays in decision-making, particularly with off-chain votes, can also be a concern. To enhance the efficiency and effectiveness of DAOs, further refinement and automation of their core processes might be required.

5. The fifteen properties of DAOs

Through a meticulous examination of diversified datasets coupled with direct observational methodologies, this study has unearthed fourteen distinct attributes intrinsic to Decentralized Autonomous Organizations.

This exploration, grounded in rigorous analytical frameworks, unveils the multifaceted nature of DAOs, shedding light on their operational dynamics, governance structures, and the inherent decentralization that underpins their autonomous functionalities. By delving into an extensive analysis, this investigative endeavor has paved the way for a deeper understanding of the foundational principles and operational mechanics that characterize Decentralized Autonomous Organizations, thereby contributing a robust analytical lens through which the realm of decentralized governance can be further explored and comprehended.

5.1. Autopoiesis

Pertaining to Decentralized Autonomous Organizations (DAOs), the notion of autopoiesis signifies the capacity of such entities to self-sustain and self-replicate devoid of a singular point of vulnerability. The metaphor of the multi-headed hydra may be summoned to elucidate this characteristic: akin to how the mythical creature is capable of regenerating two heads for each one severed, a DAO can robustly endure and adapt to adversities. The network architecture intrinsic to decentralized autonomous organizations accentuates its peripheral nodes, thereby diminishing the reliance on a central node. This structural orientation markedly contributes to the enduring nature of the organization by mitigating the risks associated with central points of failure. This decentralization, in essence, propels a self-sustaining operational modality, fostering a resilient organizational framework capable of autonomously navigating through operational exigencies [29]. Expanding further, the concept of autopoiesis in DAOs encapsulates a self-organizing and self-maintaining mechanism. DAOs operate on blockchain technology which provides a decentralized ledger to encode rules, transactions, and operational protocols. This technology undergirds the autopoietic quality of DAOs, as it enables a distributed consensus mechanism, ensuring that the organizational operations continue seamlessly even in the face of individual node failures or adversarial attacks. Moreover, the governance structures within DAOs are typically designed to be participatory and consensus-driven, which further enhances the decentralized and self-sustaining ethos of such entities. The collective decision-making processes, often facilitated through token-based voting systems, underpin the regenerative and adaptive capacities analogous to the regrowth mechanism of the hydra in mythology. Through a decentralized consensus and governance framework, DAOs epitomize a resilient organizational model aimed at obviating centralized vulnerabilities and promoting sustained communal governance and operational continuity.

5.2. Alegal

Decentralized Autonomous Organizations (DAOs) occupy a complex and often ambiguous legal territory, which has led to them being considered alegal in certain discussions. Here are some of the factors contributing to this status:

- Lack of Central Authority: DAOs operate without a centralized authority or management, making it difficult to apply traditional legal frameworks that often rely on the presence of identifiable decision-makers or representatives.
- Blockchain Basis: DAOs are typically based on blockchain technology, which itself is a relatively new and legally ambiguous terrain. The decentralization and anonymity provided by blockchain can complicate legal enforcement and regulation.
- Jurisdictional Challenges: DAOs operate globally and it is unclear which jurisdiction's laws would apply [30]. Different countries have different legal frameworks, and a DAO could be considered legal in one jurisdiction and illegal in another.
- Absence of Legal Precedent: There is limited legal precedent regarding the regulation and operation of DAOs. The lack of clear legal guidelines or established case law makes it challenging to determine their legal status.

- Smart Contracts: DAOs often operate through smart contracts which execute automatically. The legal status of smart contracts is still being debated in many jurisdictions.
- Liability and Accountability: It's difficult to establish liability or accountability within a DAO due to its decentralized nature. This is a significant challenge for legal systems that traditionally rely on the ability to assign liability.
- Regulatory Recognition: Regulatory bodies may not have specific provisions or recognition for DAOs, leaving them in a legal gray area.

These and other factors contribute to the alegal status of DAOs, which can be seen as operating outside or in between existing legal frameworks. The ongoing evolution of legal frameworks and the establishment of precedent over time may gradually change the legal standing of DAOs. The notion of alegal quality posits that an organization does not breach legal parameters, instead, it cultivates a foundational framework over an extended period. This concept bears a resemblance to the idea of functional equivalence derived from the field of ecology. Functional equivalence refers to the phenomenon where different systems or entities assume similar functional roles within their respective ecosystems, despite inherent differences in structure or form [31]. In a parallel vein, Decentralised Autonomous Organisations, while not always encapsulated within formal legal frameworks, exhibit foundational attributes that can be closely aligned with those of traditional associations when necessitated. This alignment potentially facilitates a nuanced understanding and possible integration of DAOs within existing legal and organizational paradigms . The alegal characteristic thus underscores an evolutionary trajectory, where an organization, over time, refines its structural and operational modalities to resonate with established legal and organizational frameworks, without contravening the prevailing legal norms.

5.3. Superscalable

The attribute of super-scalability underscores the capability of decentralized autonomous organizations (DAOs) to expand their membership significantly, thereby diverging from the conventional firm's operational dynamics which often become encumbered as they scale. According to traditional organizational theories, there is a direct proportionality between an organization's size and the inefficiency costs it incurs; as the organization expands, so does the complexity and the associated managerial challenges, often leading to diminishing returns. On the contrary, DAOs embody a distinctive operational framework that facilitates a fractal growth in membership. This denotes a form of growth wherein each additional unit or 'cell' within the organization not only adds to the collective capacity but also enhances the overall synergy, thereby enabling a more coherent and effective large-scale coordination [32]. The toolset intrinsic to DAOs plays a pivotal role in this regard. It provides the requisite infrastructure for such fractal growth, ensuring that the organizational synergy is amplified rather than diluted with each incremental unit of growth. Decentralized Autonomous Organizations represent a paradigm shift in organizational structure and operational ethos. They leverage blockchain technology to enable a decentralized decision-making process and operational autonomy. Through smart contracts and consensus mechanisms, DAOs ensure transparency, trust, and collective governance, which are foundational to their ability to scale effectively. Unlike traditional organizations, where hierarchical structures and bureaucratic processes often impede scalability and foster inefficiencies, DAOs thrive on a flat organizational topology and a collaborative ethos. The decentralized and autonomous nature of DAOs significantly mitigates the bureaucratic red tape and the associated inefficiency costs, making them a viable model for large-scale, collaborative endeavors.

5.4. Executable

The mention of 'executable quality' implies that the organization can conduct its operations via basic protocols embodied in software applications. The journey towards such operational autonomy began with the simplification of corporate registration to a one-click process. Following this, the emergence of capabilities to create an autonomous company via command line interfaces marked a significant stride. DAOs envisage a realm where software product suites encapsulate the entire operational spectrum of a firm right from the get-go. This operational autonomy isn't confined to digital infrastructure access but extends to embodying a set of sturdy design patterns. These design patterns can be effortlessly replicated across the organization, establishing a framework for seamless and automated operations. To delve deeper, Decentralized Autonomous Organizations (DAOs) are essentially governed by smart contracts and consensus among its members, rather than a central authority. The core idea is to have pre-programmed rules defining how the organization functions, and all the decisions are made through a consensus mechanism among its members. This leads to a democratized and transparent organizational structure where operations and transactions are executed automatically through software protocols. The robust design patterns mentioned can be seen as predefined templates or frameworks which ensure that the organization's operations adhere to certain standards, and can be easily replicated or scaled as the organization grows. By encapsulating operational processes within software suites, DAOs aim to create a plug-and-play model for organizational management, reducing the barriers to entry and operational overheads.

5.5. Permissionless

The notion of being "permissionless" implies that any entity can join or leave the organization based on established public criteria. This ties into broader discussions on agency, particularly through the lens of "exit, voice, and loyalty," a framework often discussed. Decentralized Autonomous Organizations extend this discourse by introducing the aspect of "entrance." This means any entity has the capacity to not only join or leave, but also to create, fork, or become a part of the network [33]. Decentralized Autonomous Organizations are a form of digital organization represented by rules encoded as a computer program. They are designed to be open source and global, with the particular characteristic of operating without centralized control. The notion of being permissionless is crucial here as it underpins the democratic ethos of DAOs—anyone, regardless of their identity or status, can participate in the organization as long as they adhere to the predefined rules. The trio of "exit, voice, and loyalty," is a framework coined by economist Hirschman [34], which is often used to understand the dynamics of participation and response to deteriorating performance in organizations. In the context of DAOs, this framework becomes particularly pertinent. Individuals have the "voice" to propose changes, the "loyalty" to stick with the organization through thick and thin, and the "exit" to leave the organization if they disagree with its direction. The introduction of the "entrance" qualifier in DAO discussions further enriches this framework. In traditional organizations, entrance can be heavily regulated or restricted. However, in DAOs, the entrance is democratized. Anyone can create a new project or initiative, fork an existing one to create a new direction, or simply join an existing one. This radical openness could potentially foster a highly innovative and collaborative environment, as it minimizes barriers to entry and encourages a diverse range of participants to contribute to the ecosystem. Through this lens, DAOs can be seen as a playground for exploring new organizational models and governance structures in a digital, decentralized age.

5.6. Aligned

The phrase "aligned quality" suggests that the organization has built-in incentives to tackle typical coordination challenges. Coordination problems often arise in groups or organizations where individuals have differing preferences or information. Game theory, a field that studies strategic interactions among rational decision-makers, helps in understanding these challenges by exploring various scenarios like cooperative, zero-

sum, and symmetric games, and their opposite situations. Decentralized Autonomous Organizations, on the other hand, serve as a remedial force against such coordination issues. They extensively employ a strategy known as mechanism design to foster a common ground among participants. Mechanism design, often regarded as the "reverse game theory", is about setting up a game with particular rules to achieve desired outcomes. In DAOs, this is achieved through either economic incentives or the adherence to social norms, aiming to reach a general agreement and to keep the organization operational [35]. This process of achieving agreement is often referred to as reaching a "rough consensus". Moreover, the concept of "headless brands" and cultural values are introduced as potent tools to foster a sense of belonging or affinity among the participants. In a DAO, a headless brand could refer to a collective identity that isn't tied to a central figure or a set of leaders, but rather is driven by the shared values and goals of its community. Cultural values within a DAO play a critical role as they can significantly influence the behavior of the members, fostering a sense of community and common purpose, which in turn, can contribute to overcoming coordination hurdles. In summary, DAOs utilize a blend of economic, social, and cultural tools to tackle inherent coordination challenges, creating a self-governing, consensus-driven environment that operates smoothly even in the absence of centralized control.

5.7. Co-owned

The attribute of co-ownership in a decentralized autonomous organization signifies that the organization allocates ownership shares to its members in a fair manner. This form of ownership is a part of a broader shift towards an "ownership economy," where services are owned by the participants, rather than centralized entities. This shift is made possible through the use of peer-to-peer financial systems that facilitate not only the exchange of information but also of value within networks. DAOs, acting as programmable cooperatives, ensure that members have a fair share in the financial, material, and social capital generated through their involvement. Expanding on the concept of decentralized autonomous organizations, these are essentially digital entities that operate without centralized control, governed by code and consensus among its members. DAOs represent a form of collective ownership and decision-making, enabling a self-organized community to collaborate, allocate resources, and make decisions together without a hierarchical management structure [36]. At the core of a DAO is a set of smart contracts on a blockchain which automates the organization's rules and operations. The blockchain's transparency and immutability ensure that every action within the DAO is recorded and verifiable by all members, promoting trust and collaboration. In a DAO, the ownership and control are distributed among members based on the shares or tokens they hold. These tokens can represent a member's voting power, equity, or any other form of stake in the organization, and they are often acquired through contributions of value, like money, time, or resources. The emergence of an ownership economy, as mentioned in the text, is a paradigm shift from traditional centralized models of ownership to models where participants have stakes in the services they use. This economy is facilitated by blockchain technology, which underpins the operation of DAOs and other peer-to-peer financial systems. It allows not only the exchange of information but also the direct transfer of value without intermediaries, enabling the flow of financial, material, and social capital within decentralized networks. This way, participants in a DAO can equitably share the benefits produced by their collective efforts.

5.8. Mnemonic

The phrase "mnemonic quality" refers to a decentralized autonomous organization's ability to automatically create a public record of its activities. Traditionally, the preservation of both explicit and implicit knowledge has been carried out through storytelling and established institutions like archival libraries and monasteries. However, DAOs revolutionize this by partially automating the process of capturing institutional

memory. This automation not only ensures accountability but also facilitates the transfer of knowledge across generations.

5.9. Composability

Composability in the context of Decentralized Autonomous Organizations (DAOs) refers to the ability of individual, self-governing entities or components to interact and cooperate in a modular and interchangeable manner, while still retaining their autonomous decision-making capabilities. This property is crucial as it allows for the creation of complex organizational structures and ecosystems through the combination of simpler, independently functioning parts.

- Modular Design: Composability advocates for a modular design where each DAO or component operates independently but can be combined or linked with others to form more complex structures.
- Interoperability: This is the ability for various DAOs and smart contracts to interact seamlessly. Interoperability is a hallmark of composability, enabling different entities to communicate and share resources or information without central coordination.
- Standardized Interfaces: Composability often relies on standardized interfaces which ensure that different components can interact in a predictable manner. These interfaces define the rules for interaction and data exchange among the entities involved.
- Autonomy and Decentralization: Despite being composed into larger ecosystems, each DAO retains its autonomy and decentralized decision-making. This decentralization is a core aspect of composability, ensuring that the integrity and independence of each entity is maintained even when functioning within a larger composite structure.
- Recursive Composition: In a composable system, DAOs can be nested within other DAOs, creating recursive structures. This recursive composition allows for a high degree of organizational complexity and flexibility.
- Shared Protocols and Infrastructure: Composability often leverages shared protocols and infrastructure which facilitate interaction and cooperation among disparate entities, reducing friction and enabling synergy within the decentralized ecosystem.
- Emergent Properties: When DAOs and other decentralized components are composed together, new, emergent properties can arise. These properties are often not predictable from the behavior of the individual components, showcasing the potential for innovative and novel organizational structures and dynamics to emerge from composable systems.

Through these aspects, composability plays a crucial role in realizing the potential of DAOs, enabling the creation of dynamic, adaptable, and complex decentralized ecosystems.

5.10. A-territoriality

The property of a-territoriality in Decentralized Autonomous Organizations (DAOs) refers to the notion that these organizations operate beyond the confines of geographic or jurisdictional boundaries. This characteristic is intrinsic to blockchain technology, which underpins DAOs, and allows for global participation and interaction in a decentralized manner without being tied to any specific territorial legal systems. Scientifically, this property can be discussed in terms of how blockchain technology enables the decentralization and global distribution of governance structures. Blockchain's inherent design allows for transactions and governance processes to be conducted in a way that is not bound by traditional territorial legal and political systems.

5.11. Pseudonymity

Pseudonymity in DAOs refers to the feature where individuals interact and operate within the organization

using pseudonyms instead of their real identities. This property enhances privacy and security as it helps to protect personal information while still maintaining a level of accountability among members. Scientifically, pseudonymity can be analyzed in terms of how it impacts the governance structures, trust mechanisms, and operational dynamics of DAOs. It may also be explored in terms of its implications for legal frameworks and regulatory compliance. Research in this domain might explore the cryptographic and algorithmic mechanisms that underpin pseudonymity, and how they contribute to the broader goals and functioning of DAOs.

5.12. Meritocracy

Meritocracy in Decentralized Autonomous Organizations refers to a governance model where decision-making authority is granted based on merit, often determined by a participant's contributions, skills, or achievements, rather than on the basis of personal relationships or seniority. This ideal aims to ensure that the most competent individuals have a significant influence over the organization's decisions, promoting efficiency and fairness. In a DAO, meritocracy can be operationalized through various mechanisms such as token-based voting where tokens might be earned through contributions to the organization, or through reputation systems that reflect the quality and quantity of a participant's contributions.

5.13. Leaderless

The property of "leaderlessness" in Decentralized Autonomous Organizations refers to the absence of a centralized authority or a single leader directing the operations and decisions within the organization. Instead, DAOs operate on the basis of consensus mechanisms and smart contracts on a blockchain, enabling a collective decision-making process among its members. In a leaderless setup, the governance and decision-making processes are distributed among the participants, often in a democratic or consensus-driven manner. This decentralization fosters a level of autonomy and reduces the potential for a single point of failure or control, which is a stark contrast to traditional centralized organizations where decision-making is hierarchical. Scientifically, the leaderless nature of DAOs has been explored in terms of its implications for organizational governance, resilience, and collaborative decision-making. The exploration often encompasses the study of consensus algorithms, governance models, and the social, economic, and technological underpinnings of such decentralized setups.

5.14. Non-hierarchical

The property of being non-hierarchical in Decentralized Autonomous Organizations refers to a flat or horizontal organizational structure where decisions are made collectively without a centralized authority. In this setup, every member has an equal say in the decision-making process, which can foster a more inclusive and democratic environment. Scientifically, this property can be analyzed in terms of network theory, where the nodes (members) interact with each other directly, without going through a central node (authority). It can also be examined through the lens of game theory, to understand the incentives and strategies that drive the behavior of individuals in a non-hierarchical setup.

5.15. Neutrality

The principal attributes that differentiate DAOs from conventional organizations, and render them relatively insulated from governmental influence, encompass the following:
- Decentralization: DAOs operate on decentralized networks, which means they are not confined to a specific geographic location. This inherently global nature makes them less susceptible to the jurisdiction of any single government, thereby limiting the extent of governmental influence.
- Autonomy: DAOs function autonomously once deployed, with operations governed by smart contracts

that execute automatically without the need for human intervention. This level of autonomy can minimize the scope for governmental interference which typically manifests through regulatory bodies or individuals in positions of authority.

- Transparency: Blockchain technology fosters transparency by recording all transactions on a public ledger that is immutable and verifiable. This transparency can act as a deterrent to governmental influence as all actions within the DAO are visible and accountable.
- Consensus Mechanisms: DAOs employ consensus mechanisms that enable collective decision-making. These mechanisms dilute the concentration of power and reduce the likelihood of external influence, including that from governmental entities.
- Anonymity and Pseudonymity: Participants in a DAO can often operate under pseudonyms or remain anonymous, which can further insulate the organization from governmental influence as it becomes challenging for authorities to identify and target individuals.
- Borderless arbitrage where organizations can navigate through the most favorable legal frameworks, thereby mitigating the impact of restrictive governmental regulations.

Through these attributes, DAOs manifest a structure and operational ethos that significantly mitigate the potential for governmental interference and influence compared to conventional, centrally organized entities.

6. Future and challenges

Historically, traditional assets have been grounded in legal constructs, with the rights of asset holders maintained within established legal frameworks. With the advent of blockchain technology, there's been a notable transition of assets to on-chain systems, classifying them as crypto assets. This raises the potential for smart contracts and algorithmic incentives to act as alternative means for ensuring ownership rights, bypassing conventional legal mechanisms. Decentralized Autonomous Organizations present another emerging model, potentially serving as primary coordinating entities for on-chain assets. Instead of relying on traditional legal company structures, there is a possibility for DAOs to become the preferred choice for managing these assets. Distinctly, DAOs have inherent characteristics that differentiate them from traditional entities. They are inherently global, can initiate on-chain, are open for anyone to join or contribute, and may reduce complications related to identity verification, employment contracts, and real-time compensation. Furthermore, DAOs function largely independent of specific national legal frameworks, deriving their operational rules primarily from the underlying blockchain. However, like all evolving systems, DAOs are not without challenges. Present-day DAOs grapple with governance complexities, voter participation, concentration of power, cybersecurity threats, and regulatory ambiguities. While these challenges are tangible, there is ongoing research and evidence suggesting possible resolutions in the future. In light of these developments, several research directions are emerging:

- Comparing the governance mechanisms of DAOs with traditional legal entities.
- Exploring avenues to integrate DAO structures within national legal systems, potentially drawing parallels with concepts like legal personhood.
- Investigating the feasibility of amplifying DAOs' efficiency and functionality by incorporating AI technologies and other IT governance methods.

It is evident that DAOs and crypto assets introduce innovative governance models and mechanisms that operate outside traditional legal paradigms, offering a more streamlined way to transmute assets into capital. Nevertheless, given the nascent stage of this governance model, it is essential to approach the potential of DAOs with both anticipation and caution, awaiting empirical evidence and rigorous scientific research to shed further light on their real-world implications and long-term viability.

In particular, all things considered within this scenario, key questions have emerged about possible further

goals of DAO's investigation research: identifying the advantages and disadvantages of DAO's governance compared to the traditional legal entities and corporate governance; evaluating the possibility to connect and combine DAO's entities with the nation-state's legal frameworks like the notion of legal personhood; the possibility to increase the level of automation of these organizations in order to enhance effectiveness and efficiency by combining DAO's governance with AI technologies and other IT and governance techniques and thus improving the DAOs' overall performances and features. It is clear that DAOs and crypto-assets offer alternative governance and "alegal" protections for property rights within a global "permissionless" financial system that anyone can leverage to convert assets into capital in a far more efficient way than today's old-fashioned alternatives. However, considering the early adoption of this governance, whether DAOs will live up to their optimistic promise remains to be seen and verified in the future through empirical evidence and scientific research.

Conflict of Interest

The authors declare no conflict of interest.

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