

Political Economy of Cryptocurrency Mining: China's Dominance and Implications for Global Governance

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Abstract

This study critically examines the political economy of cryptocurrency mining, focusing on China's enduring dominance and its implications for global governance in the post-ban era. Before the 2021 regulatory crackdown, China accounted for over 65 per cent of the global Bitcoin hash rate, leveraging cheap electricity, advanced hardware manufacturing, and a favourable policy environment. Although the ban prompted a redistribution of mining activities to countries such as the United States and Kazakhstan, recent evidence shows that Chinese miners still control a substantial share of the global network through clandestine operations and industrial advantages. This paper applies World-Systems Theory and the Techno-Political Economy framework to analyse how mining power concentration reinforces global inequalities and geopolitical influence despite the ostensibly decentralised ethos of blockchain technologies. Drawing on qualitative analysis of secondary data from academic studies, industry reports, and regulatory documents, the study highlights how state power, infrastructural control, and energy politics intersect to shape the governance of digital finance. The findings reveal that China's persistence in Bitcoin mining raises concerns about decentralisation, environmental sustainability, and the vulnerability of blockchain networks to state influence. The paper concludes by advocating for multilateral governance frameworks, sustainable mining incentives, and policies that encourage geographic decentralisation, emphasising the need for coordinated global action to balance innovation with energy, economic, and political considerations.

Keywords: Cryptocurrency Mining, China, Global Governance, Decentralisation, Bitcoin, Digital Sovereignty

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Introduction

Cryptocurrencies have, over the past decade, transitioned from a niche technological experiment into a transformative force in the global financial system. Among these digital currencies, Bitcoin remains the most prominent, operating on a decentralised blockchain network that relies on a process known as “mining” to validate transactions and secure the network. Mining is highly energy-intensive and computationally demanding, which has historically caused it to cluster in regions with abundant, low-cost electricity, advanced hardware production, and regulatory environments conducive to large-scale operations. China became the leading hub for Bitcoin mining before 2021, benefitting from plentiful coal and hydroelectric power, a highly developed supply chain for specialised mining hardware, and permissive government policies. At its peak, China accounted for more than 65 per cent of the global Bitcoin hash rate, a concentration of power that posed a paradox for a network built on the principle of decentralisation (Cambridge Centre for Alternative Finance, 2020).

The scale of China’s dominance generated significant academic debate. On one hand, scholars such as Cong, He and Tang (2021) argue that excessive geographical concentration of mining power undermines decentralisation and introduces risks of manipulation or censorship in blockchain networks. Environmental concerns have also been at the centre of the debate, with de Vries (2023) highlighting that China’s reliance on coal-fired power plants for mining exacerbated Bitcoin’s carbon footprint. On the other hand, some researchers, including Yermack (2022), contend that some level of state participation and industrial organisation could provide regulatory stability and infrastructural reliability, tempering some of the risks inherent in unregulated crypto-markets.

In 2021, the Chinese government enacted a sweeping ban on cryptocurrency mining, citing environmental concerns and financial risk mitigation as the primary justifications for the policy. The ban was expected to significantly reduce China's dominance and lead to a more geographically dispersed distribution of hash power, particularly across countries such as the United States, Kazakhstan, and Canada (Jiang et al., 2022). Nevertheless, contrary to these expectations, recent evidence indicates that Chinese miners have continued to play a dominant role in the global Bitcoin network. By September 2024, Chinese mining pools still accounted for approximately 55 per cent of the world’s Bitcoin hash rate, demonstrating the resilience and adaptability of the industry (Vardai, 2024). Meanwhile, the United States emerged as a significant hub, hosting roughly 40 per cent of the global hash rate (Cambridge Bitcoin Electricity Consumption Index, 2024).

Although Bitcoin mining operations have become more geographically diverse, China’s dominance has not significantly diminished. The continued concentration of mining power has raised profound questions about the extent to which Bitcoin can be considered decentralised, as well

as the geopolitical consequences of a single state retaining such significant influence over a supposedly borderless financial system. Roberts and Zhang (2023) caution that states with dominant mining power could, in theory, exert influence over transaction validation, network forks, or even transaction censorship, thereby shaping the governance of blockchain networks. Conversely, Catalini and Gans (2021) argue that the inherent market incentives of decentralised systems limit the potential for any single actor, including states, to exercise lasting control.

Ibañez et al. (2024) show that mining bans can create unintended consequences such as carbon leakage, where mining relocates to more carbon-intensive jurisdictions. Neumuller (2023) highlights that rapid improvements in ASIC efficiency have altered key assumptions about electricity usage, while the Cambridge Digital Mining Industry Report (2025) documents the rising institutionalisation of mining and the increasing role of renewable and nuclear power, which now account for over half of Bitcoin's reported energy mix. These findings suggest that while the geography and environmental footprint of mining are evolving, China's enduring industrial advantage and access to sophisticated hardware supply chains have enabled it to maintain considerable influence despite official prohibition.

Despite these developments, the political-economy dimensions of China's continuing role in Bitcoin mining remain underexplored. Many of the existing scholars have focused on technical or environmental considerations, with comparatively little analysis of how state policy, industrial organisation, and global financial dynamics interact to sustain China's dominance. In Nigeria, for example, Oladipupo, Oyedokun, and Nesiamia (2023) examined the consequences of a domestic cryptocurrency ban on trade and innovation, revealing how restrictive regulations can inadvertently drive crypto-related activity into informal, unregulated spaces. This underscores the delicate balance policymakers must strike between promoting financial innovation and ensuring stability.

This paper seeks to address this gap by critically examining the political economy of cryptocurrency mining, focusing on China's historical role and its continuing influence on global Bitcoin governance. It is guided by the overarching research question: how and why has China maintained a dominant role in Bitcoin mining despite a regulatory ban, and what are the implications for the governance, security, and decentralisation of global cryptocurrency networks? The study draws on secondary data from the Cambridge Centre for Alternative Finance, Cointelegraph, CryptoQuant, and relevant academic literature. It adopts a qualitative political-economy approach to analyse how technological innovation, state policy, and international finance intersect to shape power dynamics in the cryptocurrency sector.

This paper makes three main contributions. First, it highlights the structural and geopolitical factors that have allowed China to retain

significant influence over Bitcoin mining, thereby challenging the assumption that regulatory crackdowns necessarily lead to decentralisation. Second, it provides new insights into how states can maintain indirect influence over decentralised technologies even when official policies prohibit them. Third, it explores the implications of China's dominance for global governance, financial stability, and the future regulation of digital currencies.

Theoretical Framework

Political Economy as an Analytical Lens

Political economy explores the interaction between power, institutions, and economic structures in shaping how resources are produced, controlled, and distributed. It examines how state policies, market forces, and technological developments intersect to reinforce or challenge existing power relations (Mosley, 2022; Rella, 2023).

From this perspective, cryptocurrency mining is not merely a technical process but a deeply political and economic phenomenon. Mining requires vast energy resources, advanced hardware, and access to capital, resources that are unevenly distributed across states. The ability to concentrate these resources provides some countries and corporate actors with disproportionate influence over a supposedly decentralised technology. This aligns with the political-economy concern with who controls productive capacity, under what institutional arrangements, and with what consequences for power distribution.

Applying this lens to Bitcoin mining highlights how China leveraged cheap hydroelectric and coal power, industrial manufacturing capabilities, and permissive regulatory policies to consolidate mining power. Even after the 2021 ban, Chinese miners retained a significant share of global hash power through clandestine operations and access to infrastructure, underscoring the persistence of state-linked structural advantages. Political economy, therefore, provides the conceptual tools to interrogate how economic resources and state power interact in the governance of digital technologies.

World-Systems Theory

World-Systems Theory (Wallerstein, 1974) examines global inequalities through a core-periphery-semi-periphery model, arguing that economic and political power is structured hierarchically. Core countries dominate global trade and high-value industries, while peripheral countries provide raw materials and low-value production. Semi-peripheral states, positioned between these two extremes, can disrupt core dominance by leveraging comparative advantages to penetrate high-value sectors (Clegg, Gertz, & Samman, 2021).

China's pre-2021 role in Bitcoin mining can be interpreted through this lens as that of a semi-peripheral power challenging the U.S.-led financial core. By combining inexpensive energy, a robust hardware manufacturing

sector, and state-driven industrial policies, China was able to dominate a strategic frontier of digital finance. This temporarily shifted power away from traditional Western financial centres, reflecting how semi-peripheral states can exploit technological opportunities to reshape global power structures (Zhang & Huang, 2022).

Furthermore, World-Systems Theory explains the uneven geography of mining. Peripheral countries with limited infrastructure or restrictive regulations remain excluded from large-scale mining. In contrast, the U.S. and China, as dominant players, capture disproportionate benefits, reinforcing global digital inequalities. This framework underscores how cryptocurrency mining is embedded in broader patterns of global stratification and capital accumulation.

Techno-Political Economy Framework

The Techno-Political Economy framework (Mansell & Steinmueller, 2020) emphasises that technologies are not neutral tools but infrastructures embedded with political choices and power relations. It highlights how control over digital infrastructures, such as mining farms, energy grids, and specialised hardware, translates into geopolitical leverage and shapes governance outcomes.

From this perspective, China's pre-ban dominance in Bitcoin mining was not simply the product of market forces but of state-enabled infrastructural power. By fostering favourable industrial conditions and supporting hardware manufacturing, the Chinese state positioned itself to influence a supposedly decentralised network. The 2021 mining ban, while appearing to cede control, paradoxically demonstrated how state regulatory actions can reshape global mining geographies and open new opportunities for rival states, such as the United States, to expand their influence (AlShehabi & Malik, 2022).

This framework also explains the post-ban resilience of Chinese miners, who continue to exploit existing infrastructure, regulatory loopholes, and access to low-cost energy. It highlights the political character of mining as a site of contestation over sovereignty, economic power, and technological control, rather than a purely technical or market-driven activity (Morozov, 2019).

China's Dominance in Cryptocurrency Mining

China's position as the global hub of Bitcoin mining before 2021 resulted from a combination of favourable structural conditions. Provinces such as Sichuan, Yunnan, and Xinjiang offered abundant low-cost electricity from hydroelectric and coal sources. At the same time, domestic manufacturers like Bitmain, Canaan, and MicroBT provided most of the world's application-specific integrated circuit (ASIC) mining hardware (Cambridge Centre for Alternative Finance, 2020). By 2019, China accounted for approximately 75 per cent of the global Bitcoin hash rate, which only declined to around 46 per cent by April 2021, shortly before the government crackdown (Wired, 2021). This dominance extended

beyond mining activities to the control of the hardware supply chain, which became a key element of China's structural power in the cryptocurrency ecosystem.

In May 2021, the Chinese State Council initiated a nationwide clampdown on cryptocurrency mining, citing concerns over energy consumption, financial stability, and illicit financial flows (Investopedia, 2021). The ban was enforced in key mining provinces such as Inner Mongolia and Sichuan, leading to the shutdown of numerous mining farms. The global Bitcoin hash rate consequently dropped by nearly 50 per cent, and China's reported contribution to the hash rate fell to almost zero by July–August 2021 (Nasdaq, 2022). This sudden disruption triggered what has been termed the "Great Mining Migration," as miners relocated to countries with more favourable regulatory and infrastructural conditions, particularly the United States, Kazakhstan, and Russia (Bitcoin Insider, 2021). By August 2021, the United States' share of the global hash rate had surged to 35 per cent, Kazakhstan to 18 per cent, and Russia to 11 per cent (Bitcoin Insider, 2021).

Although the ban was expected to diminish China's influence in Bitcoin mining permanently, empirical evidence demonstrates a strong recovery. By early 2022, China had regained approximately 21 per cent of the global hash rate, and its share has not fallen below 18 per cent since then (Cointelegraph, 2022). By September 2024, data from CryptoQuant revealed that Chinese mining pools controlled approximately 55 per cent of the global Bitcoin network, while U.S.-based pools accounted for around 40 per cent (Vardai, 2024). However, pool headquarters do not necessarily reflect the actual geographic location of miners; many Chinese pools operate globally dispersed mining rigs, often through virtual private networks (VPNs), making the real distribution of hash power more opaque (Cointelegraph, 2024).

Migrations, Infrastructure, and Industrial Influence

The rapid relocation of mining operations to countries such as Kazakhstan and Russia produced significant energy and political consequences. Kazakhstan, for example, experienced severe strain on its energy grid due to the influx of miners, which resulted in power blackouts and social unrest (Estecahandy, 2024). Despite the migration of physical mining operations, Chinese firms retained control over a critical portion of the hardware manufacturing industry. Bitmain and Canaan, for example, continue to dominate the production of ASIC rigs, giving China significant leverage over the global mining supply chain (Reuters, 2025).

From a political-economy perspective, China's persistent dominance illustrates how state-linked industrial infrastructures, hardware control, and capital-intensive operations enable enduring influence even after regulatory prohibition. The ban did not decentralise power as anticipated but instead displaced operations while leaving structural control intact. The resilience of Chinese-linked mining pools and hardware firms underscores that decentralised technologies remain susceptible to

concentrations of power in the hands of well-resourced actors and states with strategic industrial advantages (Mosley, 2022; Rella, 2024).

This dynamic challenges the assumption that regulatory interventions automatically lead to the diffusion of power. Instead, it reveals the limits of formal state prohibition in an industry where infrastructure, capital, and supply chains remain deeply tied to the same geopolitical actor. Consequently, the Chinese case highlights the paradox of decentralised technologies that remain dependent on highly centralised industrial capacities and state-linked networks of power.

China's Semi-Peripheral Advantage

World-Systems Theory (Wallerstein, 1974; Clegg et al., 2021) helps explain how China, positioned as a semi-peripheral state, leveraged its structural advantages to challenge core economies in the emerging bitcoin industry. Before the 2021 ban, China controlled over 65 per cent of the global hash rate, thanks to abundant low-cost hydropower, domestic ASIC supply chains, and favourable provincial policies (Cambridge Centre for Alternative Finance, 2020). These capabilities allowed China to operate at scale, capturing rent from global mining demand and thus replicating the rent-extraction dynamics typical of semi-peripheral states in resource-based industries.

Even after the ban, China's dominance re-emerged through clandestine pool operations and indirect control over hardware supply, despite official prohibition. This illustrates how semi-peripheral actors can wield influence through industrial ecosystems and capital-intensive coordination, even when formal policies appear restrictive (Vardai, 2024). The post-ban redistribution to Kazakhstan and North America followed hydraulic development patterns seen in resource migration, but did not eliminate China's structural leverage.

The concept of techno-political economy (Mansell & Steinmueller, 2020; Rella, 2023) also foregrounds how technological infrastructures embody political power. Rella's notion of a "material political economy of computation" examines how physical infrastructures, such as ASIC farms, cooling systems, and grid access, intersect with institutional and state logics to define who benefits from computation (Rella, 2024). Chinese miners, through dominance in hardware production (Bitmain, MicroBT), supply chain control, and access to excess electricity infrastructure, translate industrial capability into governance influence.

States and firms have responded by treating Bitcoin mining as part energy-optimisation strategy, part techno-economic lever. Countries like Norway and parts of the U.S. have set up mining operations near stranded or flared energy sources, monetising otherwise wasted capacity (D-Central, 2024). These techno-economic models illustrate how states can weaponise energy arbitrage for economic and political gain, structurally analogous to China's earlier industrial strategies.

Regulatory Arbitrage and Energy Politics

The migratory pattern of mining, driven by regulatory divergence and energy costs, reflects global regulatory arbitrage, a hallmark of political-economy dynamics. After China's ban, miners relocated to jurisdictions with cheap energy (e.g., Kazakhstan, the USA, and Canada), sometimes overwhelming local infrastructure. Estecahandy (2024) documents how Kazakhstan's grid suffered instability and civil unrest under the surge in mining demand, illustrating how regulatory shifts in one country can trigger ripple effects elsewhere.

Similarly, in Iran, unregulated mining surged during energy crises, leading to rolling blackouts and public outrage, often concentrated in poorer regions, highlighting how energy inequality and institutional failure intensify social costs (AP News, 2025). These dynamics emphasise the political-economy point that state policy and energy infrastructure define both winners and losers in mining transitions.

Concentration of Capital and Corporate Power

Bitcoin's decentralised ethos has been eroded by the rise of industrial-scale mining operations controlled by well-capitalised pools. Hayes (2023) and Vardai (2024) document how individual hobbyist miners have mainly been supplanted by large operators tied to Chinese-origin companies, reflecting a shift to corporate control and centralised validation power. Capponi et al. (2021) further model how rent-seeking behaviour among large miners alters network dynamics, reducing meaningful decentralisation even in technically open systems.

This consolidation enables actors to shape global blockchain governance subtly, ensuring that validation rules, forks, and deployment of new protocol features remain within strategic influence grids. Mining pools, predominantly Chinese, still command economic and computational leverage, even outside China.

Implications for Global Governance and Decentralisation

Bitcoin was conceived as a decentralised digital currency, yet the reality of its mining landscape tells a different story. The concentration of mining power, particularly in China, raises fundamental concerns about decentralisation, security, and global governance. Although the Bitcoin network remains technically distributed, control over validation and decision-making processes is disproportionately influenced by a small number of dominant mining pools. These actors possess the capacity to shape protocol outcomes and potentially compromise network neutrality. Scholars such as Capponi et al. (2021) and Halaburda (2025) note that concentrated mining power increases the risk of attacks, censorship of transactions, and undue influence over protocol upgrades, undermining the trustless premise of blockchain technologies. This situation exposes the fragility of the ideal of decentralisation, revealing that network governance is deeply entangled with power asymmetries.

The implications of this concentration extend far beyond technical vulnerabilities. Mining at an industrial scale creates significant ethical and environmental challenges. Benetton, Compiani and Morse (2023) demonstrate that communities hosting large mining operations often bear higher energy costs and receive minimal economic benefits, while the profits accrue primarily to capital-intensive operators. De Vries and Stoll (2021) further highlight the substantial carbon footprint of proof-of-work systems, illustrating that the environmental externalities of mining are distributed unevenly across the globe. These dynamics reveal how mining has become a political-economy issue: costs are externalised onto vulnerable communities, while the benefits of coin generation and network control remain concentrated among a small group of actors with access to capital and hardware.

The geographic concentration of mining also has implications for economic sovereignty and regulatory coherence. Countries with cheap electricity often attract mining operations, creating opportunities for economic growth but also exposing them to increased energy demand, infrastructure strain, and environmental degradation. At the same time, disparities in national regulations have led to regulatory arbitrage, where mining operators relocate to jurisdictions with the weakest rules or cheapest energy. This dynamic limits the ability of individual states to manage cryptocurrency mining within their borders effectively and underscores the absence of a coherent multilateral framework to govern these activities. International organisations such as the IMF and UN have begun to discuss proposals for global crypto mining regulation, including the possibility of climate taxes on energy-intensive proof-of-work systems, but progress remains slow and fragmented (IMF, 2021; UN Task Force, 2024).

Dominant mining pools also exert influence over governance decisions in blockchain networks. Ballandies et al. (2025) demonstrate that voting power on protocol upgrades correlates strongly with hash-rate control, giving large pools disproportionate influence in decision-making. This undermines the democratic ideals that underpin decentralised finance, as smaller participants have little meaningful power in shaping the future of the network. The emergence of alternative pool structures, such as the OCEAN project backed by Jack Dorsey, which allows miners to select their own block templates, represents an attempt to reduce centralised gatekeeping by pool operators. However, such initiatives remain nascent compared with the entrenched power of established mining pools.

The persistence of Chinese influence in Bitcoin mining, even after the 2021 ban, illustrates the complex interplay of state power, industrial capacity, and global financial networks. From a political-economy perspective, this resilience reflects more than technical adaptation; it is the outcome of material advantages and institutional legacies that enable states and corporations to shape ostensibly decentralised systems. World-Systems Theory highlights that China's semi-peripheral position, combined with its manufacturing capabilities and energy resources,

allows it to disrupt U.S.-dominated digital finance (Clegg et al., 2021). Techno-Political Economy scholarship similarly shows that infrastructures such as mining farms and energy grids are not neutral but embedded in political choices and power relations (Mansell & Steinmueller, 2020; Rella, 2023).

Addressing these challenges requires more than domestic regulation. Protocol-level solutions, such as incentives for geographic dispersion of miners or adaptive block-reward mechanisms, could help reduce the risks of recentralisation. Energy-based taxation, including climate levies for proof-of-work systems, has been proposed as a way to encourage cleaner energy use and discourage concentration in fossil-fuel-rich jurisdictions (UN Task Force, 2024). However, without coordinated international action, such initiatives risk being undermined by regulatory arbitrage. The development of a multilateral governance framework for cryptocurrency mining, akin to existing regimes for climate change or nuclear non-proliferation, would provide an avenue to address the environmental, economic and political risks associated with mining concentration.

Ultimately, the case of China's enduring dominance in Bitcoin mining underscores that decentralised technologies are deeply entangled with global power structures. Far from being a purely technical phenomenon, mining is a site of contestation where states, corporations, and communities negotiate control over digital infrastructures and economic rewards. The persistence of these power imbalances poses a fundamental challenge to the ideals of decentralised finance. It highlights the urgent need for governance frameworks that can balance innovation with sustainability, equity, and genuine democratic participation.

Conclusion

This study critically examined the political economy of cryptocurrency mining with a particular focus on China's historical dominance and the paradox of its continued influence despite the 2021 regulatory ban. Using World-Systems Theory and the Techno-Political Economy framework, the paper has demonstrated that Bitcoin mining is not simply a technical or economic process but a profoundly political and geopolitical phenomenon shaped by power relations, state capacities, and global inequalities. The findings revealed that although the 2021 ban initially redistributed mining activities to other regions, most notably the United States, Kazakhstan, and Russia, Chinese miners have retained significant influence through clandestine operations, industrial advantages, and their control over hardware manufacturing.

This persistence underscores a fundamental paradox: cryptocurrencies, envisioned as decentralised and resistant to state control, remain susceptible to the power of well-resourced actors and state-linked infrastructures. The case of China highlights how states can indirectly shape decentralised technologies even while ostensibly withdrawing support for them. By leveraging structural advantages such as cheap energy, advanced hardware supply chains, and strong organisational

capacity, China has maintained a central role in global Bitcoin mining, which raises concerns about the security and neutrality of blockchain networks.

The political economy lens adopted here demonstrates that mining power concentration is not merely an unintended consequence of market forces but rather a reflection of broader power asymmetries in the global economic system. Through the World-Systems perspective, China can be understood as a semi-peripheral actor strategically challenging the traditional dominance of core Western economies in digital finance. At the same time, the Techno-Political Economy framework shows how control over infrastructures, such as ASIC production and energy resources, serves as a tool of geopolitical leverage. Together, these perspectives reveal that mining is part of a broader struggle over digital sovereignty and global financial governance.

The implications of this persistence are multifaceted. First, the continued concentration of mining power in a handful of jurisdictions contradicts the ethos of decentralisation that underpins Bitcoin and other blockchain-based technologies. Such concentration raises the risk of 51 per cent attacks, transaction censorship, and undue state influence over a supposedly borderless financial system. Second, the environmental externalities of mining remain significant. Although the ban in China temporarily reduced Bitcoin's carbon footprint (Bankless Times, 2023), the relocation of mining to jurisdictions with fossil-fuel-intensive energy grids risks increasing global emissions through "carbon leakage" (Ibañez et al., 2024). Third, the lack of a coordinated global regulatory framework creates opportunities for regulatory arbitrage, where miners relocate to jurisdictions with weak environmental and governance standards, perpetuating inequities in both energy use and economic gains.

Recommendations

Establish a Multilateral Crypto Governance Framework: There is a pressing need for an international regulatory framework for cryptocurrency mining akin to existing mechanisms for climate change and nuclear non-proliferation. Organisations such as the United Nations, the G20, or a dedicated coalition of states could facilitate agreements on standards for transparency, environmental sustainability, and fair competition in the mining sector.

1. **Promote Sustainable Mining Practices through Incentives:** International financial institutions and national governments should provide incentives for miners to adopt renewable energy sources. Subsidies, tax credits, and certification schemes could encourage a shift to green energy in mining operations.
2. **Encourage Geographic Decentralisation via Protocol-Level Solutions:** To mitigate the systemic risks associated with concentrated mining power, blockchain developers and communities can integrate incentives for geographic dispersion directly into network protocols.
3. **Support Digital Infrastructure Development in Emerging Economies:** Global efforts to promote inclusion in blockchain innovation must

recognise that developing countries risk exclusion due to limited infrastructure and regulatory capacity. Investment in digital infrastructure, renewable energy, and technical expertise in these regions could enable them to participate in cryptocurrency mining under sustainable and transparent conditions.

4. Align Blockchain Governance with Broader Good-Governance Goals: As states and international organisations regulate mining and blockchain more broadly, governance frameworks should incorporate mechanisms that protect the democratic potential of these technologies while preventing their capture by authoritarian regimes or powerful corporate actors.

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