A Review of the Application of Blockchain in Enhancing Transparency and Reducing Insider Information Risk in Iran's Capital Market

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Abstract

This narrative review analyzes blockchain technology as a strategic tool for enhancing transparency and reducing insider trading risks in Iran's capital market. Drawing on theoretical frameworks, global case studies, and domestic regulatory insights, it explores blockchain's potential as a decentralized, tamper-proof, and auditable infrastructure. The findings suggest blockchain can strengthen market integrity by reducing information asymmetry, automating compliance, and enabling real-time traceability. While countries such as India, Turkey, Malaysia, Indonesia, and the UAE have advanced through regulatory sandboxes, tokenized securities, and digital supervisory tools, Iran remains at an early adoption stage. Key barriers include legal uncertainty, technical limitations, and institutional fragmentation. The study proposes a localized roadmap including phased pilots, smart contract deployment, and AI-enabled monitoring under regulatory oversight. Ultimately, blockchain's success in emerging markets depends on institutional readiness and adaptive governance, urging Iran to embrace technology and restructure policies for a transparent and resilient financial ecosystem.

Keywords :
Blockchain; Capital Markets; Transparency; Insider Trading; Regulatory Technology

1. Introduction

The integrity of capital markets hinges on transparency and the equitable dissemination of information among all participants. In Iran's capital market, however, persistent challenges—such as fragmented oversight, information asymmetry, and widespread insider trading—have eroded investor confidence and distorted price discovery. Existing monitoring and compliance mechanisms, often reliant on centralized infrastructures and manual reporting procedures, have proven inadequate in mitigating these risks, particularly in environments marked by limited auditability and operational opacity.

In response to these systemic deficiencies, recent years have seen growing interest in the use of distributed ledger technologies (DLTs), especially blockchain, to enhance transparency, support real-time data access, and curb illicit informational advantages. Blockchain's core features—immutability, decentralization, and traceability—offer a compelling alternative to traditional regulatory architectures. Global evidence demonstrates that blockchain can improve capital market integrity by automating transaction recording, enhancing reporting accuracy, and reducing dependency on intermediaries. However, within the context of Iran's capital market, there remains a scarcity of consolidated academic evidence and applied experimentation that investigates blockchain's role in curbing insider information abuse and addressing enforcement gaps.

This article seeks to address that void by synthesizing conceptual and empirical studies published between 2020 and 2025, with a particular focus on blockchain's application in promoting financial transparency and reducing insider trading risks. It examines international implementations of blockchain in capital markets and evaluates their mechanisms for enhancing transactional trust. Furthermore, it analyzes how such insights might be adapted to Iran's regulatory and institutional frameworks. Comparative case studies from emerging markets—including India, Turkey, Malaysia, Indonesia, and the United Arab Emirates—are explored to identify practical strategies and regulatory innovations applicable to Iran's ecosystem.

To support this analysis, empirical data from Iranian regulatory institutions—including the Securities and Exchange Organization (SEO) and the Central Securities Depository of Iran (CSDI)—for the years 2023 and 2024 are reviewed. These statistics highlight ongoing transparency deficiencies, insider trading concerns, and enforcement challenges. The methodology of this review is rooted in narrative synthesis, drawing upon diverse sources ranging from theoretical

frameworks to applied case studies. Key references include works by Fauzan et al. (2024) on blockchain and market transparency, Adewale et al. (2022) on decentralized reporting infrastructures, Weixiong (2023) on blockchain efficiencies in China, Félez-Viñas et al. (2022) on insider trading dynamics in crypto markets, and BCG & GFMA (2023) on global DLT applications. The remainder of the article is structured as follows: Section 2 outlines the theoretical foundations, including key concepts such as blockchain technology, financial transparency, and insider information risk. Section 3 presents a critical review of national and international studies. Section 4 offers a comparative analysis across selected countries, identifying thematic patterns and research gaps. Section 5 proposes a localized roadmap for blockchain implementation in Iran's capital market, while Section 6 concludes with strategic policy recommendations and future research directions.

2. Theoretical Foundations and Conceptual Framework

2.1. Blockchain Technology: Definitions and Characteristics

Blockchain technology is fundamentally a decentralized, immutable, and transparent system governed by consensus-based protocols. Wu et al. (2024) describe blockchain as a distributed ledger that ensures data authenticity without reliance on centralized intermediaries. Their framing highlights blockchain's capacity to foster trust in financial environments by replacing institutional authority with mathematical consensus.

Shukla (2024) expands this conceptualization by identifying key research themes in blockchain literature namely decentralization, privacy, governance, and security. This broader view positions blockchain not merely as a technological tool, but as a structural enabler of institutional reform. Javaid (2022), further, bridges technical and ethical dimensions by arguing that blockchain enables transparency while safeguarding sensitive data, pointing toward its dual functionality: openness and confidentiality. Together, these perspectives build a robust theoretical base: blockchain is not only a means of recording transactions but a paradigm shift in how financial systems can be made transparent, decentralized, and accountable.

2.2. Information Transparency in Financial Markets

Transparency in capital markets is defined by timely, accurate, and reliable disclosure of relevant financial information. Where traditional reporting systems rely heavily on centralized gatekeepers and periodic filings, blockchain offers continuous and tamper-proof access to data. Adewale et al. (2022) introduce a conceptual model in which blockchain serves as the backbone of automated

financial reporting, utilizing smart contracts and real-time data sharing. Their framework underscores how blockchain transforms compliance from a reactive process into a proactive, system-embedded mechanism. Wu et al. (2024) reinforce this view by illustrating how blockchain-based trading platforms reduce information asymmetries and eliminate opaque intermediaries—thereby enhancing auditability and market efficiency. In theoretical terms, blockchain provides an infrastructural pathway to information transparency, especially in systems where conventional oversight mechanisms have proven inadequate or vulnerable to manipulation.

2.3. Insider Information Abuse and Its Associated Risks

Insider information abuse occurs when individuals with privileged access exploit non-public information for personal gain, thereby eroding fairness and investor trust. Even in blockchain-based systems, this risk is not automatically eliminated.

Félez-Viñas, Johnson, and Putnins (2022) provide empirical evidence that up to 48% of token listings in cryptocurrency markets involve insider trading detectable via on-chain data. Their findings highlight a paradox: while blockchain increases transparency, it does not prevent misconduct unless paired with active surveillance and enforcement.

A compelling real-world illustration of this dynamic is the SEC v. Wahi case, in which a Coinbase employee used non-public token listing information to profit from blockchain-recorded trades—ultimately leading to criminal prosecution. These examples underline that technological transparency alone is insufficient without regulatory frameworks and legal accountability.

2.4. Linkages Between Blockchain, Transparency, and Insider Risk Mitigation

Theoretical integration across blockchain, transparency, and insider risk mitigation reveals that these domains are not only related but mutually reinforcing when appropriately implemented. Wu et al. (2024) propose that blockchain's immutable ledgers and consensus-based records enable enhanced observability in securities markets—making illicit trades more traceable and anomalies easier to detect.

Adewale et al. (2022) go further, suggesting that smart contracts can be used to embed compliance logic into the system, automatically flagging or blocking suspicious transactions. Yet, as Félez-Viñas et al. (2022) caution, blockchain's open structure may ironically enable more sophisticated manipulation unless oversight is deliberately built in. Javaid (2022) adds nuance by advocating for

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privacy-preserving transparency—where regulators have privileged access while broader market actors retain necessary confidentiality.

In sum, the theoretical consensus suggests that blockchain can serve as both a transparency infrastructure and a compliance mechanism—provided it is embedded within an intelligent governance and legal framework. This understanding lays the groundwork for applying blockchain technology within the institutional realities of Iran's capital market.

3. Literature Review

3.1. National Studies on the Topic

With the emergence of transformative digital technologies, global financial systems have entered a new era of structural change. Among these, blockchain stands out for its decentralization, immutability, transparency, and data security—features that have significant potential for redesigning information and operational processes within financial institutions (Javadian, 2024). As a highly information-sensitive component of the economy, the capital market is particularly affected by blockchain, and researchers and policymakers are increasingly interested in leveraging its capabilities to enhance informational integrity.

Iran's capital market has long faced persistent challenges such as information asymmetry, lack of transparency, and the risk of insider information abuse. These issues have undermined investor trust, distorted price discovery, and reduced market liquidity (Varahani, 2022; Aflatooni, Eivani, & Inkachat, 2022). In a financial system characterized by high volumes and complex data flows, the need for innovative infrastructures that can ensure data transparency, security, and accuracy has never been more critical.

International studies have extensively documented how blockchain improves financial reporting and investor confidence by offering immutable, real-time data visibility. Its distributed nature eliminates tampering and central points of failure, enabling traceable and equitable access to data across market participants (Madadaha, 2024). In such an ecosystem, the informational playing field is leveled, and the opportunity for insider exploitation is substantially reduced.

In line with this, other studies have explored how blockchain reduces disclosure delays, enhances audit reliability, and facilitates regulatory oversight. By eliminating intermediaries and incorporating smart contracts, blockchain improves the speed and credibility of financial reporting, contributing to the overall quality of disclosed information (Martínez et al., 2024). These

enhancements not only reduce informational risk but also strengthen the regional and global competitiveness of capital markets.

However, the success of blockchain implementation hinges on legal and ethical safeguards. The collapse of the FTX platform exemplifies how even advanced technologies can be misused in the absence of appropriate governance structures (Alibasic, 2023). This suggests that robust legal and regulatory infrastructure is a prerequisite for leveraging blockchain securely and effectively.

Domestically, most blockchain studies in Iran have focused on banking and accounting contexts, with limited attention paid to its role in capital markets and insider information control (Badii, 2023). A more targeted examination of blockchain's legal, technical, and institutional implications in capital markets is crucial for evidence-based policymaking.

Several national studies have confirmed blockchain's positive role in reducing fraud, increasing transparency, and enhancing oversight. By offering immutable data records and full traceability of transactions, blockchain serves as a vital tool against financial opacity and information misuse (Saberbeigi, Nazari-Nia, & Jalilifar, 2024; Sarfi, Sarfi, & Sharifi, 2024). In high-volatility environments, technologies that ensure both transparency and security are especially attractive to regulators and market participants (Elyasin & Pourzamani, 2022).

Taken together, these observations underscore the central research question of this study: Can the implementation of blockchain-based systems significantly enhance information transparency and reduce insider information risk in Iran's capital market? By integrating national and international literature with an analysis of Iran's institutional landscape, this review aims to offer a strategic framework for deploying blockchain to improve informational integrity and market performance.

3.2. International Studies on Blockchain, Transparency, and Insider Information

In contrast to the Iranian context, international literature presents a growing body of evidence examining blockchain's utility in promoting transparency, improving market efficiency, and reducing insider trading risks.

Fauzan et al. (2024) investigate blockchain's contribution to capital market transparency and security through a qualitative synthesis of existing frameworks. They argue that blockchain integration can address reporting inefficiencies and enhance market resilience—particularly during periods of volatility. Their study suggests that blockchain's immutable and decentralized

architecture can replace fragmented legacy systems and foster systemic trust, though regulatory adaptation remains a persistent challenge.

Similarly, Weixiong (2023) focuses on blockchain's role in securities settlement systems, demonstrating that smart contract-enabled automation can significantly reduce settlement times, operational costs, and counterparty risks. The empirical scope includes blockchain pilot programs across securities exchanges, illustrating measurable gains in auditability and transactional visibility— benefits particularly relevant to emerging markets like Iran.

Félez-Viñas, Johnson, and Putnins (2022) provide a cautionary perspective by analyzing insider trading in cryptocurrency markets. Using on-chain transaction analysis, they reveal that between 28% and 48% of token listings exhibit signs of insider activity, resulting in over $30 million in illicit gains. Their findings demonstrate that blockchain's transparency facilitates detection, but only if accompanied by strong enforcement mechanisms.

In a related line of inquiry, Zhou et al. (2020) examine exploitative trading practices—such as front-running and sandwich attacks—on decentralized exchanges like Uniswap. Their results show how blockchain's transparency, while designed to enhance fairness, can also enable adversarial behavior by making order flows publicly visible. This "transparency paradox" highlights the importance of coupling blockchain adoption with regulatory safeguards.

Finally, Wu et al. (2024) offer a comprehensive review of blockchain applications in finance, particularly in the context of securities trading. Their survey maps out a spectrum of use cases ranging from settlement and clearing to regulatory compliance and anti-fraud enforcement. They emphasize blockchain's potential to replace trust in intermediaries with trust in code, thus streamlining oversight and reducing transactional opacity.

3.3. Integrative Commentary

A synthesis of the national and international literature reveals a significant dichotomy: on the one hand, Iran has taken commendable steps toward digital transformation—such as launching electronic financial infrastructures and integrating digital reporting systems—yet academic research and applied experimentation with blockchain in the capital market remain limited. On the other hand, global studies offer rich empirical and conceptual evidence confirming blockchain's potential to enhance transparency, automate regulatory compliance, and detect insider trading. At the same time, these studies caution that blockchain introduces new forms of risk, such as privacy erosion and novel

avenues for predatory trading, which must be addressed through adaptive oversight and policy design.

This divergence underscores the importance of a context-aware, strategically phased approach to blockchain integration in Iran's capital market. The juxtaposition of Iran's institutional readiness with globally validated use cases provides a rare opportunity to localize best practices while mitigating known pitfalls. Designing a blockchain framework that is tailored to Iran's legal, technical, and market-specific characteristics—particularly one that balances transparency with control—can yield significant gains in market integrity.

In this light, the present literature review serves not only to map the state of research but also to lay the groundwork for forward-looking analysis. The findings presented thus far establish the conceptual and empirical foundation for the next sections, in which potential implementation models, regulatory pathways, and governance implications tailored to the Iranian context will be critically examined.

Figure 1. Conceptual Model for Integrating Blockchain and AI in Enhancing Transparency and Reducing Insider Information Risk in Iran's Capital Market.

Conceptual Model for Integrating Blockchain and AI in Enhancing Transparency and Reducing Insider Information Risk in Iran's Capital Market
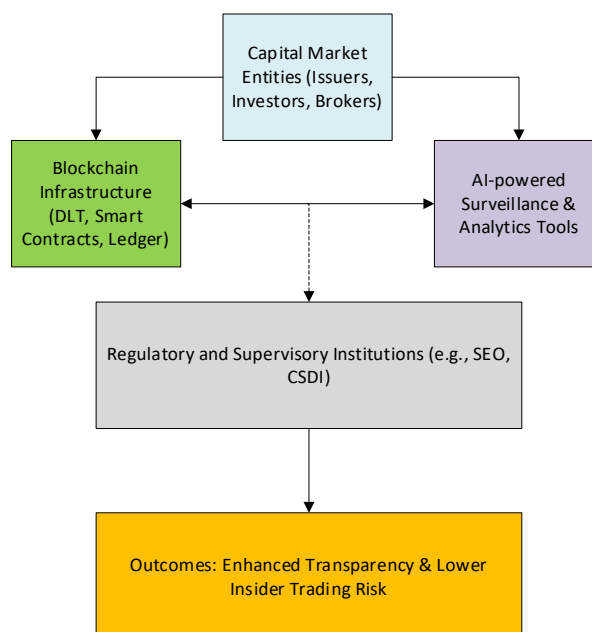

Figure 1

Figure 1. Conceptual framework for integrating blockchain, regulatory oversight, and AI-enabled surveillance to enhance transparency and reduce insider information risk in Iran's capital market.

4. Analysis and Classification of the Reviewed Studies

4.1. Conceptual Categorization of Studies

A critical synthesis of the selected literature reveals three overarching conceptual categories: (1) theoretical frameworks and models; (2) structural reform analyses; and (3) empirical investigations of insider risk.

In the first category, Adewale et al. (2022) present a comprehensive conceptual model that integrates blockchain into financial reporting systems. Their framework emphasizes tamper-proof ledgers, real-time data exchange, and AI-augmented auditability, proposing a future in which compliance becomes automated and embedded in the transaction infrastructure. Similarly, Le and Campbell (2025) explore systemic reforms in capital markets, suggesting that blockchain could replace entrenched intermediaries with a decentralized, trustless infrastructure.

The second category comprises empirical and risk-oriented studies. Sedlmeir et al. (2022) delve into the "transparency paradox," arguing that while blockchain

enhances visibility, it simultaneously exposes sensitive organizational data— necessitating privacy-preserving technologies and permissioned systems. Zhou et al. (2020) develop analytical models of front-running and sandwich attacks on decentralized exchanges, revealing how latency and transparency can be weaponized. Wachter et al. (2022) identify insider and wash trading practices in NFT markets using Ethereum data, illustrating how on-chain observability can detect but not inherently prevent manipulative behavior. Finally, Garno (2025) approaches the issue from a legal-ethical lens, highlighting how blockchain and smart contracts challenge conventional regulatory norms.

Together, these studies offer a layered understanding of blockchain's dual nature: as both a transparency-enhancing infrastructure and a potential vector for new forms of market exploitation.

4.2. Similarities and Differences in Research Findings

Across the reviewed literature, several points of convergence and divergence emerge. On the convergence side, there is broad agreement that blockchain offers transformative potential in promoting financial transparency and efficiency. For instance, both Adewale et al. (2022) and Le & Campbell (2025) emphasize blockchain's ability to reduce reliance on centralized intermediaries and improve auditability.

Another point of convergence is the need for regulatory adaptation. Sedlmeir et al. (2022) and Garno (2025) underscore that the benefits of transparency must be balanced with privacy and institutional oversight, advocating for hybrid models that blend technical innovation with legal safeguards.

However, divergence arises in terms of optimism versus caution. While Adewale et al. adopt a solutionist perspective, Zhou et al. (2020) and Wachter et al. (2022) stress the potential for predatory behavior even within fully transparent systems. There is also a difference in emphasis: Sedlmeir et al. focus on institutional and governance adaptation, whereas Zhou et al. and Wachter et al. foreground specific exploit mechanisms, such as front-running and wash trading. These variations reflect the multidimensionality of blockchain adoption and suggest that technical solutions must be contextually grounded in governance realities.

4.3. Identified Research Gaps

Despite the richness of theoretical and empirical studies, several critical gaps remain evident in the existing literature:

1. **Contextual Relevance for Iran:**

There is an absence of research directly examining blockchain implementation in Iran or in markets with comparable institutional structures. This gap raises questions about the feasibility, localization, and cultural compatibility of blockchain solutions in the Iranian context.

2. **Integration of Governance and Technology:**
   While governance challenges (Sedlmeir et al., 2022) and technical vulnerabilities (Zhou et al., 2020; Wachter et al., 2022) have been studied independently, few works provide a holistic, operational framework that integrates these elements. The lack of such models limits progress toward deployable real-world systems.

3. **Regulatory Strategies in Emerging Markets:**
   Current literature is heavily concentrated on Western markets, with little exploration of normative and regulatory pathways suited to non-Western or emerging economies. Although Garno (2025) discusses the U.S. context, comparable strategies for developing markets remain underexplored.

4. **Empirical, Post-Implementation Evidence:**
   There is insufficient empirical research assessing the actual effectiveness of blockchain after implementation. Limited evidence exists on whether blockchain adoption tangibly reduces insider trading or enhances transparency in live capital markets, leaving many claims untested beyond theory or simulation.

4.4. Suggested Directions for Future Research

To bridge the identified gaps, several research directions are proposed:

1. **Context-Specific Case Studies in Iran**

   Conduct empirical studies—ideally in collaboration with institutions such as the Central Securities Depository of Iran (CSDI)—to evaluate how blockchain adoption can improve transparency and reduce insider information risks in Iran's capital market.

2. **Design of Hybrid Governance-Technical Models**

   Develop integrated frameworks that combine smart contract automation with permissioned access controls and cryptographic privacy protections. Such models should be tailored to the legal and cultural constraints of emerging markets.

3. **Interdisciplinary Policy Research**

Explore regulatory roadmaps that adapt blockchain's unique features while ensuring market integrity. Building on insights such as Garno (2025), future research should propose mechanisms for oversight, enforcement, and inter-agency coordination.

4. **Post-Implementation Evaluation**

After initial pilot deployments, empirically assess key indicators—including insider trading frequency, transaction auditability, and investor trust—to generate evidence-based feedback for refining blockchain adoption strategies.

4.5. Empirical Context in Iran's Capital Market

Despite multiple rounds of regulatory reform, Iran's capital market continues to exhibit structural deficiencies in transparency, enforcement efficiency, and equitable information access. These shortcomings are not merely conceptual; they are substantiated by official statistics and regulatory reports, which collectively make a compelling case for the adoption of blockchain infrastructure.

According to the 2023 annual report of the Central Securities Depository of Iran (CSDI), only 62% of listed firms on the Tehran Stock Exchange (TSE) and Iran Fara Bourse (IFB) fully complied with disclosure requirements issued by the Securities and Exchange Organization (SEO). Additionally, 28% of companies submitted their financial reports with significant delays—highlighting widespread noncompliance and institutional bottlenecks in financial transparency (CSDI, 2023).

In parallel, the SEO's Enforcement Division recorded 112 formal insider trading complaints in the first half of 2024 alone—marking a 21% increase compared to the same period in 2022 (SEO, 2024a). Many of these violations involved pre-announcement trading activities linked to confidential disclosures such as dividend policies, earnings results, or executive turnover. These patterns suggest systemic weaknesses in preventing unauthorized access to market-sensitive information.

Moreover, surveillance reports from SEO's early-warning system show that 74% of investigated insider trading cases lacked sufficient digital audit trails, limiting the ability to build admissible evidence or initiate timely enforcement

(SEO, 2024b). These deficiencies stem from the market's reliance on centralized systems, fragmented reporting mechanisms, and manual auditing procedures.

Additional supervisory statistics further reveal the scale of enforcement gaps. In 2023–2024, the SEO reported 4,479 automated system alerts, 37 supervisory warnings, and three confirmed violations requiring direct intervention—figures that underscore the growing complexity of oversight (IRNA, 2024). In some cases, the lack of compliance has led to judicial involvement: for instance, a Tehran Appeals Court issued a final conviction in 2023 against individuals accused of insider trading in the Heyv Telecom case, imposing a fine of IRR 3 billion as legal sanction (Judiciary of Iran, 2023).

Complementary data from capital market news agencies indicate that over 60 institutions and individuals—including brokerage firms, fund managers, and senior executives—were publicly sanctioned or warned during the 2022–2023 fiscal years (SENA, 2023a). The increase in public violations, alongside the publication of names of violators for the first time, illustrates a notable policy shift toward transparency but also reflects the scale of misconduct still present in the market.

Taken together, these empirical indicators paint a clear picture: Iran's capital market requires a technological leap toward transparency and traceability. Blockchain systems, with their immutable ledgers, real-time data logging, and smart contract–based automation, provide a viable pathway to address these enforcement and information challenges. The integration of AI-enabled surveillance—capable of detecting trade clustering, abnormal pre-disclosure activity, and behavioral anomalies—can further augment regulatory effectiveness. By grounding policy innovation in data-driven realities such as delayed disclosures, insufficient audits, and rising insider complaints, Iranian regulators can tailor blockchain-based reforms that are both context-sensitive and forward-looking. In this sense, blockchain is not merely a theoretical upgrade; it is a necessary institutional intervention grounded in empirical urgency.

Table 1 Empirical Indicators in Iran's Capital Market (2022–2024)

Source	Year	Value / Status	Indicator
Central Securities Depository of Iran (2023)	2023	62% of listed firms comply	Compliance with disclosure regulations
Central Securities Depository of Iran (2023)	2023	28% of firms had significant delays	Delays in financial reporting
Securities and Exchange Organization – SEO (2024a)	1H 2024	112 formal complaints filed	Registered insider trading complaints

SEO (2024a)	2024	+21% vs. 2022	Growth in insider trading complaints
SEO (2024b)	2024	74% of reviewed cases	Violations lacking digital audit trails
SENA News (2023a)	2022–2023	Over 60 executive or firm-level penalties	Public disclosure of violations
SEO (2024, via IRNA)	2023–2024	4,479 system alerts; 37 supervisory warnings; 3 confirmed violations	Supervisory enforcement actions
SEO (2023b, via SENA)	2023	Public disclosure of insider trading suspicion in May 2023 (Heyv telecom case)	Transparency in handling insider cases
Judiciary Report (2023)	2023	Court conviction for insider trading – fine of IRR 3 billion	Legal enforcement of insider trading

4.6. Markets Comparative Review of Blockchain Integration in Selected Emerging Markets

4.6.1. Blockchain Strategy and Capital Market Reform in India

India has emerged as a critical reference point for understanding the phased integration of blockchain into emerging capital markets. Over the past five years, it has initiated a wide range of reforms—including policy experimentation, legal development, and live pilots—across various sectors such as central banking, securities, and digital assets. These efforts offer valuable insights for countries like Iran, which face similar institutional challenges in adopting blockchain to enhance transparency and reduce insider trading risks.

Libeesh (2024) presents a comprehensive policy analysis of blockchain regulation in India's financial system, identifying key institutional fragmentation. Oversight responsibilities remain divided among the Ministry of Finance, the Reserve Bank of India (RBI), and the Securities and Exchange Board of India (SEBI), leading to gaps in governance and compliance. The study recommends integrated legal reforms and coordinated sandbox environments to facilitate blockchain experimentation while maintaining regulatory integrity.

Building on this, Moudgil (2025) investigates the legal standing of tokenized securities in India's capital market. Despite technological advancements, the country still lacks explicit legislation recognizing blockchain registries or smart contract–based ownership. The author stresses the importance of legislative amendments and institutional frameworks to legitimize token-based securities and ensure investor protection—a challenge equally relevant to Iran's evolving regulatory landscape.

India's most high-profile achievement came with the launch of its Central Bank Digital Currency (CBDC), known as the Digital Rupee (e₹). The RBI's pilot

program, initiated in 2022, has since expanded to include both wholesale and retail use cases. According to official RBI disclosures and industry coverage, the platform has processed over one million daily retail transactions, while reducing settlement times in interbank transfers and bond markets (RBI, 2024; Economic Times, 2024). These results affirm the capacity of blockchain infrastructure to support sovereign digital payment systems with enhanced transparency and efficiency.

Chakravorty et al. (2025) conduct a simulation-based study to evaluate blockchain's impact on transaction security and efficiency in capital markets. Their findings show that consensus protocols and smart contracts substantially enhance auditability, reduce fraud, and shorten transaction cycles. However, the study also notes critical gaps in ethical safeguards, compliance protocols, and behavioral readiness, stressing the need for supportive institutional reform before real-world deployment.

On the demand side, Reuters (2024), drawing on Chainalysis data, reports that India has ranked first globally in retail cryptocurrency adoption for two consecutive years. Despite a challenging tax regime, Indian retail investors maintain strong activity, indicating a population-level openness to blockchain-based financial instruments. This trend underscores the urgency of regulatory adaptation to accommodate demand while safeguarding transparency.

In sum, India's experience demonstrates that real-world blockchain implementation in capital markets is both feasible and impactful—but only under conditions of legal certainty, inter-agency coordination, and technical readiness. For Iran, the Indian model suggests clear priorities: sandbox-based pilots, CBDC exploration, legal recognition of tokenized assets, and public–private partnership. These lessons, when adapted to Iran's context, can accelerate reform while mitigating insider trading and information asymmetries. A structured comparison of India's blockchain efforts is summarized in Table 2.

Table 2 Comparative Summary: Blockchain Implementation in India's Capital Market

Source	Geography	Focus Area	Methodology	Key Insights
Libeesh (2024)	India	Blockchain regulation in finance & markets	Policy review	Fragmented regulation; calls for unified legal framework and interagency sync
Moudgil (2025)	India	Tokenized securities	Legal-regulatory analysis	Legal gaps persist; needs legislative change and sandboxing
Chakravorty et al. (2025)	India/global	Blockchain performance in finance	Simulation-based experiment	Enhanced efficiency; ethical & compliance issues must be addressed

Reuters (2024)	India/global	Crypto adoption	Market data (Chainalysis)	High user adoption; persistent demand despite compliance restrictions

4.6.2. Blockchain Development and Pilot Projects in Turkey

Although the adoption of blockchain in Turkey's capital market is still in its formative stage, several significant initiatives—especially those involving gold-backed digital assets and central bank digital currency (CBDC)—have positioned Turkey as a regional innovator. Unlike more mature implementations in jurisdictions such as India or the UAE, Turkey's approach emphasizes controlled experimentation within existing legal structures, particularly through public–private collaborations and regulated pilots.

A landmark initiative is the BiGA Digital Gold platform, developed by Takasbank, the Istanbul Clearing and Settlement Bank. Launched in January 2020, this project allows participating banks to transfer digital tokens backed 1:1 by physical gold held in the vaults of Borsa Istanbul. The system operates on a permissioned blockchain, where each transaction is cryptographically private but fully visible to the regulatory node. According to institutional reports, the system supports 24/7 gold transfers, and six major banks participated in the initial phase. The BiGA project demonstrates the capacity of blockchain to modernize traditional asset trading within Turkey's financial regulations, combining real asset backing with digital settlement infrastructure.

In parallel, the Central Bank of the Republic of Türkiye (CBRT) has developed a digital Turkish Lira prototype, launched in late 2022. The first-phase pilot involved four commercial banks and two domestic fintechs. It tested smart contract infrastructure, distributed ledger integration, and digital identity modules in a controlled test environment. The Digital Turkish Lira Evaluation Report (2024) noted that initial tests successfully demonstrated core system functionality and revealed critical dependencies on secure identity management. The pilot's next phases aim to expand user interaction while addressing legal and technical constraints.

Beyond pilot projects, Turkey ranks among the top ten countries globally in cryptocurrency adoption. According to the 2024 Chainalysis Global Crypto Adoption Index, Turkey was ranked 7th worldwide and 1st in the MENA region. This surge in grassroots usage—especially during periods of Lira volatility—has raised concerns among regulators about financial stability and potential abuses. Consequently, the Capital Markets Board (CMB) and CBRT have accelerated efforts to define crypto assets under national law. While Turkey's

2024 amendment to its Capital Markets Law introduced a formal licensing regime for crypto asset service providers, there remains ambiguity in classifying decentralized finance (DeFi) platforms and blockchain-based securities within existing frameworks.

Overall, Turkey's case highlights a hybrid model that leverages state-driven pilots while cautiously engaging with broader decentralized trends. Regulatory innovation, infrastructure development, and high public adoption are occurring in parallel, albeit not always in synchrony. The Turkish experience offers several lessons for Iran: (1) the importance of designing limited but functional pilot environments, (2) the need for legal clarity before widespread deployment, and (3) the potential of asset tokenization as an entry point for blockchain-based financial modernization.

Table 3 Comparative Summary: Blockchain Implementation in Turkey's Capital Market

Source	Geography	Focus Area	Methodology	Key Insights
Takasbank & Ledger Insights (2020)	Turkey	Tokenized gold (BiGA)	Institutional implementation	Permissioned blockchain; 6 banks; 1 token = 1g gold; regulator node ensures compliance; real asset backing with digital infrastructure
CBRT (2024)	Turkey	CBDC – Digital Turkish Lira	Pilot evaluation	Distributed ledger, smart contracts, digital identity tested; pilot showed system readiness and legal gaps
Chainalysis (2024)	Turkey	Crypto adoption	Global index	Turkey ranked 7th globally, 1st in MENA; high grassroots usage; rapid growth linked to currency instability
Chainalysis (2023)	Turkey	Retail crypto usage	Market analytics	P2P trading surged post-2021; crypto seen as hedge; compliance and consumer risk rising

4.6.3. Malaysia's Legal and Regulatory Framework for Blockchain

Malaysia has positioned itself as one of the leading Southeast Asian economies engaging in blockchain regulation and experimentation, although its framework remains in development. The Malaysian Ministry of Science, Technology, and Innovation introduced the National Blockchain Roadmap (2021–2025) to guide the technology's adoption across government and industry. According to AlAfnan and MohdZuki (2024), the roadmap emphasizes transparency, immutability, and efficiency as key objectives of blockchain integration. However, the policy framework is framed in broad, cross-sectoral terms, with limited attention to specific applications in capital markets or explicit provisions

for insider information risk management. This highlights the roadmap's role as an early-stage governance vision rather than a detailed financial market regulation.

In the capital market domain, the Securities Commission Malaysia (SC) has taken steps to classify and regulate digital assets. Wardoyo and Hapsari (2024) observe that Malaysia treats certain crypto assets as securities, thereby requiring them to comply with investor protection and disclosure obligations similar to conventional securities. Nevertheless, gaps persist, particularly regarding licensing criteria for service providers and enforcement powers against misconduct. Ambiguities in defining the scope of digital assets and decentralized finance platforms hinder consistent oversight. These limitations increase the possibility of insider exploitation in crypto-linked markets, signaling the need for clearer regulatory categorization.

Investor behavior further underscores the urgency of robust regulation. Sukumaran, Thai, and Wasiuzzaman (2022) report that between August 2020 and September 2021, MYR 16 billion (approximately USD 3.85 billion) worth of cryptocurrencies were traded in Malaysia. Their survey of 211 retail investors found that perceived value strongly influenced adoption, while perceived risk had little deterrent effect. This dynamic suggests that high levels of adoption may outpace regulatory preparedness, potentially exacerbating informational asymmetry and insider manipulation. The findings imply that regulatory frameworks must evolve quickly to address the transparency challenges posed by rapid market participation.

Institutional perspectives also highlight the potential of tokenization in capital markets. A commentary by the Institute of Capital Market Research (ICMR, 2024) argues that blockchain-enabled tokenization could expand liquidity and product variety in Malaysia's financial sector. Real-time traceability and auditability inherent in tokenized systems could strengthen safeguards against insider trading. However, without clear governance mechanisms, token markets risk replicating the same opacity that characterizes traditional systems. This reflects a recurring pattern in Malaysia's discourse: enthusiasm for innovation without parallel institutional reforms.

Finally, banking sector readiness plays a critical role in the trajectory of blockchain integration. Wang, Wu, Zainordin, and Annuar (2023), using survey data from 300 banking professionals, demonstrate strong institutional willingness to adopt blockchain, driven by expectations of improved performance and efficiency. Such adoption within banking lays an important foundation for potential capital market reforms. Enhanced blockchain literacy

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and infrastructure within financial institutions can strengthen transparency in financial transactions, while also reducing opportunities for insider exploitation.

Malaysia presents a fragmented but dynamic picture of blockchain development in capital markets. The National Blockchain Roadmap provides a strategic vision, the SC has introduced initial regulatory categorizations, and investor adoption is accelerating rapidly. Yet the lack of comprehensive, sector-specific regulatory clarity leaves significant gaps in managing transparency and insider risks. Malaysia's case illustrates the importance of aligning technological innovation with regulatory adaptation, offering valuable lessons for countries like Iran that face similar challenges in balancing innovation with oversight.

Table 4 Comparative Summary: Blockchain Implementation in Malaysia's Capital Market

Source	Geography	Focus Area	Methodology	Key Insights
AlAfnan & MohdZuki (2024)	Malaysia	National Blockchain Roadmap (2021–2025)	Critical Discourse Analysis (CDA)	Highlights transparency and governance goals; lacks capital market–specific provisions; signals early-stage policy vision.
Wardoyo & Hapsari (2024)	Malaysia (compared to Indonesia & Singapore)	Digital asset regulation (Securities Commission Malaysia)	Comparative legal analysis	SC treats some digital assets as securities; legal ambiguities remain in licensing and enforcement; clearer regulation could improve transparency and reduce insider risks.
Sukumaran et al. (2022)	Malaysia	Investor behavior in crypto adoption	Survey (n=211), PLS-SEM	Perceived value drives adoption despite risks; MYR 16 billion (~USD 3.85B) traded (Aug 2020–Sept 2021); high adoption raises transparency concerns.
ICMR (2024)	Malaysia	Tokenization discourse	Policy commentary / conceptual analysis	Tokenization seen as liquidity and inclusion tool; regulatory uncertainty persists; real-time auditability could deter insider trading.
Wang et al. (2023)	Malaysia	Blockchain adoption in banking	Survey (n=300), regression & factor analysis	All predictors (performance, effort expectancy, etc.) significant; banking adoption readiness supports future capital market integration.

4.6.4. Indonesia's National Approach to Blockchain and Crypto Markets

Indonesia presents a rapidly evolving blockchain and crypto regulatory landscape, shaped by both explosive market adoption and ambitious institutional reforms. With

over 16.5 million crypto investors by 2022—nearly double the number of traditional capital market participants—the Indonesian case provides critical insights into the balance between innovation, transparency, and insider risk (Fitriadi et al., 2023). The urgency to develop a coherent legal and supervisory infrastructure has spurred regulatory, fiscal, and structural responses across multiple government bodies.

Fitriadi et al. (2023) emphasize the significance of BAPPEBTI Regulations No. 8/2021 and 11/2022 in defining crypto assets and overseeing exchanges. Their normative-legal analysis reveals a dramatic growth in transaction volume—from IDR 64.9 trillion in 2020 to IDR 859.4 trillion in 2021, alongside a near-tripling in investor accounts. Despite these strides, the authors highlight persistent legal ambiguity regarding asset classification and enforcement mechanisms, which may expose the ecosystem to insider abuse and opacity.

Further legal analysis by Santoso et al. (2023) explores the design elements and risks of Indonesia's planned Central Bank Digital Currency (CBDC), the Digital Rupiah. Their findings suggest that unresolved issues regarding the currency's legal classification, data privacy under existing laws, and inadequate cybersecurity protocols may limit CBDC integration into broader market infrastructure. Without proper safeguards, the very transparency and traceability benefits blockchain promises may be undermined, particularly in sensitive domains such as clearing, settlement, or interbank reconciliation.

The fiscal and legal posture toward digital assets is further critiqued by Hadiyantina et al. (2024), who compare Indonesia's approach with that of Canada, the U.S., and Singapore. They note that Indonesia's relatively low transaction tax policies have incentivized high investor participation and foreign investment. Yet without parallel enhancements to regulatory oversight, low-tax environments can intensify information asymmetries and delay detection of insider-driven market distortions.

One of the most significant institutional changes is the transfer of crypto supervisory authority from BAPPEBTI to the Financial Services Authority (OJK), effective January 2025, under the Financial Sector Omnibus Law (Law No. 4/2023). Alfiani (2024) argues that this structural shift may harmonize standards between crypto and traditional capital markets, enabling unified supervision, better audit protocols, and clearer disclosure norms. However, the success of this transition hinges on the quality of implementation and the strength of secondary regulations.

Lastly, Fitriana (2023) offers a historical overview of Indonesia's crypto regulation trajectory, emphasizing the classification of crypto assets as commodities tradable on futures exchanges. As of 2023, over 383 crypto assets have been approved for trade. The study underscores that crypto investor accounts have already surpassed those in traditional equities—a demographic and systemic shift that necessitates comprehensive transparency strategies, including mandatory wallet rules and transaction reporting protocols.

Taken together, these findings suggest that Indonesia is moving toward an integrated financial governance model, wherein blockchain regulation becomes increasingly interwoven with capital market oversight. While the country's regulatory foundations have matured considerably since 2020, critical gaps remain in areas such as legal certainty, cybersecurity, and supervisory capacity. For markets like Iran, the Indonesian experience offers a compelling case study in managing rapid adoption, institutional coordination, and the regulatory framing of blockchain within a hybrid financial ecosystem.

Table 5 Comparative Summary: Blockchain Implementation in Indonesia's Capital Market

Source	Geography	Focus Area	Methodology	Key Insights
Fitriadi et al. (2023)	Indonesia	Crypto asset classification and market regulation	Normative juridical analysis	Crypto volume grew from IDR 64.9T (2020) to IDR 859.4T (2021); investors rose to 16.5M by 2022. Regulations exist (BAPPEBTI 8/2021, 11/2022) but lack clarity on insider risk and legal certainty.
Santoso et al. (2023)	Indonesia	CBDC – Digital Rupiah design & legality	Legal–technical review	Identifies gaps in CBDC legal definition, privacy law, and cybersecurity frameworks; unclear legal status may undermine trust and transparency.
Hadiyantina et al. (2024)	Indonesia vs. global	Crypto taxation and investment law	Comparative legal research	Indonesia's low-tax policy fosters participation but risks transparency erosion without regulatory depth. Incentives must be balanced with compliance.
Alfiani (2024)	Indonesia	Structural reforms – Omnibus Law No. 4/2023	Legislative policy analysis	Transfers oversight from BAPPEBTI to OJK (2025); aims for unified supervision across crypto and traditional markets. If well-implemented, may align disclosure and insider control frameworks.
Fitriana (2023)	Indonesia	Legal evolution of crypto assets as commodities	Doctrinal legal review	383+ cryptos tradable; crypto investors outnumber stock market investors. Reporting and custody rules introduced, but regulatory scale must match adoption.

4.6.5. Blockchain and Capital Market Modernization in the UAE

The United Arab Emirates (UAE) has emerged as a global pioneer in the institutionalization of blockchain regulation, with a multi-regulator framework that spans national and emirate-level jurisdictions. Through the efforts of entities such as the Virtual Assets Regulatory Authority (VARA), the Securities and Commodities Authority (SCA), the Financial Services Regulatory Authority (FSRA), and the Dubai Financial Services Authority (DFSA), the UAE has

established a sophisticated licensing structure for virtual asset service providers (VASPs), designed to enhance market integrity, compliance, and capital market integration (DLA Piper, 2025).

DLA Piper (2025) provides an in-depth legal analysis of this regulatory ecosystem. The UAE mandates licensing for all VASPs engaged in trading, custody, or issuance of digital assets. VARA regulates VASPs within the Emirate of Dubai (excluding the DIFC), while SCA oversees activities across the mainland. Free zones like DIFC and ADGM maintain their own frameworks, under DFSA and FSRA respectively. A landmark 2024 inter-agency cooperation agreement further allows licenses granted by VARA to be recognized nationwide. This regulatory interoperability enhances legal certainty and creates a robust foundation for tokenized securities to operate under capital market standards.

Beyond structure, regulatory precision has been deepened through updates like VARA Rulebook Version 2.0, which according to Hogan Lovells (2025), strengthens controls around margin trading, collateralization, and token issuance. The update includes activity-specific compliance guidelines, enforceable within a formal 30-day transition window. These reforms are instrumental in preventing price manipulation, improving disclosure obligations, and enforcing transparency—key safeguards against insider trading and market exploitation.

Charltons (2025) further elaborates on the evolution of VARA's regulatory role, particularly its expansion into decentralized finance (DeFi), stablecoin platforms, and NFT marketplaces. VARA's enforcement mechanisms now include real-time transaction monitoring and cybersecurity incident reporting, which represent significant progress toward active surveillance of digital markets. This live oversight mechanism marks a transformation from post-facto investigation to proactive governance in blockchain-based capital markets.

According to PwC's 2022 market assessment, the UAE's policy environment has successfully attracted top-tier global exchanges like Binance and Kraken. Regulatory focus on Anti-Money Laundering (AML) and Counter-Terrorism Financing (CFT) compliance, aligned with international standards, has helped foster a transparent, crime-resistant financial ecosystem. These controls are crucial not only for security but also for creating a trusted environment in which digital securities and smart contracts can flourish (PwC, 2022).

Lastly, the Central Bank of the UAE (CBUAE) is actively piloting a CBDC project (Digital Dirham) for both domestic and cross-border use. Hogan Lovells (2025) reports that bilateral testing with India is ongoing, while retail and wholesale applications are under development. The CBDC infrastructure is

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expected to support programmable payments and blockchain-based settlement, which would reduce settlement risk, increase transaction traceability, and eliminate time lags—thereby modernizing the operational backbone of the UAE's capital markets.

Taken together, the UAE demonstrates a comprehensive and forward-looking approach to blockchain regulation, combining legal clarity, market engagement, real-time supervision, and payment innovation. For jurisdictions like Iran, the UAE's model provides a clear case of how regulatory modernization, if properly coordinated across agencies, can transform blockchain from a technological novelty into a pillar of capital market infrastructure.

Table 6 Comparative Summary: Blockchain in the UAE's Capital Market

Source	Focus Area	Regulatory Strengths	Transparency & Insider Risk Impact
DLA Piper (2025)	Licensing framework	Multi-agency coordination, national license recognition	Legal clarity, cross-jurisdictional consistency
Hogan Lovells (2025)	VARA Rulebook v2.0	Activity-specific regulation (margin, collateral)	Reduces insider risk, enhances auditability
Charltons (2025)	VARA evolution	Real-time monitoring, DeFi/NFT coverage	Live oversight and governance standards
PwC (2022)	Market diagnostics	VASP attraction, AML/CFT alignment	Secure infrastructure, investor confidence
Hogan Lovells (2025)	CBDC development	Programmable currency, bilateral pilots	Blockchain-native settlement with high traceability

4.6.6. Comparative Analysis and Key Insights for Iran

The cross-country review conducted in this study offers several critical insights for shaping Iran's blockchain integration strategy, particularly with respect to enhancing financial transparency and mitigating insider trading risks. The selected jurisdictions—India, Turkey, Malaysia, Indonesia, and the UAE—demonstrate diverse regulatory postures, technological maturity levels, and institutional pathways for blockchain adoption in capital markets. Despite their differences, they collectively highlight several structural enablers that remain underdeveloped in Iran's current financial governance framework.

Regulatory Clarity and Asset Classification

In all reviewed countries, regulatory bodies have either formally defined crypto assets (e.g., Indonesia and Malaysia) or instituted functional licensing regimes for virtual asset service providers (e.g., UAE, Turkey). These regulatory mechanisms serve to reduce legal ambiguity, set minimum compliance expectations, and bring emerging blockchain-based activities under capital market jurisdiction. In contrast, Iran lacks a coherent legal classification for digital assets. This regulatory gap contributes to fragmented oversight and impairs the state's ability to enforce auditability and prevent informational asymmetries.

Licensing, Supervision, and Inter-agency Coordination

Countries such as the UAE and India have shown the importance of cross-institutional coordination, where central banks, capital market regulators, and innovation agencies collaborate to govern distributed ledger technologies. For example, the UAE's VARA operates under a multi-tiered framework where licenses are valid across emirates through legal cooperation agreements. Similarly, India's sandbox initiatives bring together SEBI and RBI to jointly test blockchain-enabled securities and digital currencies. In Iran, the absence of centralized or sandboxed blockchain trials involving the SEO, CBI, and CSDI continues to limit experimentation and oversight capacity.

Digital Identity, Smart Contracts, and Real-time Monitoring

Across the sample countries, the deployment of blockchain is increasingly linked with adjacent infrastructures such as digital identity systems, smart contract automation, and real-time surveillance mechanisms. These elements significantly reduce the scope for backdated manipulations, late disclosures, and off-ledger trading—core issues afflicting Iran's capital market. For instance, the UAE's enforcement of margin controls, collateral tracking, and token issuance disclosures through VARA Rulebook 2.0 exemplifies this technological integration. Iran's regulatory bodies, however, continue to rely on ex-post reporting and manual auditing procedures, which are insufficient to track modern digital trades or algorithmic market abuse.

Data-Driven Enforcement and Market Signals

Empirical indicators from the reviewed countries demonstrate robust data transparency practices. Malaysia and Indonesia, for example, publish statistics on investor growth, asset volume, and compliance metrics. These data flows enable risk forecasting and trend detection in market misconduct. In contrast, Iran's enforcement data—such as insider trading complaints or audit trail deficiencies—are often published in disconnected reports or media disclosures, hindering longitudinal policy evaluation. Table 2 earlier demonstrated that 74% of insider

trading violations in Iran lacked digital audit trails, and over 21% growth in complaint volume occurred between 2022 and 2024.

Key Strategic Insights for Iran

Based on the comparative analysis, five actionable insights emerge for Iran's policy framework:

1. Legal Definition and Asset Classification: Introduce a legal taxonomy of crypto and tokenized assets aligned with international practices, under the Capital Markets Law.
2. Pilot Sandbox Program: Establish regulatory sandboxes involving the SEO, CBI, and CSDI for controlled blockchain pilots in securities issuance and disclosure automation.
3. Digital Oversight Infrastructure: Integrate smart contracts and blockchain-based disclosure tools into existing trading platforms, with real-time audit and surveillance modules.
4. Unified Licensing and Registry System: Create a cross-institutional licensing portal for blockchain financial service providers, following models like UAE VARA.
5. Transparent Statistical Reporting: Commit to structured and periodic publication of enforcement data, transaction audits, and compliance breaches in open formats.

Ultimately, Iran's ability to modernize its capital market through blockchain depends not merely on adopting technological tools, but on executing institutional reforms that enhance transparency, regulatory agility, and inter-organizational trust. The experiences of comparable emerging markets suggest that while blockchain itself is neutral, its governance design determines whether it becomes an enabler of market integrity or a new domain of risk.

Table 7. Cross-country comparison of blockchain initiatives in capital markets and key lessons applicable to Iran.

Country	Key Initiatives	Strengths	Challenges	Lessons for Iran
India	CBDC (Digital Rupee), regulatory sandboxes (SEBI + RBI), tokenized securities pilots	Strong inter-agency coordination, high retail adoption, CBDC success	Legal gaps for tokenized assets, fragmented regulation	Pilot sandboxes, legal reform for tokenized securities, CBDC exploration
Turkey	BiGA Digital Gold, Digital Lira pilot, crypto regulation under CMB/CBRT	Asset-backed tokenization, early CBDC testing, high crypto adoption	Legal ambiguity for DeFi, macroeconomic volatility	Start with low-risk tokenization (e.g., gold, sukuk), clarify legal frameworks

Malaysia	National Blockchain Roadmap, SC regulation for digital assets, strong banking readiness	Institutional adoption, investor demand, early regulation	Fragmented oversight, high adoption vs. weak enforcement	Align innovation with clear regulation, leverage banking sector readiness
Indonesia	BAPPEBTI regulations, planned CBDC (Digital Rupiah), Omnibus Law (OJK supervision), high retail adoption	Rapid adoption (16.5M investors), structural reform (OJK integration)	Legal ambiguity, weak cybersecurity, low compliance depth	Integrate crypto and capital market oversight, strengthen cybersecurity/legal certainty
UAE	Multi-regulator framework (VARA, SCA, FSRA, DFSA), CBDC (Digital Dirham), VARA Rulebook v2.0	Legal clarity, nationwide license recognition, real-time oversight, global VASP attraction	Complexity of multi-regulator governance, ongoing adaptation	Develop unified licensing, cross-agency coordination, real-time monitoring
Iran	Early digitalization efforts (SEO, CSDI reports), fragmented supervision, limited blockchain pilots	Institutional base exists, rising awareness, initial transparency measures (naming violators)	No legal taxonomy for digital assets, reliance on manual audits, insider trading cases rising	Adopt phased roadmap: sandbox → integration → full adoption; legal taxonomy + AI-enabled oversight

5. Practical Roadmap for Blockchain Adoption in Iran's Capital Market

5.1. Suggested Pilot Implementation Scenario

To operationalize the theoretical potential of blockchain in Iran's capital market, a structured and context-sensitive pilot program is proposed. This initiative aims to examine the technological, legal, and institutional feasibility of blockchain adoption through a controlled, small-scale deployment. Rather than attempting a full-scale transformation, the proposed pilot would focus on implementing blockchain in a confined and low-risk setting, thereby minimizing potential disruption while generating empirical insights.

The pilot should be conducted under the regulatory oversight of the Central Securities Depository of Iran (CSDI) and the Securities and Exchange Organization (SEO). These institutions are well-positioned to coordinate such a program due to their supervisory authority, access to market infrastructure, and strategic role in shaping regulatory policy. In addition, collaboration with selected financial institutions, brokerage firms, and academic research centers would

ensure that the pilot incorporates diverse technical, managerial, and evaluative perspectives.

The proposed scenario involves the tokenization of a low-volatility, fixed-income financial instrument, such as a government sukuk or a closed-end investment fund. This asset would be issued and traded on a permissioned blockchain network, accessible only to authorized participants including CSDI, SEO, selected brokers, and the issuing entity. All transactions would be processed through smart contracts designed to enforce rules related to settlement procedures, disclosure obligations, and ownership verification.

The main operational components of the pilot include the following:

- Network Design: Establishing a secure, permissioned blockchain infrastructure hosted by CSDI. This infrastructure would utilize existing data centers, supported by cryptographic protocols for access control and data integrity.
- Smart Contract Development: Implementing self-executing contracts that automate compliance with regulatory and operational rules, including transaction limits, transfer conditions, and audit logs.
- Asset Tokenization: Digitally issuing the selected financial instrument and making it available for trading within the sandbox environment. All trades would be recorded immutably, allowing full traceability of market activity.
- Regulatory Monitoring: Enabling SEO to observe transaction flows in real time through an integrated surveillance dashboard. Artificial intelligence tools could assist in identifying anomalous patterns, including timing irregularities, transaction clustering, or signs of information leakage.
- Evaluation and Reporting: Conducting periodic assessments of the pilot's technical performance, legal compatibility, user feedback, and compliance outcomes. These evaluations would be documented and presented in regular stakeholder meetings involving regulators, technology providers, and academic experts.

The broader objective of this pilot is to establish a foundation for incremental blockchain integration in Iran's capital market. Lessons learned from the pilot can inform regulatory reform, technical refinement, and institutional capacity-building. Moreover, this approach allows for risk-managed experimentation within a regulated framework, thereby fostering trust among market participants and policymakers. If the pilot achieves satisfactory outcomes, it could be gradually expanded to include additional asset classes, trading venues, or reporting functions. Each stage of expansion would build on the insights obtained

from prior phases, ensuring that growth is accompanied by appropriate safeguards and institutional adaptation. In sum, a carefully designed and closely monitored pilot implementation can serve as a critical first step in introducing blockchain technology to Iran's capital market. It provides a practical mechanism for testing assumptions, identifying obstacles, and demonstrating the value of digital infrastructure in enhancing transparency and reducing insider information risks.

5.2. Phased National Roadmap for Blockchain Integration in Iran

Implementing blockchain in Iran's capital market requires a phased strategy that takes into account institutional limitations, legal constraints, and the evolving technological landscape. A gradual, step-by-step roadmap not only mitigates implementation risks but also ensures the alignment of technical innovations with national policy objectives. This section proposes a three-phase roadmap designed to guide the transition from limited experimentation to broad-based adoption of blockchain infrastructure within the capital market.

Phase I: Experimental Deployment in Regulatory Sandboxes (Short-Term)

The initial phase focuses on the establishment of regulatory sandboxes, coordinated by the Securities and Exchange Organization (SEO), to support limited and controlled blockchain experimentation. These sandboxes would provide a supervised environment for financial institutions, fintech startups, and academic partners to test blockchain solutions without the burden of full regulatory compliance.

Key initiatives in this phase include:

- Development of sandbox guidelines and participant selection criteria
- Pilot programs involving the tokenization of government securities or investment fund units
- Legal assessments to identify gaps in existing financial regulations
- Capacity-building workshops for regulators and compliance officers

The primary objective at this stage is to generate empirical evidence regarding blockchain's impact on compliance automation, transaction transparency, and information disclosure quality.

Phase II: Institutional Integration and Legal Reform (Medium-Term)

Following successful experimentation, the second phase aims to integrate blockchain into selected institutional processes and update the legal framework accordingly. This stage involves transitioning from isolated pilots to regulated adoption within specific segments of the capital market.

Strategic priorities include:

- Adoption of blockchain-based reporting and disclosure platforms by listed companies
- Integration of smart contract systems in post-trade settlement and clearing mechanisms
- Revision of securities laws to recognize tokenized financial instruments and digital registries
- Establishment of technical standards for interoperability and data security

This phase requires strong coordination between financial regulators, the Central Bank of Iran, the judiciary, and relevant ministries to ensure that regulatory innovations are supported by appropriate legal foundations.

Phase III: Full-Scale Adoption and Cross-Market Integration (Long-Term)

The final phase envisions the comprehensive integration of blockchain technology across the capital market ecosystem. This includes the use of distributed ledger systems for securities issuance, investor onboarding, corporate actions, and inter-institutional information sharing.

At this stage, the following measures are recommended:

- Implementation of a national blockchain infrastructure for financial market supervision
- Full digitization of securities registries and shareholder records
- Cross-border coordination for blockchain interoperability with other emerging markets
- Integration of artificial intelligence tools for continuous compliance monitoring and fraud detection

By this phase, blockchain would become a foundational component of Iran's financial market infrastructure, enhancing transparency, reducing administrative costs, and strengthening investor confidence.

This phased roadmap provides a pragmatic and adaptable framework for introducing blockchain into Iran's capital market. By advancing from targeted experimentation to full institutionalization, the roadmap facilitates learning, reduces systemic risks, and ensures that technological adoption proceeds in alignment with national priorities and regulatory capacities.

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5.3. Institutional Recommendations for Effective Blockchain Adoption

The successful integration of blockchain technology into Iran's capital market requires more than technical readiness. It demands a cohesive institutional framework that fosters regulatory innovation, inter-agency collaboration, and a commitment to capacity-building across all stakeholder groups. This section outlines several policy and organizational recommendations aimed at supporting the phased adoption strategy introduced earlier.

1. Strengthening Inter-Institutional Coordination

Given the cross-cutting nature of blockchain applications, a multi-agency governance model is essential. Coordination between the Securities and Exchange Organization (SEO), the Central Securities Depository of Iran (CSDI), the Central Bank of Iran, and relevant financial ministries must be institutionalized through a formal steering committee or task force.

This coordinating body should be mandated to:

- Align blockchain initiatives with national financial modernization strategies

- Ensure interoperability across regulatory and technical systems

- Establish a roadmap for legal and procedural harmonization

2. Enhancing Regulatory Capacity and Digital Literacy

Effective oversight of blockchain-based systems requires regulators to acquire new competencies in digital infrastructure, cryptographic security, and data science. It is essential to design and implement targeted training programs for SEO and CSDI personnel, with the support of universities and technical institutes.

Suggested initiatives include:

- Certification programs in blockchain regulation and compliance analytics

- Technical exchanges with countries that have implemented similar systems

- Regular policy dialogues between regulators, academia, and the private sector

3. Encouraging Public–Private Partnerships (PPPs)

To accelerate innovation while managing risk, the involvement of private sector actors including fintech startups, IT firms, and market infrastructure providers should be institutionalized through structured partnerships.

These collaborations can:

- Facilitate rapid prototyping of blockchain tools

- Improve the cost-efficiency of implementation

- Ensure that regulatory requirements are incorporated into system design from the outset

Incentivizing such partnerships through grants, tax benefits, or recognition schemes could stimulate market participation and broaden the innovation ecosystem.

4. Establishing Evaluation Mechanisms and Feedback Loops

A continuous assessment framework is required to monitor the impact of blockchain adoption and ensure that implementation is aligned with strategic objectives. Such a framework should be evidence-based, inclusive of stakeholder feedback, and transparent in its reporting.

Proposed mechanisms include:

- Development of key performance indicators (KPIs) related to transparency, auditability, and compliance efficiency
- Regular publication of blockchain performance audits by SEO
- Stakeholder consultation forums at each phase of roadmap execution

By enacting these institutional recommendations in parallel with the technological roadmap, Iranian capital market authorities can ensure that blockchain implementation is both sustainable and context-appropriate. The transition to a more transparent, efficient, and trust-enhancing infrastructure will not be achieved solely through innovation, but through deliberate and coordinated institutional action

6. Conclusion

This narrative review explored the application of blockchain technology as a structural solution to persistent transparency deficits and insider trading challenges in Iran's capital market. Drawing on a combination of conceptual theories, international regulatory experiences, and domestic institutional realities, the study examined how blockchain's core attributes—immutability, decentralization, and traceability—can be strategically deployed to modernize oversight, automate compliance, and build investor trust in the Iranian financial ecosystem.

Evidence from global case studies indicates that jurisdictions with clear regulatory frameworks, pilot programs, and cross-agency coordination have achieved notable advances in transparency, fraud detection, and efficiency. Countries such as the UAE, India, and Malaysia have integrated blockchain into securities settlement, tokenized asset issuance, and real-time reporting infrastructures. However, these benefits are conditional upon robust legal safeguards, secure digital infrastructure, and a gradualist approach to adoption that considers institutional constraints.

In Iran, while initial steps toward financial digitalization have been taken—particularly by agencies such as the Securities and Exchange Organization (SEO) and Central Securities Depository of Iran (CSDI)—practical experimentation with blockchain in capital markets remains scarce. This review has underscored a pressing need for a localized integration strategy, tailored to Iran's specific legal, technological, and institutional context. In this regard, the proposed three-phase roadmap offers a practical framework: beginning with experimental pilots in regulatory sandboxes, proceeding to controlled integration with reporting mechanisms, and eventually enabling full-scale deployment across trading, auditing, and surveillance systems.

Moreover, the review highlights that blockchain's success in enhancing market transparency is contingent not only on its technical functionality but on institutional readiness. Regulatory coherence, alignment across oversight bodies, legal adaptation to decentralized processes, and digital literacy among regulators and market participants are pivotal enablers. The transformative potential of blockchain lies in its capacity to reshape institutional relationships, reduce information asymmetry, and embed accountability into the fabric of capital markets.

From a policy perspective, this study outlines actionable implications. For regulators, it provides a blueprint for updating supervisory frameworks and introducing adaptive compliance infrastructures. For market institutions, blockchain opens opportunities to streamline operations, reduce manual inefficiencies, and elevate governance standards. For academic stakeholders, this study identifies multiple research trajectories—ranging from empirical evaluations of pilot programs to behavioral analyses of market actors under heightened transparency conditions.

Finally, the comparative findings reinforce the value of learning from structurally similar economies. India's success with phased deployment of tokenized securities and central bank digital currencies, Turkey's asset tokenization initiatives, and Malaysia's institutional openness toward

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blockchain adoption collectively offer instructive pathways. These experiences suggest that a calibrated mix of global benchmarking and domestic adaptation is essential for effective implementation.

Like all narrative reviews, this study is subject to certain limitations. The analysis is based primarily on secondary sources, regulatory reports, and conceptual frameworks, and therefore does not provide field-based empirical testing or pilot implementation evidence. Future research could complement this review by conducting experimental blockchain trials in Iran's capital market and evaluating their impact on transparency, auditability, and insider trading risk. Such empirical validation would not only strengthen the theoretical claims of this article but also provide actionable insights for regulators and market participants.

In conclusion, the future of blockchain in Iran's capital market will not be defined solely by the availability of technical infrastructure, but by the strategic foresight, regulatory innovation, and institutional commitment to reform. With deliberate planning, cross-sector collaboration, and sustained policy experimentation, blockchain can evolve from a theoretical possibility into a cornerstone of Iran's next-generation financial market architecture.

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