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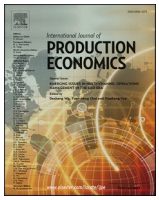

Tokenized assets in a decentralized economy: Balancing efficiency, value, and risks

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ABSTRACT

The emergence of blockchain technology is compelling firms to rethink traditional operations and management strategies, with asset tokenization presenting a transformative potential to optimize transaction processes and redefine value chains. This study explores how blockchain-enabled asset tokenization influences transaction efficiency, value creation, and risk distribution across different market contexts. Utilizing a multiple-case study design, this research analyzes four asset tokenization business cases in multiple sectors —real estate, gold, gaming assets, and carbon credits—through 30 semi-structured interviews with participants from each case. Our research findings indicate that while tokenization significantly enhances transaction efficiency and creates new value propositions, it also introduces complexities in governance and risk distribution, which may challenge market stability. This study contributes to the contemporary blockchain literature by empirically illustrating how asset tokenization alters traditional asset management and investment models, highlighting the importance of tailored regulatory frameworks to address this emerging blockchain-enabled business models. Additionally, the research offers practical insights for business practitioners, suggesting that a balanced approach is necessary to leverage the benefits of asset tokenization while safeguarding market trust and sustainability.

1. Introduction

The advent of blockchain technology has introduced transformative changes across various industries, particularly in the way assets are represented, transferred, and traded (Nguyen et al., 2021; Wankmüller et al., 2023). One of the most significant innovations facilitated by blockchain is asset tokenization, which involves converting physical or digital assets into tokens on a blockchain (Zheng and Sandner, 2022). These tokens can be traded and managed on decentralized platforms, enabling new forms of ownership, liquidity, and participation in markets that were previously inaccessible or inefficient. Asset tokenization is increasingly being adopted in various sectors, including real estate, precious metals, gaming assets, and environmental credits, among others (Wankmüller et al., 2023). While the promise of streamlined transactions, reduced costs, and democratized access to investment opportunities has made asset tokenization an attractive proposition for businesses and investors, the decentralized nature of blockchain also introduces critical complexities (Hoang and Phan, 2022; Narayan and Tidström, 2020). Issues related to governance, security, and market trust can significantly influence not just transaction efficiency and value creation, but also broader systemic risks (Sunyaev et al., 2021). Indeed, decentralized mechanisms may exacerbate challenges such as dispute resolution, fraud detection, and regulatory ambiguities, raising questions about how best to balance the benefits of tokenization against its vulnerabilities (Gan et al., 2021; Narayan et al., 2020). Thus, understanding these unintended consequences of decentralization is critical for stakeholders who aim to harness the innovation's potential while safeguarding the stability and trustworthiness of tokenized markets.

This research originates from the emerging discourse on blockchain-enabled asset tokenization and its transformative impact on traditional financial models. It aims to explore how tokenization alters transaction efficiency, value creation, and risk distribution among market participants. Specifically, the study seeks to address two core questions:

RQ1. How do blockchain-enabled asset tokenization business models influence transaction efficiency and value creation?

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RQ2. What are the unintended consequences of decentralization in blockchain-enabled asset tokenization on risk distribution and market trust?

This research employs Transaction Cost Theory (TCT) as the theoretical foundation to analyze how blockchain-enabled asset tokenization influences transaction efficiency, value creation, and risk distribution among market participants (Schmidt and Wagner, 2019; Chen et al., 2022). TCT is particularly relevant for this study because it offers a structured lens to examine how decentralized technologies can alter traditional cost structures, reduce intermediary roles, and reshape economic exchanges. The interpretivist approach adopted in this study enables a nuanced exploration of stakeholders' perceptions and experiences, providing deeper insights into the complexities of this emerging phenomenon. Utilizing a multiple-case study design (Yin, 2004), the research focuses on four diverse cases—real estate, gold, gaming assets, and carbon credits—to illustrate the varied applications of asset tokenization. These four sectors—real estate, gold, gaming assets, and carbon credits—were chosen to represent a broad spectrum of economic and technological contexts, thereby illuminating how tokenization interacts with distinct market characteristics (Bhatia et al., 2024; Hanneke et al., 2024). Real estate, renowned for illiquidity and high transaction costs, serves as a prime case for examining how fractional ownership and disintermediation might lower barriers and democratize investment. By contrast, gold, traditionally valued as a stable store of wealth, highlights how tokenization can enhance liquidity and custodial practices within a predominantly physical market. Gaming assets, being intrinsically digital, offer insights into how tokenization could transform virtual economies and ownership models. Lastly, carbon credits, as intangible and highly regulated assets, underscore how blockchain-based tokenization can foster transparency, trust, and verifiability in sustainability-focused markets (Messina et al., 2024; Gan et al., 2021). Data collection through semi-structured interviews and archival documents, involving 30 participants across these cases, allows for a rich, contextual understanding of the implications of blockchain technology. Open-ended questions facilitate detailed insights, contributing to a comprehensive view of how asset tokenization is transforming market dynamics and presenting both opportunities and challenges.

The remaining sections of this study are organized as follows. The next section presents the theoretical framework guiding this research, and Section 3 details the methodology employed. Section 4 focuses on analyzing the results, while Section 5 offers an in-depth discussion of the findings. Finally, Section 6 highlights the theoretical and practical implications of this study, addresses its limitations, and suggests directions for future research.

2. Literature review

2.1. Asset tokenization

Asset tokenization represents a significant shift in the financial landscape, leveraging blockchain technology to convert tangible and intangible assets into digital tokens that can be traded on decentralized platforms (Sazandrishvili, 2020). The concept of tokenizing assets emerged in the early 2010s, with the advent of blockchain technology, particularly through the development of smart contracts on platforms like Ethereum. These smart contracts enable the automatic execution of agreements based on predefined conditions, thereby facilitating the fractional ownership, transfer, and trading of assets without the need for traditional intermediaries such as banks or brokers (Roth et al., 2021; Harish et al., 2023a). The rationale behind asset tokenization lies in its potential to enhance liquidity, democratize access to investments, and reduce transaction costs. By breaking down high-value assets into smaller, more affordable tokens, asset tokenization allows a broader range of investors to participate in markets that were previously inaccessible due to high entry barriers (Guggenberger et al., 2024). This is particularly relevant for illiquid assets such as real estate, where tokenization can enable fractional ownership, making it possible for individuals to invest in small portions of a property without the need to purchase the entire asset (Hanneke et al., 2024). Similarly, tokenization of commodities like gold, intellectual property, and even environmental assets such as carbon credits, has gained traction, offering new avenues for asset management and investment.

The process of asset tokenization involves several key steps. First, the asset to be tokenized is identified and its value is assessed. Next, a digital representation of the asset is created in the form of tokens on a blockchain. These tokens are then made available for purchase on a digital platform, where they can be bought, sold, or traded like traditional securities (Hanneke et al., 2024). Importantly, the ownership and transfer of these tokens are recorded on the blockchain, providing a transparent and immutable record of all transactions (Guggenberger et al., 2024). This process is governed by smart contracts, which ensure that all terms and conditions of the asset's ownership and transfer are enforced automatically, without the need for intermediaries. However, despite its potential, asset tokenization is not without challenges (Guggenberger et al., 2024; Hanneke et al., 2024). The regulatory environment remains ambiguous, with different jurisdictions offering varying levels of clarity regarding the legal status of tokenized assets (Harish et al., 2023b; Chen et al., 2022). Moreover, issues related to security, market manipulation, and the technological maturity of blockchain platforms pose significant risks that could hinder the widespread adoption of tokenization (Lei and Ngai, 2023). As such, while asset tokenization offers a promising avenue for enhancing market efficiency and accessibility, it is essential to critically assess its broader economic and social implications. Fig. 1 outlines the mechanism of asset tokenization. Furthermore, recent regulatory developments highlight the evolving legal and security considerations vital to successful tokenization endeavors. In particular, the forthcoming Markets in Crypto-Assets (MiCA) regulation in the European Union and ongoing discussions by the U.S. Securities and Exchange Commission (SEC) underscore the need to define legal classifications for digital assets and clarify compliance obligations (Van der Linden and Shirazi, 2023). Nevertheless, these initiatives remain fragmented, as jurisdictions vary in their approaches to licensing, investor protection, and anti-money-laundering requirements (Chen et al., 2022; Hanneke et al., 2024). This uneven regulatory environment, combined with the technical complexities of smart contracts and blockchain infrastructures, heightens vulnerabilities related to fraud, hacking, and other security breaches (Lu et al., 2024; Bhatia et al., 2024). Consequently, the successful adoption of tokenized assets hinges on navigating shifting legal frameworks, mitigating cross-border inconsistencies, and implementing robust cybersecurity strategies.

2.2. Transaction cost theory (TCT) and asset tokenization

Transaction Cost Theory (TCT), formulated by Ronald Coase and later expanded by Oliver Williamson (1979), provides a structured lens to analyze how economic exchanges are shaped by the costs of search, bargaining, monitoring, and enforcement. In traditional financial systems, these transaction costs can be considerable due to reliance on intermediaries and extensive regulatory oversight, rendering certain markets inefficient or inaccessible (Roth et al., 2021; Harish et al., 2023a). By contrast, asset tokenization harnesses blockchain technology and smart contracts to automate key processes, potentially lowering or even eliminating some intermediary-related costs (Schmidt and Wagner, 2019; Chen et al., 2022). This can enhance market efficiency, transparency, and liquidity, thus aligning well with TCT's central premise of minimizing transaction costs. However, TCT's foundational assumptions about structured markets and well-defined governance frameworks warrant careful consideration in decentralized contexts. Blockchain-based environments may lack formal hierarchies and centralized oversight, introducing governance voids and trust dilemmas that TCT does not fully account for. The decentralized architecture of

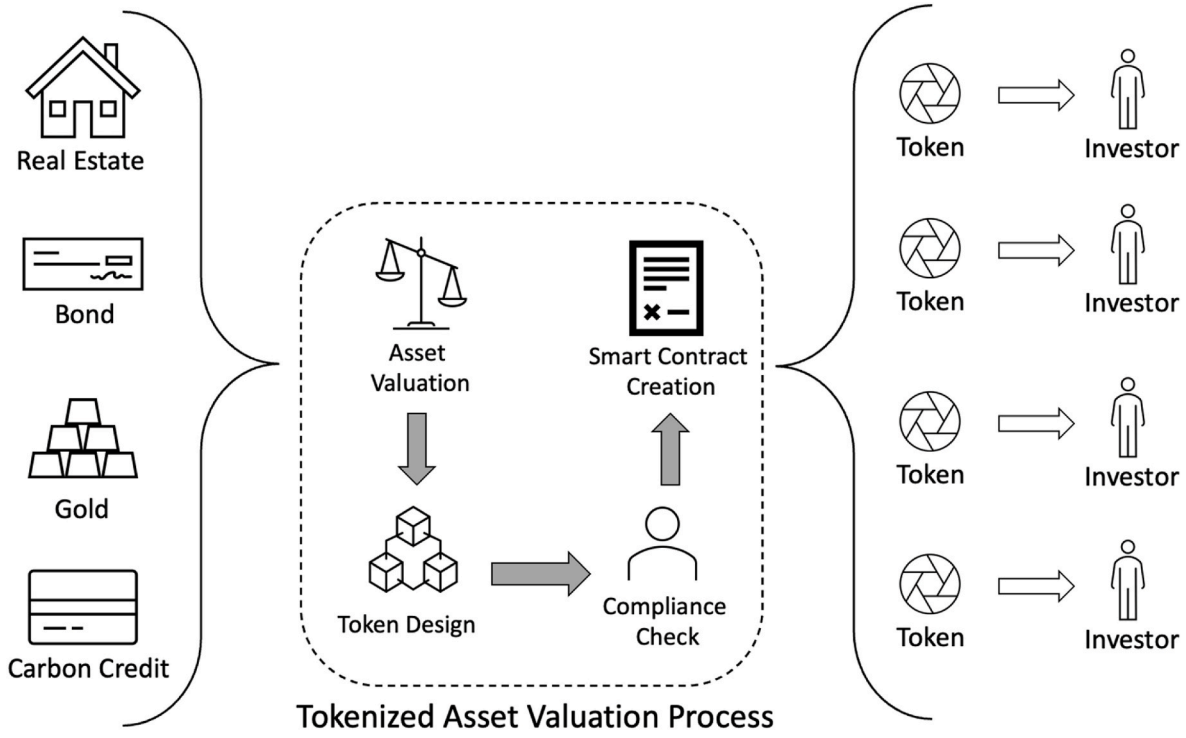

Fig. 1. Asset tokenization mechanism.

tokenized markets can complicate monitoring and enforcement, shifting risk distribution and intensifying uncertainties around dispute resolution, regulatory compliance, and consensus-building (Guggenberger et al., 2024; Lu and Wu, 2024). Such complexities emphasize the importance of complementing TCT with a critical examination of blockchain's distinctive trust structures. In this study, TCT remains the guiding framework but is applied with an awareness of these limitations, recognizing that the interplay between decentralized governance, automation, and market trust may both confirm and extend TCT's core propositions.

2.3. Transaction cost theoretical framework

2.3.1. Transaction efficiency and cost reduction

In traditional asset markets, transaction efficiency is often hindered by numerous intermediaries, extensive paperwork, and lengthy settlement processes. For example, in real estate transactions, the involvement of brokers, legal advisors, and financial institutions adds complexity and time, resulting in higher transaction costs and reduced market liquidity (Chen et al., 2022). Similarly, trading in commodities like gold typically involves physical custody and verification, further complicating the transaction process. These inefficiencies can deter investment and restrict market participation, particularly for small-scale investors (Roth et al., 2021). The TCT suggests that by minimizing these costs, markets can operate more efficiently, enabling higher levels of trade and investment. Asset tokenization, using blockchain technology and smart contracts, has the potential to streamline transaction processes by automating verification and settlement, reducing the need for intermediaries (Ciriello, 2021). However, the literature indicates that the actual impact on transaction costs may vary depending on the asset class and the regulatory environment. While blockchain can reduce some costs, others, such as those related to technology adoption and compliance, may emerge.

2.3.2. Value creation mechanisms

Traditional forms of asset ownership and investment are often constrained by illiquidity, high entry barriers, and limited diversification opportunities. Real estate, for example, is a highly illiquid asset that requires substantial capital investment and is difficult to liquidate quickly (Bhatia et al., 2024). In the same vein, the investment in art, rare collectibles, or specialized financial products often remains accessible only to a small group of affluent investors, limiting broader market participation. From the perspective of TCT, the high transaction costs associated with these traditional investments inhibit efficient allocation of resources, which could otherwise lead to higher value creation. Asset tokenization aims to address these inefficiencies by enabling fractional ownership, thus lowering entry barriers and enhancing liquidity (Lei and Ngai, 2023; Roth et al., 2021). By allowing investors to buy and sell small portions of tokenized assets on digital platforms, tokenization can potentially unlock new sources of value. However, existing literature emphasizes that while tokenization can democratize access and create liquidity, it also introduces challenges related to market volatility and speculative behavior, which may undermine the anticipated benefits (Harish et al., 2021a).

2.3.3. Governance and risk distribution

Governance in traditional asset markets is typically centralized, with regulatory bodies, financial institutions, and other intermediaries playing key roles in monitoring and enforcing compliance. This centralized structure, while providing oversight and stability, can also lead to inefficiencies, conflicts of interest, and limited participation in decision-making processes (Chen et al., 2022; Harish et al., 2023b). In traditional corporate governance, for instance, shareholders may have limited influence over strategic decisions, and there is often a disconnect between management and ownership. Asset tokenization, theoretically, offers a more decentralized approach to governance by allowing token holders to participate directly in decision-making processes through mechanisms such as Decentralized Autonomous Organizations (DAOs) (Roth et al., 2021; Gan, 2021). This shift could distribute risks more evenly among participants, potentially leading to a more resilient market structure. However, the literature on decentralized governance highlights several challenges, such as coordination problems, the risk of

oligarchic control by large token holders, and the need for robust regulatory frameworks to prevent misuse and ensure accountability.

2.3.4. Market trust and Adoption

Market trust in traditional financial systems is built on a foundation of regulatory oversight, established institutions, and the historical performance of markets. Trust is maintained through mechanisms such as investor protection, market surveillance, and the enforcement of legal contracts (Wankmüller et al., 2023; Zheng and Sandner, 2022). However, these systems can also be opaque and slow to innovate, potentially eroding confidence among some market participants. In contrast, asset tokenization relies on the transparency and security provided by blockchain technology to foster trust. The immutable nature of blockchain records and the automated enforcement of smart contracts can theoretically increase transparency and reduce fraud. Yet, the literature underscores that trust in tokenized markets is contingent on several factors, including the security of the underlying blockchain, the quality of the smart contracts, and the regulatory environment (Lu and Wu, 2024). High-profile incidents of fraud, hacking, and the collapse of poorly designed token projects have highlighted the risks associated with tokenized assets, suggesting that building and sustaining trust in these markets is a complex and ongoing challenge. Moreover, the legal ambiguity surrounding tokenized assets in many jurisdictions further complicates their widespread adoption, as investors remain cautious about the regulatory implications of engaging in these markets (Chen et al., 2022).

3. Methodology

3.1. Research settings and sample

This study adopts a multiple-case research design, an approach that provides a robust framework for investigating complex and multifaceted phenomena (Gibbert et al., 2008; Yin, 2017). The study focuses on four distinct blockchain-enabled asset tokenization business models. These cases were selected to represent a diverse range of asset classes and industries, each with unique characteristics and challenges. Case A was chosen due to its potential to revolutionize property markets by increasing liquidity and access to investment opportunities. Case B represents the commodification of physical assets, with a focus on how tokenization can enhance the liquidity and traceability of precious metals. Case C offers insights into the financial sector, where tokenization could streamline debt issuance and trading processes. Lastly, Case D provides a perspective on the environmental sector, where tokenization could facilitate more efficient trading of carbon credits and contribute to sustainability efforts. Collectively, these cases were selected to illustrate scenarios commonly encountered in tokenization, rather than to showcase atypical or niche applications. They therefore serve as representative instances of how different sectors—ranging from mature, heavily regulated markets (e.g., securities) to emerging, less conventional arenas (e.g., environmental assets)—respond to blockchain-enabled innovations. Although not exhaustive of all tokenizable assets, this selection is sufficiently diverse to allow for a comparative analysis that uncovers both the shared drivers (e.g., cost reduction, liquidity enhancement) and sector-specific obstacles (e.g., varying regulatory requirements, differing levels of public trust) encountered in the tokenization process. This representativeness underpins the study's broader goal of identifying cross-cutting themes and challenges that hold relevance across multiple economic domains, thereby strengthening the external validity of the findings.

The interpretive approach employed (Gibbert and Ruigrok, 2010) facilitates a deep exploration of the unique dynamics within each case, allowing the research to uncover the intricate mechanisms through which these organizations engage with and implement asset tokenization. This approach is particularly well-suited for exploring the complex interplay of technological, regulatory, and market factors that shape the evolution of tokenized assets, thus capturing the multifaceted nature of participant experiences and perceptions. The use of a multiple-case research design strengthens the rigor of this study by enabling systematic comparisons and contrasts across different organizational settings (Gioia et al., 2013; Yin et al., 2017). This comparative analysis helps to identify patterns, commonalities, and variations in how blockchain-enabled asset tokenization impacts transaction efficiency, value creation, and risk distribution. Consequently, this methodology enhances the generalizability of findings and contributes to a deeper, more comprehensive exploration of the phenomenon under investigation. Table 1 provides an overview of the selected case studies and their respective contexts.

3.2. Data collection

The data collection process for this study was meticulously structured to provide a robust understanding of blockchain-enabled asset tokenization across multiple industries. Initially, the lead researcher reached out to managers from the selected case organizations to gauge their willingness to participate in the study. During this phase, the research objectives were clearly communicated, emphasizing the significance of their insights in advancing the academic discourse on the implications of asset tokenization for transaction efficiency, value creation, and risk distribution. The affirmative responses from these managers demonstrated a high level of engagement, thereby establishing a strong foundation for the ensuing data collection activities. Subsequent to the initial outreach, a series of online meetings were conducted with key personnel holding various roles within the participating organizations. These preliminary discussions were crucial for gaining a nuanced understanding of each case's context and for evaluating the organizations' preparedness to contribute meaningful data to the study. Such engagement ensured that the data collection process would be comprehensive and closely aligned with the research objectives.

The primary data collection method employed in this study was semi-structured interviews, involving a total of 30 participants. These participants, including senior managers, technical experts, and other key stakeholders, were carefully selected based on their decision-making authority and their extensive involvement in the asset tokenization projects under investigation. The semi-structured interview format was purposefully chosen to strike a balance between a structured inquiry guided by the principles of TCT and the flexibility to explore emergent themes and insights unique to each case context. To ensure a diverse and comprehensive dataset, the snowball sampling technique was employed (Mayring, 2004; Eisenhardt and Graebner, 2007), whereby initial participants recommended additional informants who possessed relevant expertise. Snowball sampling facilitated access to participants with in-depth, firsthand knowledge that may have been difficult to identify through other sampling methods. To mitigate potential biases commonly associated with snowball sampling—such as the risk of homogeneity in participant perspectives—care was taken to initiate the sampling process with participants from varied organizational roles and sectors. This approach facilitated the inclusion of senior managers and experts from various organizational levels across the four cases, thereby enriching the data with multiple perspectives and ensuring a thorough exploration of the research phenomenon. The data collection period extended from March 2024 to August 2024, utilizing digital communication platforms such as Zoom and Microsoft Teams, along with telephone interviews. Each interview session, lasting between 60 and 90 min, provided ample opportunity for participants to articulate their experiences and insights in detail. An open and non-directive interviewing technique was adopted (Gioia et al., 2013; Yin et al., 2017), allowing participants to freely express their perspectives, which facilitated the capture of in-depth and candid responses. Follow-up emails and phone calls were employed as necessary to seek clarifications and additional information. With the consent of the participants, all interviews were recorded and meticulously transcribed to support the

Table 1
Case narratives.

Cases	Established year	Company size and partnerships	Business Narrative	Targeted Markets
A	2019	SME	Case A operates a blockchain-based platform that allows investors to purchase fractional ownership in real estate properties through tokenized assets. Case A's model is built around democratizing real estate investment by lowering the barriers to entry and enabling micro-investments. The platform issues digital tokens on the Ethereum blockchain that represent legal ownership in real properties, allowing investors to receive rental income proportional to their holdings. These tokens are tradable on secondary markets, increasing liquidity in traditionally illiquid real estate assets.	Primarily focuses on real estate properties in Western developed countries, with a growing interest from international investors seeking real estate exposure. It targets retail investors, crypto enthusiasts, and those interested in decentralized finance (DeFi).
B	2018	(SME), with close partnerships with financial institutions	Case B offers a blockchain-based platform that digitizes physical gold into tradable digital tokens. The company provides a secure and transparent mechanism for investors to own gold through tokenization, bypassing traditional storage and transaction challenges associated with physical gold. Case B collaborates with their partnerships to ensure that every token is backed by real gold stored in highly secure facilities. This model aims to provide a more efficient and cost-effective alternative to gold ETFs and other physical gold investment mechanisms.	Global investor base, including institutional investors, gold traders, and individual retail investors interested in holding gold in a digital format without the overhead costs of storage, insurance, or transfer.
C	2017	Medium enterprise, with over 100 employees and partnerships with major financial institutions	Case C is a leader in digital securities issuance and management, specializing in tokenizing traditional financial instruments such as bonds and equities. The platform simplifies the issuance process of bonds through blockchain technology, allowing companies to raise capital more efficiently while offering investors enhanced liquidity through tokenized securities. Case C also focuses on regulatory compliance, ensuring that all tokenized assets meet the necessary legal frameworks across different jurisdictions. The company's solution provides a seamless transition from traditional paper-based bond issuance to a fully digital format that can be easily traded on secondary markets.	Case C operates globally, catering to institutional investors, issuers of corporate bonds, and high-net-worth individuals. Its focus is on enhancing bond market liquidity and efficiency while ensuring regulatory compliance.
D	2018	Medium-sized enterprise, with significant partnerships in sustainability and blockchain sectors	Case D leverages blockchain technology to enhance transparency in supply chains and has expanded its model to include the tokenization of carbon credits. By offering tokenized carbon credits, case D allows	Global focus, targeting corporate sustainability programs, ESG initiatives, and individual investors interested in carbon offsetting. Case D also collaborates with governments and non-profits to

(*continued on next page*)

Table 1 (*continued*)

Cases	Established year	Company size and partnerships	Business Narrative	Targeted Markets
			companies and individuals to participate in carbon offset programs more efficiently. Each token represents a verified carbon credit, and the company ensures transparency in carbon accounting and offset initiatives. Case D's blockchain-based solution aims to solve issues of fraud, double-counting, and inefficiencies in the current carbon credit market.	foster greater accountability in carbon reduction efforts.

subsequent data analysis process. In addition to the interview data, archival documents such as internal reports and presentations were collected to triangulate and validate the findings, thereby enhancing the credibility and rigor of the study. A summary of the interview guide is provided in Appendix 1, and Table 2 presents the detailed profiles of the interview participants.

3.3. Data analysis

The data analysis for this study followed a systematic, multi-phase approach inspired by Gioia et al. (2013) to ensure the robustness and reliability of the findings. This methodology was further reinforced by principles outlined by Yin (2017), which were applied throughout the research to enhance rigor and maintain methodological integrity. In the first phase, a comprehensive content analysis was conducted on the data collected from interviews, focus groups, and archival records. This process involved meticulously reviewing all transcripts and documents to identify significant statements, recurring phrases, and patterns in participants' perspectives and experiences. Initial open coding was applied to break down the data into discrete units of meaning, allowing for the emergence of first-order concepts closely aligned with the participants' language and viewpoints.

In the second phase, these first-order concepts were systematically compared and refined to identify similarities, differences, and relationships across cases. Through this iterative process, the research team grouped related concepts into broader second-order themes that captured more abstract and theoretically meaningful insights. This step involved constant comparison between the data and emerging themes to ensure that the analysis accurately reflected the empirical evidence. Finally, in the third phase, these second-order themes were organized into aggregate dimensions that provided a cohesive framework for interpreting the data. These dimensions were cross-validated with existing literature and theoretical frameworks, such as TCT, to establish their relevance and rigor. This multi-layered approach ensured that the derived themes were both grounded in the data and conceptually robust, offering a comprehensive understanding of how blockchain-enabled asset tokenization impacts transaction efficiency, value creation, and risk distribution.

To bolster the validity and reliability of the findings, various strategies proposed by Yin (2017) were integrated into the data collection and analysis process. Triangulation was employed, incorporating multiple data sources—focus groups, interviews, and archival documents—to enhance the construct validity of the research. Moreover, the data analysis involved a dual-coding process where two researchers independently coded the transcripts. This independent coding process,

Table 2
Interview details.

Interviewee Code	Interviewee's position	Education	Gender	Interview time (minutes)
Case A				
A1	Chief Technology Officer (CTO)	MA	M	70
A2	Head of Blockchain Development	MBA	M	90
A3	Head of Compliance or Legal Counsel	MA	F	70
A4	Head of Real Estate Asset Management	BA	F	80
A5	Project Manager for Real Estate Tokenization	BA	F	60
A6	Regulatory Affairs Manager	BA	M	60
A7	Blockchain Architect	BA	M	70
A8	Business Development Manager	BA	F	80
Case B				
B1	Chief Operating Officer (COO)	MA	M	70
B2	Head of Commodities Trading	BA	F	60
B3	Chief Financial Officer (CFO)	MBA	M	80
B4	Blockchain Analyst specializing in Precious Metals	MA	M	70
B5	Commodities Market Research Analyst	BA	F	80
B6	Blockchain Product Manager	BA	M	60
B7	Director of Regulatory Affairs	BA	F	60
Case C				
C1	Chief Product Officer (CPO)	MBA	F	60
C2	Chief Innovation Officer (CIO)	MBA	M	80
C3	Chief Marketing Officer (CMO)	MBA	F	70
C4	Head of Blockchain Integration	MA	M	90
C5	Lead Developer of Tokenization Technology	BA	F	80
C6	Head of Legal and Compliance	BA	M	60
C7	Director of Fixed Income Trading	BA	F	60
C8	Fixed Income Investment Analyst	BA	F	70
Case D				
D1	Chief Sustainability Officer (CSO)	MBA	F	90
D2	Chief Technical Officer (CTO)	MA	M	90
D3	Environmental Policy Analyst	MBA	M	70
D4	Head of Blockchain Solutions	MBA	M	60
D5	Director of Regulatory Affairs	BA	F	60
D6	Carbon Credits Auditor	BA	F	80
D7	Project Developer for Carbon Offset	BA	F	60

followed by a meticulous comparison and resolution of any discrepancies, ensured a high degree of analytical consistency and reliability. Regular discussions among the research team, as well as follow-up consultations with the informants, were conducted to refine the data interpretation and ensure that the findings accurately reflected the participants' perspectives (Yin, 2017). These iterative consultations contributed to the credibility of the study by providing a comprehensive and nuanced understanding of the data. The resultant data structure is illustrated in Fig. 2.

4. Findings

4.1. Transaction mechanisms

4.1.1. Reduction of intermediaries

The first finding theme highlights how blockchain-enabled tokenization across the selected cases transforms traditional transaction processes by minimizing or removing intermediaries (see Fig. 3). Through the adoption of blockchain, these firms can facilitate more direct, efficient exchanges between stakeholders, significantly altering established transaction flows.

In Case A, the tokenization of real estate allows peer-to-peer property transactions directly on the platform, reducing the role of traditional intermediaries like brokers and agents. This not only lowers costs but also shortens transaction times, providing a more streamlined investment experience. A manager from Case A emphasized, "*With tokenized real estate, we've eliminated the need for brokers. Investors can purchase property fractions directly, completing the transaction without any intermediaries, which significantly cuts both time and* fees" (A4). In Case B, tokenization of gold replaces custodians who typically safeguard physical assets. By digitizing ownership records and utilizing blockchain for verification, the company reduces intermediary fees and improves asset liquidity, making gold investments more accessible and easier to trade. In Case C, tokenization in bond issuance automates tasks traditionally managed by underwriters and clearinghouses. Using blockchain and smart contracts, the company has streamlined the issuance process, handling validation, settlement, and enforcement directly on the platform, bypassing the need for financial intermediaries and reducing both time and costs.

Across the cases, asset tokenization consistently reduces the reliance on intermediaries in various sectors, whether it be real estate brokers, gold custodians, or bond underwriters. By facilitating direct transactions between participants, tokenization eliminates third parties that previously added costs and delays. Smart contracts are integral to this process, automating the trust, validation, and enforcement of agreements, which previously required manual oversight. This decentralization across asset markets not only reduces fees but also significantly enhances transaction speed and efficiency, marking a major shift in how assets are traded and managed.

4.1.2. Lower transaction costs

The second theme examines how asset tokenization directly impacts transaction costs by eliminating or reducing fees traditionally imposed by intermediaries. This analysis focuses on the cost advantages that blockchain-enabled tokenization brings across different asset classes.

In Case C, tokenization of bonds drastically reduces costs by removing layers of financial intermediaries like banks and brokers. Smart contracts handle bond issuance, validation, and settlement, resulting in significantly lower fees for investors. One manager from Case C highlighted, "*With smart contracts managing bond transactions, we've cut out underwriters and brokers entirely. The cost savings are substantial, and investors see this reflected in much lower* fees" (C7). In Case A, the tokenization of real estate enables property transfers without traditional legal fees. Ownership terms are embedded within smart contracts on the blockchain, reducing the need for costly services like notary and registration. This automation streamlines the transfer process and makes real estate investment more accessible by lowering barriers to entry. In Case D, the use of blockchain to tokenize carbon credits reduces administrative overhead. The system automates verification and traceability processes, cutting down on the manual work

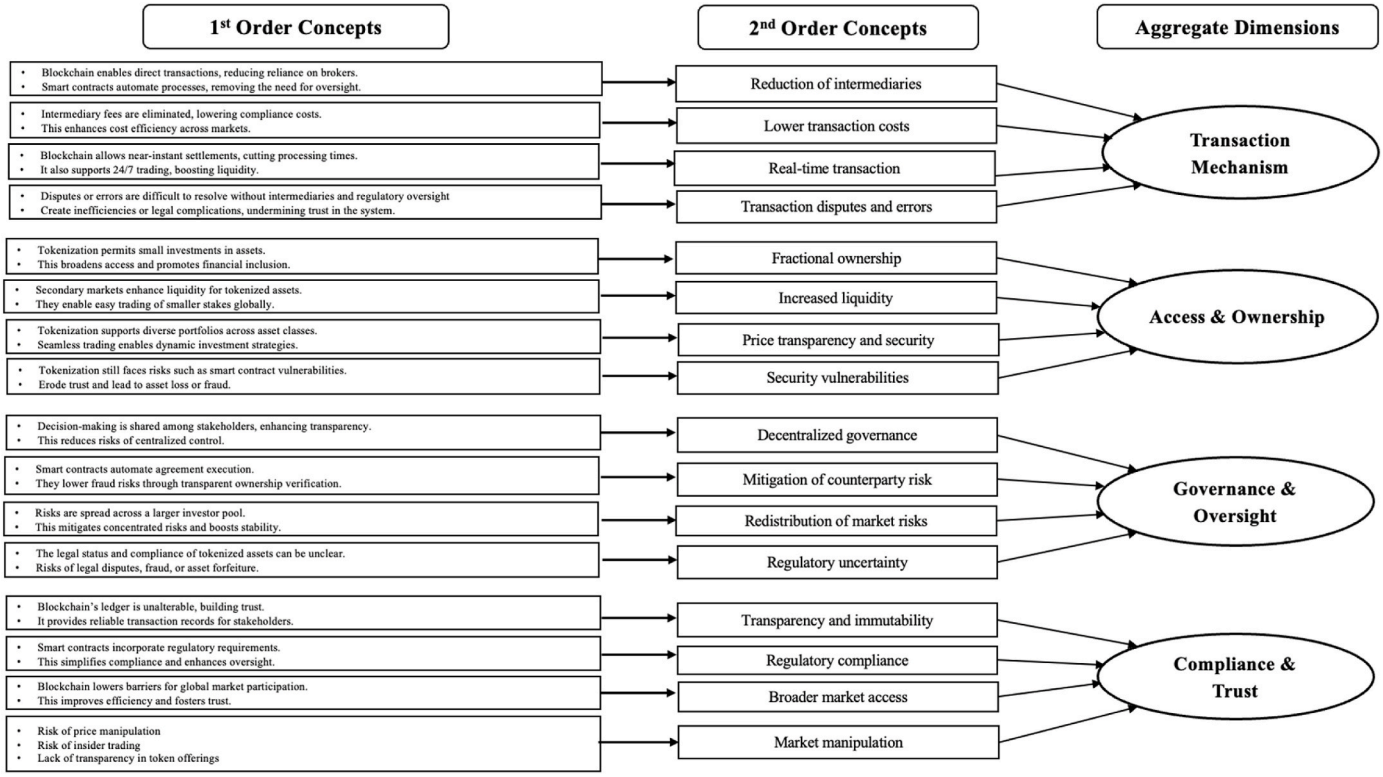

Fig. 2. Data structure.

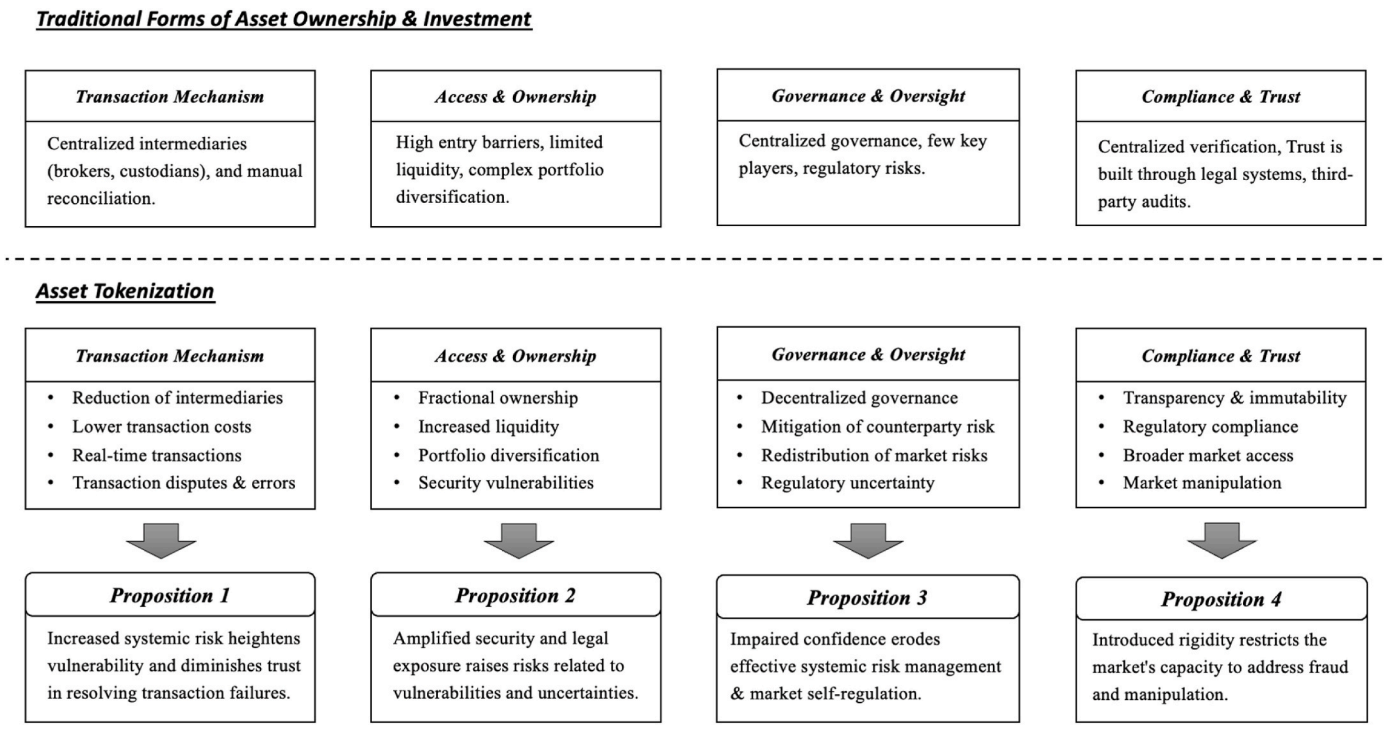

Fig. 3. Uncertainties of asset tokenization.

required for compliance audits. By minimizing labor-intensive tasks, the firm significantly lowers its operating costs, allowing for more efficient carbon trading.

Across all cases, blockchain tokenization consistently lowers transaction costs by eliminating intermediary fees, whether they pertain to real estate transactions, bond underwriting, or carbon credit verification. Tokenization removes the need for third-party services like brokers, auditors, and legal professionals, leading to lower overall costs for participants. Furthermore, the decentralized and transparent nature of blockchain automates regulatory compliance, reducing the costs associated with manual oversight and improving cost efficiency across each sector. This uniform reduction in fees across tokenized asset markets highlights a key advantage of blockchain in enhancing the financial accessibility of previously high-cost transactions.

4.1.3. Transaction efficiency

This theme explores how blockchain-enabled asset tokenization significantly accelerates transaction times, replacing traditionally slow settlement processes with near-instantaneous asset transfers. In Case A, tokenization of real estate through blockchain allows for the immediate execution of property sales. Unlike traditional real estate markets, where settlement periods can take days or weeks, asset transfers in this case occur in real-time, offering full transparency and immediate ownership transfer. A manager from Case A stated, "*the ability to close a property sale within minutes, instead of waiting weeks for paperwork and clearances, has been a game-changer in how we approach real estate investment* (A2)." In Case B, tokenized gold assets allow investors to execute trades instantly, circumventing the delays associated with physical gold delivery and traditional settlement processes. Blockchain technology provides immediate verification of ownership, ensuring faster and more efficient trading, which contrasts with the lengthy procedures often seen in conventional markets. Similarly, in Case C, blockchain enables real-time bond trading, bypassing the delays associated with clearinghouses and brokers in traditional bond markets. Tokenized bonds can be traded with immediate settlement, improving liquidity and allowing investors to quickly adapt to market movements.

Across all cases, blockchain technology facilitates nearly instantaneous asset transfers, with settlement times reduced from days or weeks to just minutes. Whether in real estate, gold, bonds, or carbon credits, tokenization drastically improves liquidity by enabling real-time trading. Furthermore, tokenization platforms offer continuous trading, bypassing the constraints of traditional market hours and allowing participants to respond to market conditions at any time. This enhanced liquidity and responsiveness across asset classes represent a fundamental shift in how markets operate, making investment opportunities more flexible and accessible.

4.1.4. Transaction disputes and errors

In Case A, the implementation of real estate tokenization has revealed significant challenges in resolving transaction disputes due to the absence of traditional intermediaries. A manager stated, "*In a conventional real estate transaction, we would have a broker or lawyer to mediate any issues that arise. Now, without these intermediaries, disputes are often left unresolved, leading to inefficiencies and delays* (A5)" This perspective highlights the vulnerability of tokenized real estate transactions to disputes, ultimately undermining investor trust and complicating legal processes. While other cases also faced similar challenges in dispute resolution, the lack of oversight and intermediaries was particularly pronounced in the real estate sector, revealing a critical need for new mechanisms to address these issues effectively.

Across all cases, the absence of intermediaries and regulatory oversight remains a critical challenge. The difficulties faced in resolving disputes without a centralized authority create inefficiencies and legal complications. This pattern illustrates that while tokenization offers transparency and efficiency, it simultaneously presents vulnerabilities that require the development of innovative solutions for effective dispute resolution, essential for fostering trust in tokenized assets.

4.2. Access & ownership

4.2.1. Fractional ownership

This theme examines how asset tokenization has expanded access to traditionally capital-intensive asset classes through fractional ownership. In Case A, tokenized real estate enables fractional ownership,

allowing investors to purchase portions of properties instead of requiring the full capital investment necessary in traditional real estate transactions. This has made real estate investment accessible to smaller investors, democratizing a market previously limited to those with substantial financial resources. In Case C, the tokenization of bonds through blockchain allows for fractional ownership, giving smaller investors access to portions of high-value bonds that would otherwise be unaffordable. A participant from Case C remarked, "*By allowing fractional ownership of bonds, we're enabling everyday investors to diversify their portfolios with assets that used to be exclusive to large institutional buyers*" (C8). Similarly, Case B tokenizes gold, allowing investors to purchase fractions of gold bars, rather than requiring the full price of a physical bar. This process makes gold investment more flexible and accessible, especially for smaller investors who previously could not afford to invest in precious metals.

Across all cases, tokenization enables fractional ownership, allowing investors to buy small portions of traditionally high-value assets like real estate, gold, bonds, and carbon credits. This fractionalization lowers the barrier to entry, creating a more inclusive and diversified market across asset classes. By breaking down assets into smaller, more affordable units, tokenization promotes financial inclusion, bringing more participants into sectors that were previously inaccessible to smaller or retail investors. This democratization of asset ownership fosters a more dynamic and inclusive investment environment across all markets.

4.2.2. Increased asset liquidity

This theme explores how asset tokenization has enhanced liquidity across traditionally illiquid markets. Case A improves liquidity by allowing fractional shares of real estate to be traded on secondary markets. Investors can easily buy and sell tokens representing their ownership stake in properties, significantly reducing the time and effort needed to transfer ownership compared to traditional real estate sales. Case B introduces liquidity to the gold market by enabling instant trading of tokenized gold. Unlike physical gold, which involves delays related to transportation and storage, tokenized gold assets can be traded seamlessly on blockchain platforms, providing investors with greater flexibility. Case D enhances the liquidity of carbon credits by tokenizing them and enabling instant trading on blockchain platforms. Traditional carbon markets often suffer from inefficiencies and delays, but the use of blockchain significantly streamlines the process and makes it easier for investors to buy and sell credits. A participant from Case D noted, "*The tokenization of carbon credits has not only made trading faster but also far more accessible to a global pool of investors, which wasn't possible in the traditional carbon markets* (D1)".

Across all cases, blockchain-enabled tokenization enhances asset liquidity by creating secondary markets where investors can buy and sell fractionalized shares of real estate, gold, bonds, or carbon credits. This ease of trading reduces the inherent illiquidity associated with these asset classes, offering more immediate access to capital and flexibility for investors. Moreover, global accessibility is a key benefit, as tokenized assets can be traded by investors worldwide, further bolstering liquidity and making these traditionally illiquid assets more actively traded in global markets. This increased liquidity, driven by both fractional ownership and blockchain's decentralized trading mechanisms, leads to more efficient markets and enhances the appeal of tokenized assets to a broader range of investors.

4.2.3. Price transparency and security

This theme focuses on how tokenization enhances price transparency and security across various asset markets.

Case D ensures price transparency by tracking the provenance of tokenized carbon credits on the blockchain. The use of blockchain guarantees that all credits are verified, reducing the risk of fraud and providing market participants with full visibility into the pricing and legitimacy of each carbon credit. A manager from Case D highlighted, "*Blockchain has eliminated a lot of the uncertainty in carbon credit trading. Now, buyers can trace the credits back to their source and verify their authenticity, which was a challenge in the past* (D5)". Case A utilizes blockchain's immutable ledger to offer transparent records of property values and transaction history. Token holders gain access to real-time data on property valuations, historical market trends, and ownership records, which boosts investor confidence and creates a fairer marketplace for real estate transactions. Case B provides a tamper-proof record of gold ownership and pricing on its blockchain platform. Investors can rely on this verified information to make informed trading decisions, ensuring fairness and reducing manipulation in the gold market.

Across all cases, blockchain-enabled tokenization enhances price transparency and security by recording all transactions and asset data on an immutable ledger. This transparency not only builds investor confidence but also reduces the risk of fraudulent activity, making the markets for real estate, gold, bonds, and carbon credits more secure. The transparency extends to pricing, as investors in any asset class—whether real estate, gold, or carbon credits—can access accurate, real-time data that is crucial for making informed investment decisions. Moreover, by tokenizing these asset classes, blockchain also facilitates seamless portfolio diversification, allowing investors to trade and mix assets like real estate and gold in one portfolio, thus creating more dynamic strategies for risk management and optimizing returns across markets.

4.2.4. Security vulnerabilities

In Case B, the gold tokenization project faced significant security concerns stemming from vulnerabilities in smart contracts. The project manager noted, "*While our tokenization process enhances transparency, we are acutely aware that any flaw in our smart contracts could expose us to hacking or fraud. A single vulnerability could lead to significant asset loss*. (B2)". This highlights how security vulnerabilities not only threaten the integrity of tokenized assets but also erode investor trust in the system. Similar security concerns were observed in cases A and D, emphasizing the universal need for robust security measures in all tokenized asset markets.

Across the examined cases, the risk associated with smart contract vulnerabilities poses a systemic threat to the tokenization process. Instances of potential fraud or asset loss due to security issues illustrate that, while blockchain technology provides enhanced security compared to traditional systems, it is not infallible. This situation underlines the necessity for ongoing vigilance and improved security protocols across all sectors to safeguard against these vulnerabilities and maintain trust in tokenized assets.

4.3. Governance and oversight

4.3.1. Decentralized governance structures

In Case A, decentralized governance is implemented by granting token holders voting rights on key property management decisions, allowing a distributed governance model that provides investors with a direct say in asset strategy. A manager from the case described it as "*giving more control to the investors, which helps align their interests with the property's long-term value* (A8)". In Case C, bondholders are given a similar form of decision-making power through smart contracts, enabling them to vote on financial decisions such as bond restructuring. In Case D, tokenized carbon credits are governed through a decentralized framework where no single entity controls the issuance or verification of the credits, spreading the governance risk across a broader network of stakeholders.

Across all cases, decentralized governance distributes decision-making power, traditionally held by centralized institutions or managers, to a wider network of investors. Blockchain's immutable ledger enables voting mechanisms that ensure transparency and fairness in asset management decisions. The shift toward decentralized control is particularly evident in the cases of tokenized real estate, bonds, and carbon credits, where token holders have a direct role in governance. This distributed model allows for more democratic systems but also

creates challenges in achieving consensus, particularly in managing complex assets like real estate or bonds.

4.3.2. Smart contracts for compliance

In Case C, smart contracts are essential for maintaining compliance with bond regulations, automatically verifying investor identities and ensuring trades meet legal standards. According to one participant, "*Smart contracts take out a lot of the manual processes, ensuring that we're always operating within regulatory frameworks* (C6)." Case B embeds similar compliance mechanisms in gold tokenization, where trades are executed only after meeting pre-set regulatory conditions. Case D uses smart contracts to verify the authenticity of carbon credits, ensuring that each credit meets environmental standards without requiring manual oversight, thereby reducing both compliance costs and risks of error.

Smart contracts play a crucial role in reducing compliance risks across all cases by automating processes traditionally handled by intermediaries or manual checks. In tokenized ecosystems, such contracts ensure real-time execution of trades once compliance conditions are met, significantly reducing the potential for fraud or non-compliance. This automated compliance mechanism benefits all asset classes, including real estate, gold, bonds, and carbon credits, as it minimizes the human error and delays associated with regulatory procedures. The blockchain's transparency further adds to this by providing an immutable record of transactions, accessible to both regulators and investors.

4.3.3. Risk-sharing mechanisms

In Case A, tokenized property ownership allows investors to share risk proportionally to their ownership stake. Each token holder bears financial risk for only their percentage of the property rather than the entire asset. As one manager noted, "*Fractional ownership ensures that individual investors aren't overexposed to a single property's risk, making it a safer investment* (A3)". Case D similarly enables risk distribution for carbon credits, where multiple investors hold tokens representing portions of environmental assets, reducing the risk burden for any one entity. Case C implements risk-sharing in bond markets by enabling fractional bond ownership, allowing smaller investors to share financial exposure in the case of a bond default.

Across the cases, risk-sharing mechanisms are enhanced by tokenization, allowing investors to distribute financial or environmental risks across a broader group of stakeholders. In traditional markets, risk is often concentrated in a small group of investors or institutions, but blockchain spreads this risk more equitably. Whether through fractional ownership in real estate, bonds, or carbon credits, tokenization provides a mechanism for mitigating individual exposure, thereby fostering a more resilient investment ecosystem. However, the decentralization of risk also introduces challenges, particularly in coordinating investor actions during crises or significant market changes.

4.3.4. Regulatory uncertainty

In Case C, the bond tokenization initiative encountered significant regulatory uncertainties that complicated its compliance framework. The project manager expressed, "*We are navigating a gray area when it comes to the legal status of our tokenized bonds. The lack of clear regulations makes us vulnerable to legal disputes and potential fraud* (C6)" This underscores the challenges posed by regulatory ambiguity, which not only hinders operational processes but also raises concerns about asset forfeiture and investor protection. Similar regulatory concerns were reported in real estate and gold tokenization cases, emphasizing a widespread issue across tokenized markets.

In all cases examined, the lack of clarity regarding the legal status of tokenized assets has created an environment ripe for legal disputes and uncertainty. This regulatory ambiguity can lead to significant risks, including the potential for fraud and asset forfeiture, undermining the confidence of investors. The need for clearer regulatory frameworks is critical for fostering a secure environment for tokenized assets and ensuring compliance across diverse markets.

4.4. Compliance & trust

The following analysis explores how blockchain-enabled asset tokenization enhances market trust and drives adoption.

4.4.1. Immutable record-keeping

In Case D, the use of blockchain to track carbon credits has significantly enhanced transparency, with all transactions permanently recorded on an immutable ledger. However, the platform faces challenges related to the complexity of ensuring accuracy across multiple jurisdictions and environmental standards. One manager from Case D highlighted, "*The immutability of our ledger is a double-edged sword. While it builds trust, any errors or misreporting of carbon credits are permanently recorded. This means we must be extremely cautious in verifying data before its entered* (D4)". This challenge points to the critical need for accurate initial verification, as any mistakes can damage credibility despite the transparent system. In Case C, bondholders are given a similar form of decision-making power through smart contracts, enabling them to vote on financial decisions such as bond restructuring.

Across cases, blockchain's immutable ledger fosters trust by creating a transparent and permanent record of transactions for assets like real estate, gold, bonds, and carbon credits. However, the critical challenge lies in ensuring data accuracy from the outset. Although blockchain prevents alteration or tampering, it also locks in any potential errors, making it essential for organizations to ensure that initial data entries are error-free. This aspect highlights both the strength and potential risk of relying on blockchain for record-keeping in diverse sectors.

4.4.2. Regulatory alignment and investor protection

In Case C, the integration of regulatory compliance into smart contracts for bond tokenization has significantly reduced the administrative burden. However, the complexities of international securities regulations present ongoing difficulties. The manager in Case C emphasized, "*While we've embedded key compliance checks into our system, navigating the different regulatory requirements across countries remains a challenge. For instance, what's acceptable in one jurisdiction might not apply in another, making it difficult to offer a standardized solution* (C6)". This quote points to the limitations of blockchain's regulatory alignment capabilities when dealing with global investments, where harmonizing regulations remains a significant obstacle. Case B embeds similar compliance mechanisms in gold tokenization, where trades are executed only after meeting pre-set regulatory conditions. Case D uses smart contracts to verify the authenticity of carbon credits, ensuring that each credit meets environmental standards without requiring manual oversight, thereby reducing both compliance costs and risks of error.

Blockchain's ability to integrate regulatory compliance into smart contracts streamlines processes across sectors like real estate, gold, bonds, and carbon credits. However, the main limitation arises when tokenization crosses international borders, as different regulatory environments may conflict. Although blockchain ensures compliance at the local level, the lack of global standardization remains a critical challenge for businesses looking to expand across multiple jurisdictions. This issue requires a more coordinated approach to global regulatory frameworks, as blockchain alone cannot overcome the complexities of international law.

4.4.3. Reputation of trusted custodians

In Case B, the involvement of recognized gold custodians has been crucial for building investor trust in tokenized gold. However, this reliance on external custodians also introduces risks if those institutions fail to maintain their own standards. As the Case B manager critically observed, "*While our custodians are well-established, any scandal or failure on their part could directly impact the credibility of our tokens. We're only as strong as the custodians we partner with* (B1)". This insight reveals a vulnerability in blockchain's reliance on third-party institutions to validate asset backing, highlighting the risks that exist beyond the

blockchain itself. Case D similarly enables risk distribution for carbon credits, where multiple investors hold tokens representing portions of environmental assets, reducing the risk burden for any one entity. Case C implements risk-sharing in bond markets by enabling fractional bond ownership, allowing smaller investors to share financial exposure in the case of a bond default.

Trusted custodians play a critical role across all cases in ensuring the legitimacy of tokenized assets, whether it's gold, real estate, bonds, or carbon credits. However, this dependency on external entities presents a significant risk if these custodians face issues such as financial instability, fraud, or reputational damage. While blockchain ensures transparency and immutability within the system, its reliance on real-world institutions means that trust in the entire ecosystem can still be undermined by failures outside the blockchain. This dependency points to a key limitation in blockchain's ability to fully secure trust without the involvement of reliable custodians.

4.4.4. Market manipulation

In Case D, the carbon credit tokenization project faced allegations of market manipulation, raising concerns about the integrity of token pricing. The manager commented, "*There are always worries about price manipulation in tokenized markets, especially with the lack of oversight. Insider trading could easily occur if we don't implement stricter controls* (D2)" This statement illustrates how the potential for market manipulation not only threatens the fairness of the trading environment but also poses risks to the overall trust in tokenized assets. While similar concerns regarding transparency and insider trading were observed in cases B and D, the carbon market's complexity particularly magnifies these risks.

Across all analyzed cases, the risk of market manipulation looms large, as the absence of stringent regulatory oversight can lead to price manipulation and insider trading. The lack of transparency in token offerings further exacerbates these issues, undermining investor confidence and the stability of tokenized markets. Establishing robust regulatory frameworks and transparency measures is essential to mitigate these risks and promote fair trading practices within the tokenized asset landscape.

5. Discussion

5.1. How do blockchain-enabled asset tokenization business models influence transaction efficiency and value creation?

The findings from the analysis of blockchain-enabled asset tokenization business models reveal significant influences on both transaction efficiency and value creation. These influences are in alignment with existing literature on blockchain applications in financial and asset markets (Harish et al., 2023a), while also presenting novel insights into the specific mechanisms through which tokenization transforms traditional asset exchanges.

Firstly, the reduction of intermediaries through blockchain is a critical factor in enhancing transaction efficiency. Across various case, asset tokenization eliminates the need for traditional middlemen, such as brokers or underwriters, and automates transactional processes through smart contracts. This finding supports existing research on blockchain's disintermediating effect, which highlights its capacity to streamline complex transactional ecosystems (Chen et al., 2022; Schmidt and Wagner, 2019; De Giovanni, 2020). However, what is particularly noteworthy in the analyzed cases is the magnitude of this transformation across diverse asset classes. The removal of intermediaries not only reduces costs but also fundamentally alters the operational dynamics of these markets, shifting control from traditional gatekeepers to a more decentralized and automated system. The efficiency gains are therefore not merely incremental but transformative, particularly in sectors like real estate, where transactions traditionally involved multiple layers of intermediary oversight.

In terms of cost reduction, the findings demonstrate a clear link between tokenization and lower transaction costs, primarily through the elimination of fees associated with intermediaries and compliance. This echoes the broader literature on blockchain's cost-saving potential, which attributes much of the reduction in costs to the transparency and automation inherent in blockchain systems (Narayan and Tidström, 2020; Sunyaev et al., 2021). The findings from this research underscore the uniformity of this effect across highly distinct asset markets. Whether in real estate, bonds, or carbon credits, the decentralization of compliance processes through smart contracts and blockchain's transparency uniformly leads to cost reductions. The findings further suggest that tokenization enables participants to bypass traditional regulatory and auditing procedures, which in turn decreases the financial burden on both issuers and investors. This advantage extends beyond mere transactional cost savings; it reshapes the economic landscape of these markets by increasing the accessibility of previously cost-prohibitive assets.

Blockchain also significantly enhances transaction speed, replacing slow settlement processes with near-instantaneous transfers. This supports prior studies, which emphasize blockchain's role in improving liquidity and reducing settlement times (De Giovanni, 2020). This research adds depth to the literature by illustrating how this rapid transaction capability is not limited to financial assets but extends to traditionally illiquid markets like real estate and bonds. The ability to trade these assets in real-time, facilitated by tokenization, marks a paradigm shift in how liquidity is managed across sectors. This improvement in liquidity is further amplified by the continuous nature of blockchain trading platforms, which allows for transactions outside traditional market hours, providing flexibility and responsiveness previously unattainable in these markets.

However, while blockchain enhances transactional efficiency, it also introduces complexities in dispute resolution and error management, as highlighted in the findings. The absence of intermediaries, while beneficial for cost and speed, poses challenges in handling transaction disputes. This insight adds a critical layer to the existing literature, which often focuses on blockchain's efficiency benefits but overlooks the practical difficulties of operating without centralized authorities (Chen et al., 2022; Ciriello, 2021). Our findings indicate that while blockchain's transparency reduces the likelihood of fraud, the system's decentralized nature makes it difficult to address errors or disputes that arise during transactions. This tension between efficiency and governance suggests that the full realization of blockchain's potential will require the development of more sophisticated mechanisms for managing disputes and ensuring trust in decentralized ecosystems.

In terms of value creation, the findings reveal that blockchain-enabled tokenization facilitates fractional ownership and increased liquidity, thus democratizing access to traditionally high-value assets. This aligns with the broader narrative in blockchain literature, which emphasizes its role in promoting financial inclusion (Harish et al., 2023a; Gan et al., 2021). However, the research findings provide a more nuanced understanding by showing how fractional ownership, enabled by tokenization, not only lowers the barrier to entry but also creates new opportunities for market diversification. Tokenized assets, especially in markets like real estate and carbon credits, allow smaller investors to participate in previously inaccessible markets, thereby fostering a more dynamic and inclusive investment ecosystem. This democratization of ownership and liquidity leads to broader market participation, which, in turn, enhances overall market efficiency and drives value creation.

5.2. What are the unintended consequences of decentralization in blockchain-enabled asset tokenization on risk distribution and market trust?

This section addresses the second research question, which explores the unintended consequences of decentralization in blockchain-enabled asset tokenization, specifically in relation to risk distribution and market

trust.

Decentralization in asset tokenization transforms the transaction mechanism by reducing reliance on traditional intermediaries, thus lowering transaction costs and enabling real-time exchanges. In particular, the ability to automate transactions through smart contracts offers greater efficiency and fluidity (Hoang and Phan, 2022; Narayan and Tidström, 2020). As highlighted in tokenized real estate markets like case A, the elimination of intermediaries enables direct asset transfers, which drastically reduces friction and delays. However, the absence of intermediaries creates an environment where transaction disputes, errors, or smart contract failures are more difficult to resolve. With no centralized body to mediate or reverse transactions, errors can lead to significant financial losses. Moreover, decentralized platforms may lack established dispute resolution mechanisms, which undermines confidence in the system's ability to manage risks (Lei and Ngai, 2023). The issue of irreversibility becomes critical, as seen in instances where smart contracts execute transactions based on faulty or malicious input.

Proposition 1. ***While the reduction of intermediaries in asset tokenization improves transaction efficiency, the lack of centralized oversight increases vulnerability to disputes and errors, ultimately heightening systemic risk and weakening trust in the market's capacity to resolve transaction failures.***

Decentralized asset tokenization enables fractional ownership, which broadens access to assets traditionally confined to wealthy investors or institutions. By tokenizing assets like real estate or commodities, platforms such as case B offer increased liquidity, allowing a more diverse range of participants to invest in and trade fractionalized assets. This democratization of asset ownership can enhance liquidity in previously illiquid markets, fostering market inclusivity. However, this decentralization also exposes investors to new risks. As access broadens, the potential for security vulnerabilities grows, with decentralized platforms becoming prime targets for cyberattacks. Tokenized assets held on blockchain networks are susceptible to hacking, phishing, and other forms of cybercrime, as evidenced by various security breaches in decentralized finance (DeFi) (Sazandrishvili, 2020; Harish et al., 2023a). The lack of robust legal protections around fractional ownership exacerbates these risks, particularly in cross-border contexts where regulatory clarity is often lacking.

Proposition 2. ***While decentralized asset tokenization promotes inclusivity and liquidity through fractional ownership, it simultaneously increases exposure to security vulnerabilities and legal uncertainties, threatening both investor protection and market stability.***

One of the significant promises of decentralized asset tokenization is the potential for decentralized governance, where decision-making power is distributed among network participants rather than being concentrated in centralized authorities (Sazandrishvili, 2020; Gan et al., 2021). This redistribution of power can mitigate counterparty risk by reducing dependence on centralized entities that may fail or act maliciously. Decentralized systems, as seen in platforms like Case C, often claim to offer more balanced risk distribution across participants. However, the lack of centralized governance also creates substantial regulatory challenges (Chen et al., 2022). Regulatory uncertainty remains a major issue in tokenized markets, as decentralized platforms operate across multiple jurisdictions with varying levels of oversight. This lack of clarity leaves gaps in enforcement and compliance, making it easier for bad actors to exploit decentralized systems. Additionally, the fragmented nature of decentralized governance models can lead to inefficiencies in managing systemic risks, such as market manipulation or fraud.

Proposition 3. ***While decentralized governance in asset tokenization reduces counterparty risk, it also exacerbates regulatory uncertainty and fragmentation, impeding the effective management of systemic risks and eroding confidence in the market's ability to self-regulate.***

The immutability and transparency of blockchain technology are often seen as enhancing trust and regulatory compliance. By ensuring that all transactions are permanently recorded on the blockchain, decentralized asset tokenization platforms offer unparalleled visibility into ownership and transaction histories. This level of transparency can reduce the potential for fraud, as it becomes more difficult to alter or obscure transactional data, theoretically fostering greater market trust. Yet, the immutability of blockchain also brings unintended consequences. While transparency is lauded, the inability to reverse or modify transactions can be problematic, particularly in cases of fraud or human error (Lei, C. F., & Ngai, 2023; Gan et al., 2021). Moreover, decentralized platforms face risks of market manipulation, as transparency does not necessarily prevent strategic exploitation of market dynamics. The rise of algorithmic trading in tokenized markets introduces additional complexity, as manipulation strategies can evolve alongside new technological tools (Roth et al., 2021). This can undermine both compliance efforts and trust in the platform's integrity.

Proposition 4. ***Although transparency and immutability in decentralized asset tokenization enhance regulatory compliance, they also introduce rigidity that limits the market's ability to address fraud and manipulation, undermining long-term trust in the system's adaptability and fairness.***

6. Conclusion

6.1. Theoretical contributions

This study makes several significant theoretical contributions to the literature on blockchain-enabled asset tokenization (Gan et al., 2021; Wankmüller et al., 2023; Guggenberger et al., 2024), particularly in understanding its impact on transaction efficiency, value creation, and the unintended consequences on risk distribution and market trust. First, by employing TCT as a framework (Williamson, 1985; Coase, 1993), this research extends its application to emerging decentralized systems, illustrating how asset tokenization alters traditional cost structures. The findings emphasize that while decentralization reduces transaction costs and improves access to fractional ownership, it introduces new forms of risks, such as heightened security vulnerabilities and regulatory uncertainty. This nuanced understanding contributes to the literature (Schmidt and Wagner, 2019) by offering a balanced view of both the benefits and risks associated with decentralization, enriching the ongoing debate surrounding asset tokenization and blockchain applications' potential for disintermediation and its broader market implications.

Second, this research addresses a gap in the literature concerning the unintended consequences of decentralization in tokenized asset markets. Existing literature primarily focuses on the efficiency gains brought by blockchain and smart contracts (Gan et al., 2021; De Giovanni, 2020); this study brings forward critical insights into how the lack of centralized oversight and governance structures can create new risks. By offering propositions grounded in empirical findings from cases across multiple industries (e.g., real estate, gold, carbon credits, and bonds), this research critically examines the balance between decentralization and market stability. The study contributes to a deeper theoretical understanding of how decentralized systems impact not only market trust but also the capacity for self-regulation, raising important questions about how decentralized governance and regulatory mechanisms should evolve.

Finally, this research adds to the broader discourse on the future of tokenized assets by challenging the overly optimistic narrative of blockchain as inherently trust-enhancing (Chen et al., 2022; Bhatia et al., 2024). The insights presented here illustrate that while blockchain's transparency and immutability offer significant advantages for regulatory compliance and fraud prevention (Lu and Wu, 2024), these characteristics also introduce rigidities that may hinder adaptive

responses to market manipulation and errors. This dual perspective enriches theoretical debates on the long-term viability of blockchain-enabled markets (De Giovanni, 2020; Wankmüller et al., 2023), positioning this study as a critical voice in discussions surrounding the evolving role of blockchain technology in global asset markets.

6.2. Practical contributions

The findings from this study offer several important insights for business practitioners, particularly those involved in blockchain-enabled asset tokenization. First, the study provides practical evidence of how asset tokenization can enhance transaction efficiency by reducing the need for intermediaries and lowering costs. Businesses exploring tokenization as a strategy for cost reduction and market expansion can benefit from the real-world examples discussed in this research. For instance, practitioners in real estate or commodities trading can leverage the efficiencies offered by fractional ownership and real-time transactions, gaining a competitive advantage in terms of cost savings and accessibility to new investor pools. However, businesses must also remain vigilant about transaction errors, as the decentralized nature of blockchain platforms can make dispute resolution more challenging.

Second, this study highlights the security risks inherent in decentralized asset tokenization, offering practical guidance for businesses to enhance their cybersecurity protocols. Given the potential for security breaches, businesses should prioritize robust security measures, including smart contract audits, multi-factor authentication, and insurance mechanisms for tokenized assets. For business leaders, the insights into the risks of market manipulation and cybersecurity vulnerabilities are particularly relevant, as they emphasize the need for building trust with customers by ensuring both the security and integrity of tokenized assets.

Furthermore, the research points to the critical importance of navigating regulatory uncertainty in decentralized markets. For businesses operating across jurisdictions, understanding local regulatory frameworks and being proactive in compliance is essential to mitigate risks associated with fragmented governance structures. The findings stress the need for businesses to engage with regulators and industry bodies to shape evolving regulatory standards, particularly as governments and institutions grapple with the complexity of regulating decentralized platforms.

Lastly, the study's insights into the dual nature of transparency—while enhancing regulatory compliance, also creating rigidities in handling market manipulation—highlight the need for businesses to adopt a balanced approach. Practitioners should be aware that while decentralization offers transparency, it does not automatically safeguard against malicious actors or human error. Businesses, especially those in financial services, should invest in developing adaptive mechanisms to address these issues and maintain trust in their platforms. By understanding the trade-offs between decentralization and traditional governance, business leaders can better navigate the evolving landscape of tokenized assets and leverage blockchain technology to their advantage, while mitigating risks to protect both their assets and reputations.

6.3. Limitation and future research direction

While this study offers valuable insights into the impact of decentralization in blockchain-enabled asset tokenization, it is not without limitations. First, the research focuses on a cross-case analysis of four distinct industries—real estate, gold, carbon credits, and bonds—limiting the scope to a specific set of tokenized asset markets. Although these cases provide a broad understanding of how asset tokenization operates in various sectors, the findings may not fully capture the nuances of tokenization in other markets, such as intellectual property, digital art, or gaming assets. Future research could extend this investigation to include a wider array of industries to develop a more comprehensive view of asset tokenization's impact on transaction efficiency, risk distribution, and market trust. Second, potential bias in interviewee selection may limit the diversity of perspectives captured in this study. While participants were selected based on their involvement in tokenization projects, there may be gaps in perspectives from regulatory bodies, policymakers, or smaller market participants. Future studies should broaden stakeholder engagement by incorporating viewpoints from regulators, investors, and technology developers to enrich the understanding of tokenization's broader market impact. Third, the geographical context of the study presents another limitation. Although the selected cases are global in nature, the regulatory environments and market structures examined may not fully represent the diversity of legal, cultural, and economic conditions across different regions. Regulatory frameworks for decentralized systems vary significantly, and their influence on asset tokenization could differ depending on the region. Future research should explore the role of regional differences in the adoption of blockchain-enabled asset tokenization, paying closer attention to how regulatory environments in emerging markets, for instance, shape both opportunities and risks.

Additionally, the study does not account for the rapidly evolving nature of blockchain technologies and regulatory frameworks. Blockchain is still in its formative stages, and both the technology and its legal frameworks are continuously changing. This study's insights, while relevant today, may require updates as technology advances and as decentralized systems become more integrated with traditional financial markets. Future research should focus on longitudinal studies that track the evolution of blockchain-enabled asset tokenization over time. This could involve investigating how future technological innovations, such as improvements in smart contract capabilities, interoperability across blockchains, or advancements in decentralized governance models, affect the risk landscape and market trust in these systems.

Lastly, this research highlights several unintended consequences of decentralization but does not fully explore the potential for hybrid governance models that blend decentralized and centralized elements. As firms increasingly adopt blockchain for tokenized assets, there may be opportunities to combine the efficiency of decentralization with the oversight and stability offered by centralized governance. Future studies could investigate how hybrid models could mitigate some of the risks identified in this study, such as market manipulation or regulatory uncertainty, while preserving the benefits of decentralization. Additionally, further research should develop actionable frameworks or best practices to guide businesses in managing regulatory ambiguity, cybersecurity threats, and governance challenges. Exploring these alternative governance structures and practical strategies would provide deeper insights into how businesses and regulators can strike a balance between innovation and market security in blockchain-enabled ecosystems.

CRediT authorship contribution statement

Umair Tanveer: Writing – original draft, Supervision, Conceptualization. **Shamaila Ishaq:** Validation, Software, Formal analysis, Conceptualization. **Thinh Gia Hoang:** Writing – review & editing, Visualization, Project administration, Methodology, Investigation.

Appendix 1. Interview guide

1. Transaction Efficiency and Cost Reduction
   - i How has the adoption of asset tokenization affected the efficiency of your transaction processes compared to traditional methods?
   - ii Can you describe any changes in the transaction costs you have experienced since implementing asset tokenization?
   - iii What specific challenges or barriers have you encountered in reducing transaction costs through tokenization?

   iv How has the elimination or reduction of intermediaries impacted your transaction processes and costs?
2. Value Creation Mechanisms
   i In what ways has asset tokenization created new value opportunities for your business or industry?
   ii Can you provide examples of how tokenized assets have expanded access to new markets or investor segments?
   iii How does tokenization contribute to the liquidity and marketability of your assets compared to traditional forms?
   iv What are the key factors that determine the success of value creation through tokenization in your specific industry context?
3. Governance and Risk Distribution
   i How has the governance structure of your organization or asset management practices changed due to tokenization?
   ii What risks have you identified in the management and distribution of tokenized assets, and how are these managed?
   iii Can you discuss the impact of tokenization on the distribution of control and decision-making authority within your organization?
   iv How do you address compliance and regulatory challenges associated with the governance of tokenized assets?
4. Market Trust and Adoption
   i What are the primary concerns or barriers that potential investors or stakeholders have regarding the trustworthiness of tokenized assets?
   ii How has the adoption of asset tokenization affected the level of trust and confidence among your existing clients or investors?
   iii What strategies have you implemented to build and maintain market trust in tokenized assets?
   iv How do you assess the broader market acceptance and adoption of tokenization in your industry? What factors influence this adoption?

Data availability

Data will be made available on request.

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