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Research Paper Open Access

Protocol-Based Governance Architecture in Entrepreneurial Finance: How Tokenized Ownership Reconfigures the Governance-Liquidity Trade-off

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Abstract
This conceptual theory-building article develops Protocol-Based Governance Architecture (PBGA) to explain how tokenized ownership may reconfigure the governance-liquidity trade-off in entrepreneurial finance. Existing research largely treats tokenization as a financing innovation, a market-access mechanism, or a transaction-efficiency device; emerging work recognizes its infrastructural and governance implications but does not specify how entrepreneurial ownership, investor protection, and transferability interact at the mechanism level. Drawing on agency theory, liquidity theory, financial innovation, platform and blockchain governance, and institutional theory, PBGA is defined as a digitally mediated governance arrangement in which selected ownership, compliance, transfer, and coordination rules are distributed across technical, platform, legal, and relational layers. The framework identifies four mechanisms: ownership granularity, programmable enforcement, conditional liquidity, and digital reintermediation. Regulatory clarity operates as the central boundary condition linking encoded rules to enforceable rights and accountable intermediaries. By distinguishing technical transferability from economic liquidity and code execution from legal enforcement, the article explains why tokenization may reduce perceived illiquidity without eliminating governance constraints, market-thinness risk, or the need for human judgment. PBGA contributes to entrepreneurial finance by shifting analysis from digital instruments to governance design, to governance theory by locating authority partly in programmable infrastructure, and to liquidity theory by conceptualizing transferability as conditional and rule-bound.

Keywords: entrepreneurial finance; tokenized ownership; governance architecture; conditional liquidity; programmable enforcement; regulatory clarity.

1. Introduction

Entrepreneurial finance is shaped by a persistent tension between the need for governance and the desire for liquidity. New ventures and growth-oriented small and medium-sized enterprises (SMEs) typically operate under severe information asymmetry, high uncertainty, limited collateral, and thin secondary markets (Brown and Lee 2019; Howell 2020). Investors therefore rely on screening, concentrated ownership, staged financing, covenants, board rights, and active monitoring to reduce agency conflicts and protect their claims (Berger and Udell 1998; Gompers and Lerner 2001; Jensen and Meckling 1976; Kaplan and Strömberg 2003). These mechanisms make entrepreneurial ownership governable, yet they also make ownership less transferable. In early-stage capital markets, governance strength and ownership mobility are therefore often treated as opposing forces.

The governance-liquidity tension has direct economic consequences. Illiquid entrepreneurial equity requires investors to tolerate long holding periods, uncertain exit windows, limited price discovery, and costly secondary-market search. Liquidity theory suggests that investors demand compensation for holding assets that are costly to trade or difficult to exit (Amihud and Mendelson 1986; Pastor and Stambaugh 2003). In entrepreneurial finance, however, illiquidity is not only a market-depth problem. It is also embedded in governance design: the same contractual and relational mechanisms that protect investors frequently restrict transferability. Stronger governance can reinforce illiquidity, while greater transferability may appear to weaken governance discipline.

Digital financial infrastructures challenge the assumption that this tradeoff is structurally fixed. Tokenization, distributed ledgers, smart contracts, digital securities platforms, and programmable transfer systems can encode selected governance and compliance conditions into the infrastructure through which ownership is issued,

recorded, and transferred (Catalini and Gans 2020; Cong et al. 2021; Schär 2021). In such arrangements, transferability need not be unrestricted. Ownership can become more granular and potentially more mobile while remaining subject to embedded constraints, including investor eligibility, lock-up periods, voting rules, transfer approvals, compliance checks, and disclosure triggers. This suggests that governance and liquidity may be partly co-designed through technological architecture rather than balanced only through relational monitoring.

Recent policy discussions reinforce the theoretical importance of this issue. The Bank for International Settlements and Committee on Payments and Market Infrastructures describe tokenization as a change in financial-market infrastructure involving programmable platforms, asset representation, settlement processes, and platform-based intermediation (BIS and CPMI 2024). The International Organization of Securities Commissions' final report emphasizes programmability and fractionalization while warning about operational risk, legal characterization, and investor protection (IOSCO 2025). The IMF similarly frames tokenized finance as the representation of financial assets and liabilities on programmable ledgers, with implications for settlement, liquidity management, embedded compliance, and public trust (Adrian 2026). Together, these perspectives indicate that tokenization may alter how governance, compliance, transfer, settlement, and accountability are organized. At the organizational level, evidence from Jordanian banks indicates that digital financial technologies and business intelligence are associated with stronger digital entrepreneurship (Alsuwais et al. 2025), suggesting that infrastructure and firm-level capabilities interact.

Despite this relevance, entrepreneurial finance has not yet developed a mechanism-based explanation of tokenized ownership as governance design. Existing studies primarily examine transaction costs, crowdfunding, token sales, disclosure, investor participation, or capital-market efficiency (Block et al. 2018 2021; Bourveau et al. 2022; Bruton et al. 2015; Fisch 2019; Goldstein et al. 2019; Howell et al. 2020; Momtaz 2020). Research on blockchain and platform governance explains decentralized coordination and infrastructure-mediated decision rights (Beck et al. 2018; Chen et al. 2021; De Filippi and Loveluck 2016), while recent assetization research shows that tokenization remains embedded in incumbent legal and market infrastructures and may reproduce intermediation (Proskurovska and Birch 2025). What remains underdeveloped is a framework that specifies how programmable rules, platform coordination, legal enforceability, and relational oversight jointly reconfigure the governance-liquidity trade-off for entrepreneurial ownership claims.

The central theoretical question is therefore not whether tokenization creates liquidity. It is: under what governance conditions can programmable ownership make transferability more credible without eroding investor protection in entrepreneurial finance? If transfer is organized as a rule-bound process within a technical-platform-legal architecture, liquidity becomes partly a governance-design outcome. Answering this question requires a framework that separates technical transferability from economic liquidity and code-based execution from legal and relational enforcement.

This article addresses that gap by introducing Protocol-Based Governance Architecture (PBGA), defined as a digitally mediated arrangement in which selected ownership, compliance, transfer, and coordination rules are embedded in programmable infrastructure and enacted through the interaction of protocols, platforms, legal institutions, and relational actors. PBGA does not imply that technology eliminates agency problems, creates market depth, or replaces law and judgment. It explains how governance authority and monitoring tasks are redistributed across technical, intermediary, and institutional-relational layers.

The article develops six propositions. The first four specify the effects and limits of ownership granularity, programmable enforcement, conditional liquidity, and digital reintermediation. The fifth theorizes regulatory clarity as a boundary condition that strengthens the credibility of PBGA, while the sixth identifies the specific channel through which regulatory uncertainty weakens the perceived liquidity benefit and increases required returns. The four mechanisms are complementary: granularity without coordination can fragment control; transferability without enforceable rules can create only symbolic liquidity; and automation without accountable intermediaries cannot resolve non-codifiable disputes.

The contribution is threefold. First, the article contributes to entrepreneurial finance by shifting attention from tokenization as a funding channel to the architecture that governs ownership claims. Second, it contributes to governance theory by identifying programmable infrastructure as a partial and distributed locus of authority rather than a substitute for contracts, institutions, or human oversight. Third, it extends liquidity theory by distinguishing technical transferability from conditional liquidity: an ownership claim may be easier to transfer operationally while remaining economically illiquid because of thin demand, weak price discovery, or legal uncertainty.

The novelty of PBGA therefore lies not in asserting that tokenization has governance consequences, but in specifying the mechanisms, complementarities, and boundary condition through which those consequences affect the governance-liquidity trade-off in entrepreneurial finance. This mechanism-based positioning differentiates PBGA from general tokenization, platform-governance, blockchain-governance, and assetization perspectives.

The remainder of the paper is structured as follows. Section 2 explains the conceptual methodology and theory-building process. Section 3 reviews and positions the relevant literature. Section 4 develops the PBGA framework and propositions. Section 5 integrates the mechanisms and explains the conceptual model. Section 6 discusses boundary conditions, failure risks, and limitations. Sections 7, 8, and 9 present theoretical contributions, practical and policy implications, and future research directions, followed by the conclusion.

2. Conceptual methodology and theory development

2.1 Theory-building orientation

This article follows a conceptual theory-building approach. Its objective is not to test a statistical relationship but to develop an explanatory framework that integrates fragmented literatures, clarifies construct boundaries, and generates propositions for future empirical research. Conceptual theory-building is appropriate when an emerging phenomenon is theoretically important, empirically visible, and not adequately explained by existing constructs (Jaakkola 2020; Shepherd and Suddaby 2017; Whetten 1989). Tokenized ownership in entrepreneurial finance meets these conditions because it combines elements of private equity governance, platform-mediated coordination, digital innovation processes, programmable compliance, and secondary-market transferability (Nambisan et al. 2017).

The article adopts a theory-synthesis and problematization logic. Theory synthesis is used because the phenomenon sits across multiple domains that are rarely integrated: entrepreneurial finance, liquidity theory, financial innovation, blockchain governance, platform governance, and institutional regulation. Problematization is used because the article questions a taken-for-granted assumption in entrepreneurial finance: that governance protection and ownership transferability are necessarily opposing design objectives (Alvesson and Sandberg 2011; MacInnis 2011).

2.2 Literature identification and analytical selection

The literature base was selected conceptually rather than through a bibliometric or systematic-review protocol. Sources were retained when they served at least one of three analytical purposes: explaining the governance-liquidity puzzle, differentiating PBGA from adjacent constructs, or specifying a mechanism, boundary condition, or failure risk. Agency and venture-contracting studies explain monitoring, staged financing, and concentrated control (Gompers and Lerner 2001; Kaplan and Strömberg 2003). Liquidity research explains how restricted transferability affects valuation and required returns (Amihud and Mendelson 1986; Pastor and Stambaugh 2003). Financial-innovation and entrepreneurial-finance research positions tokenization within broader changes in capital formation and market design (Chemmanur and Fulghieri 2014; Goldstein et al. 2019; Gomber et al. 2018; Tufano 2003).

Blockchain and platform-governance research was used to specify how digital infrastructures allocate decision rights, accountability, and coordination roles (Babich and Hilary 2020; Beck et al. 2018; Chen et al. 2021; Yermack 2017). Institutional, regulatory, and assetization sources were used to identify the conditions under which programmable claims become credible financial rights and to guard against technologically deterministic claims (Arner et al. 2017; BIS and CPMI 2024; Cumming et al. 2019; FSB 2024; Hinings et al. 2018; IOSCO 2025; North 1990; OECD 2020; Proskurovska and Birch 2025; Zetzsche et al. 2018). The analysis is concept-centric: evidence is organized around constructs and mechanisms rather than a sequence of authors (Webster and Watson 2002). This selection logic makes the synthesis transparent while remaining appropriate for a theory-building article rather than a systematic review.

2.3 Construct development and proposition logic

Construct development proceeded in four steps. First, the article identified the core puzzle: entrepreneurial ownership requires governance safeguards, yet those safeguards often restrict transferability. Second, it examined which governance functions can be codified and relocated into programmable infrastructure and which remain dependent on legal or relational judgment. Third, it distinguished PBGA from tokenization, blockchain governance, platform governance, and assetization by defining three interacting layers: a technical layer of protocols and executable rules; an intermediary layer of platforms, custodians, compliance providers, and data services; and an institutional-relational layer of law, contracts, dispute resolution, and human oversight. Fourth, it derived four mechanisms and regulatory clarity as the central boundary condition.

The propositions specify directional relationships and limiting conditions rather than assuming universal benefits from tokenization. They explain what changes, through which mechanism, and under what conditions. The logic is configurational: the mechanisms can operate separately, but a credible PBGA requires their complementarity. Ownership granularity can expand participation only when coordination rights are credible; programmable enforcement can reduce costs only for codifiable tasks; and conditional transferability can reduce perceived

illiquidity only when legal enforceability, accountable intermediation, and market demand are sufficient (Whetten 1989).

3. Literature review and theoretical positioning

3.1 Relational governance and liquidity constraints in entrepreneurial finance

Entrepreneurial finance has traditionally relied on relational governance. Venture capitalists, angel investors, crowdfunding platforms, and other intermediaries mitigate agency conflicts through screening, staged investment, board participation, covenants, syndication, reputation, and active monitoring (Berger and Udell 1998; Block et al. 2018; Gompers and Lerner 2001; Vismara 2016). These arrangements are especially important because early-stage ventures lack long operating histories, stable cash flows, and transparent market prices. Governance therefore substitutes for incomplete information and incomplete contracts. Recent evidence from Jordanian SMEs further shows that internal managerial and governance-related capabilities are associated with financing outcomes and financing credibility (Alrefai et al. 2026).

Relational governance is closely tied to illiquidity. Concentrated ownership makes monitoring more effective, but it restricts exit opportunities and limits secondary trading. Staged financing protects investors, but it reduces the flexibility of ownership transfer. Contractual controls reduce opportunism, but they increase complexity and constrain marketability. Liquidity is therefore not simply absent because no market exists; it is constrained because governance is built around restricted ownership mobility. This insight is central to PBGA: if governance and liquidity are linked through architecture, then technological changes that alter ownership architecture may also alter the governance-liquidity relationship.

3.2 Tokenization, programmable infrastructure, and digital intermediation

Tokenization is the digital representation of ownership, claims, or financial assets on distributed-ledger or related programmable infrastructure. In financial markets it is associated with fractional ownership, faster settlement, automated compliance, collateral mobility, and reduced reconciliation frictions (Adrian 2026; BIS and CPMI 2024; OECD 2020). These affordances matter for entrepreneurial finance because startups and SMEs often face high capital costs, limited investor reach, and ownership structures for which secondary transfer is costly or unavailable.

Tokenization should not, however, be reduced to efficiency. Its deeper theoretical significance is that it can relocate selected governance functions. Investor-eligibility screens, transfer restrictions, cap-table updates, voting processes, lock-up conditions, disclosure triggers, and compliance logs can be embedded in protocols and platform systems. Blockchain-enabled arrangements thus operate not only as technologies but also as institutional mechanisms of coordination (Davidson et al. 2018; Williamson 1985). At the same time, assetization research cautions that tokenized claims remain socio-legal constructs whose operation depends on incumbent infrastructures and regulatory authority (Proskurovska and Birch 2025). Related evidence from FinTech-oriented digital ecosystems indicates that digital entrepreneurship helps translate AI capabilities into financial innovation (Awawdeh et al. 2026), reinforcing the broader point that technological capabilities require complementary organizational mechanisms.

Digital infrastructures also complicate claims of disintermediation. Tokenized-asset arrangements commonly rely on issuance platforms, custodians, compliance providers, oracle services, wallet infrastructure, regulated exchanges, and alternative trading systems. Intermediation therefore changes form rather than disappearing. PBGA builds on this insight but focuses specifically on how the redistribution of governance functions affects entrepreneurial ownership, investor protection, and conditional liquidity.

3.3 Institutional conditions and regulatory clarity

Programmable governance depends on institutional legitimacy. A protocol may automatically execute a transfer restriction, but investor protection ultimately depends on legal enforceability, recognized ownership rights, dispute-resolution mechanisms, and regulatory supervision. When regulatory rules are clear, programmable mechanisms can support confidence by making compliance more predictable and governance more transparent. When rules are ambiguous, the same mechanisms can amplify uncertainty because investors may not know whether a token represents enforceable ownership, a contractual claim, or a technologically recorded but legally fragile entitlement. Recent regulatory discussions emphasize this institutional dependence. IOSCO (2025) identifies opportunities related to programmability and fractionalization while also highlighting technology, cyber, settlement, legal-characterization, and investor-protection risks; regulatory scholarship likewise shows that crypto-asset markets depend on credible rules for managing uncertainty (Cumming et al. 2019). The Financial Stability Board (FSB 2024) notes that tokenization remains small in scale and warns that operational fragilities, interconnectedness, and

traditional financial vulnerabilities may intensify as adoption grows. These perspectives support the PBGA argument that programmable governance cannot be separated from institutional alignment or market conditions.

3.4 Positioning PBGA within existing governance perspectives

PBGA is positioned at the intersection of relational governance, platform governance, blockchain governance, and tokenization and assetization research. Relational governance explains monitoring and control but generally treats illiquidity as a structural feature. Platform governance explains digital coordination but not necessarily the embedding of ownership-transfer logic. Blockchain governance explains protocol rules and distributed accountability, yet often focuses on networks or decentralized communities rather than entrepreneurial claims. Tokenization and assetization research explains fractionalization, market access, and the socio-legal construction of digital claims, but does not provide a mechanism-based account of how governance protection and conditional liquidity are co-designed in entrepreneurial finance.

PBGA addresses these limitations by specifying where governance functions are located, which functions are codifiable, how transferability remains conditional, and why legal enforceability and accountable intermediation determine whether tokenized ownership produces credible rather than symbolic liquidity. Table 1 summarizes these distinctions.

Table 1 Positioning PBGA in relation to existing governance perspectives

Perspective	Core logic	Role of technology	Governance implication	Limitation addressed by PBGA
Relational governance	Monitoring, contracts, staged financing, concentrated ownership	Supportive or secondary	Governance depends on investors, contracts, and intermediaries	Treats liquidity constraints as largely fixed by relational control
Platform governance	Coordination through platform rules and participation structures	Digital coordination infrastructure	Platforms organize access, participation, and rule-setting	Does not fully explain embedded enforcement and ownership-transfer logic
Blockchain governance	Distributed records, protocol rules, decision rights, accountability	Distributed technological infrastructure	Rules may be encoded and executed through protocols	Often focuses on decentralization or DAOs rather than entrepreneurial finance governance
Tokenization and assetization	Fractional ownership, digital transferability, market access, and socio-legal asset construction	Market, settlement, and asset-construction infrastructure	Broadens participation but remains embedded in incumbent legal and market arrangements	Does not specify the mechanism-level co-design of entrepreneurial governance and conditional liquidity
PBGA	Programmable governance architecture	Core governance infrastructure	Authority is redistributed across protocols, platforms, legal institutions, and actors	Explains how governance and liquidity can be conditionally co-designed

4. Protocol-based governance architecture framework

4.1 Definition and conceptual boundaries

Protocol-Based Governance Architecture is a digitally mediated arrangement in which selected ownership, compliance, transfer, and coordination rules are embedded in programmable infrastructure and enacted through the interaction of protocols, platforms, legal institutions, and relational actors. Architecture refers to the allocation

and connection of governance functions across three layers: technical execution, intermediary coordination, and institutional-relational enforcement. PBGA is therefore a governance configuration, not a single technology, token, or platform.

PBGA has three conceptual boundaries. First, it is not blockchain governance, which concerns the governance of a blockchain network, including consensus, protocol changes, incentives, and accountability. PBGA concerns the governance of entrepreneurial ownership claims. Second, it is not platform governance, although platforms form its intermediary layer; PBGA specifically addresses ownership, compliance, transfer, and enforcement rules. Third, it is not synonymous with tokenization or assetization. Tokenization creates a digital representation of a claim, and assetization explains how claims are socio-technically constructed; PBGA explains the governance configuration through which a tokenized entrepreneurial claim becomes credible, transferable under conditions, and institutionally enforceable.

4.2 Mechanism 1: Ownership granularity and capital accessibility

The first mechanism is ownership granularity. Tokenized or digitally programmable ownership can divide entrepreneurial equity or claims into smaller, modular units. This may lower minimum investment thresholds, expand investor participation, and create more flexible ownership structures. In entrepreneurial finance, granularity matters because capital access is constrained not only by investor risk appetite but also by the indivisibility and illiquidity of private ownership claims.

Granularity does not automatically improve governance. Fragmented ownership can increase collective-action problems, weaken investor monitoring, and create coordination costs. PBGA addresses this risk by linking granularity with embedded governance rules. Fractionalized ownership becomes theoretically important when it is combined with voting structures, investor eligibility controls, transfer restrictions, information rights, and platform-based coordination. Under PBGA, ownership granularity expands participation only when programmable rules preserve selected governance constraints.

Proposition 1. Ownership granularity is positively associated with entrepreneurial capital accessibility, and this relationship is stronger when embedded coordination, investor-eligibility, and governance-rights mechanisms are credible.

4.3 Mechanism 2: Programmable enforcement and monitoring reallocation

The second mechanism is programmable enforcement. Traditional entrepreneurial finance relies heavily on discretionary monitoring by investors and intermediaries. PBGA does not eliminate such monitoring, but it can reallocate codifiable enforcement functions to programmable rules. Transfer limits, eligibility conditions, compliance checks, cap-table updates, voting processes, and disclosure triggers can be executed or supported by protocols and platform systems.

This reallocation changes the economics of governance. When rules are embedded into infrastructure, enforcement may become more consistent and less dependent on repeated manual verification. Coordination costs may decline because selected governance actions are executed automatically or semi-automatically. However, programmable enforcement is not a substitute for judgment. It is most effective for codifiable governance conditions. Non-codifiable problems, such as strategic advice, managerial competence, relational trust, negotiation, and conflict resolution, continue to require human and institutional governance.

Proposition 2. Programmable enforcement reduces coordination costs for codifiable governance tasks, but the cost advantage diminishes as the required level of discretion, judgment, or dispute resolution increases.

4.4 Mechanism 3: Conditional liquidity reconfiguration

The third mechanism is conditional liquidity. In traditional entrepreneurial finance, liquidity is limited because ownership transfer may weaken governance, disrupt investor alignment, or violate contractual restrictions. PBGA reframes liquidity as rule-bound transferability. Ownership can become more mobile only under predefined conditions, such as investor accreditation, holding periods, compliance approvals, information disclosure, platform verification, or transfer windows.

This distinction is central. PBGA does not claim that tokenization creates unrestricted liquidity for entrepreneurial equity. Rather, it explains how liquidity can be reconfigured by embedding governance constraints into transfer mechanisms. Investors may perceive lower illiquidity risk because exit pathways become more visible and operationally feasible, while founders and existing investors may tolerate greater transferability because governance safeguards remain encoded. Liquidity is therefore not the opposite of governance; it becomes an outcome of governance design.

Proposition 3. Transparent and legally enforceable transfer rules reduce perceived illiquidity in tokenized entrepreneurial ownership, even when they do not create market depth or realized trading liquidity.

4.5 Mechanism 4: Digital re-intermediation and governance redistribution

The fourth mechanism is digital re-intermediation. Tokenization narratives often emphasize disintermediation, but practical tokenized-asset arrangements frequently rely on new intermediaries. Platforms may manage issuance, investor onboarding, compliance verification, custody interfaces, voting, disclosure, secondary transfer, and ownership records. Oracle services may provide data inputs. Regulated exchanges or alternative trading systems may facilitate secondary markets. Legal advisors and compliance providers may validate the enforceability of rights. PBGA conceptualizes these developments as governance redistribution. Authority shifts from a purely relational structure toward a hybrid architecture in which protocols execute rules, platforms coordinate participation, legal systems validate rights, and investors continue to exercise oversight. This redistribution is neither fully decentralized nor fully centralized. The key theoretical issue is not whether intermediaries disappear, but how their governance roles are redesigned.

Proposition 4. The more issuance, compliance, custody, voting, recordkeeping, and transfer functions migrate into digital infrastructure, the more governance authority shifts toward platform-based and protocol-enabled intermediaries.

4.6 Boundary condition: Regulatory clarity

Regulatory clarity is the central institutional boundary condition of PBGA. Programmable governance is credible only when tokenized claims have clear legal status, investor rights are enforceable, and compliance obligations are transparent. If a token represents equity, debt, revenue participation, or another contractual claim, investors must understand what legal rights they hold and how these rights can be enforced. Without this clarity, programmable rules may create the appearance of governance while leaving investors exposed to legal ambiguity.

Regulatory clarity strengthens PBGA in three ways. First, it legitimizes programmable transfer restrictions and compliance procedures. Second, it improves investor confidence by reducing uncertainty over ownership rights and dispute resolution. Third, it supports platform accountability by defining responsibilities for issuers, custodians, intermediaries, and market operators. Conversely, regulatory uncertainty increases governance risk, raises required returns, and may offset the liquidity benefits associated with tokenized ownership.

Proposition 5. Regulatory clarity positively moderates the relationship between PBGA design quality and investor confidence by linking programmable rules to enforceable claims, accountable intermediaries, and credible dispute resolution.

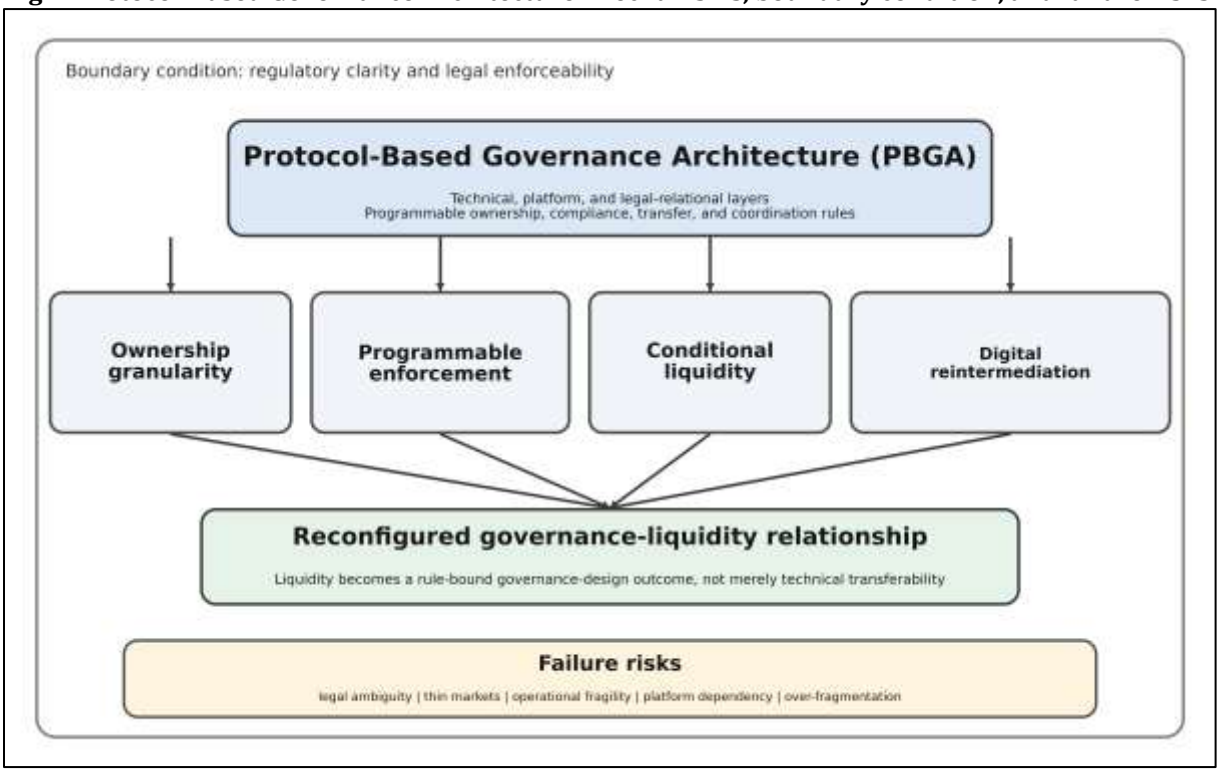
Proposition 6. Regulatory uncertainty weakens the extent to which conditional transferability reduces perceived illiquidity and consequently increases investors' required returns on tokenized entrepreneurial claims.

5. Conceptual integration and propositions

PBGA integrates four complementary mechanisms under one institutional boundary condition. Ownership granularity expands the potential investor base but also fragments monitoring incentives. Programmable enforcement stabilizes codifiable rights and restrictions at lower coordination cost. Conditional liquidity creates visible, rule-bound exit pathways without assuming continuous trading or deep demand. Digital reintermediation supplies onboarding, custody, verification, disclosure, and residual coordination. Regulatory clarity determines whether the actions performed across these layers map onto legally recognized rights and accountable governance roles.

Figure 1 presents this configurational logic. PBGA is not a linear technology-adoption model: the technical, platform, and legal-relational layers jointly enable the four mechanisms. Their combined outcome is a reconfigured governance-liquidity relationship in which transferability is conditional on governance design. The outer boundary represents regulatory clarity and legal enforceability, while the lower panel identifies risks that can interrupt the mechanism-to-outcome links.

Fig. 1 Protocol-Based Governance Architecture: mechanisms, boundary condition, and failure risks



PBGA should therefore be evaluated at the level of governance-design quality rather than technological adoption alone. A tokenized claim without enforceable rights, transparent transfer rules, credible investor coordination, and accountable intermediaries is a weak instance of PBGA and may offer only technical or symbolic transferability. A strong PBGA configuration combines executable rules with institutional enforceability, market-supporting intermediation, and relational oversight.

Table 2 Core mechanisms and theoretical roles of PBGA

PBGA mechanism	Governance function	Liquidity implication	Main risk	Theoretical role
Ownership granularity	Modularizes ownership and expands participation	May broaden investor base and enable smaller positions	Fragmented ownership and weak collective action	Connects entrepreneurial finance with digital asset modularity
Programmable enforcement	Embeds codifiable governance rules in protocols or platforms	Supports transfer without abandoning selected controls	Code errors, rigidity, incomplete codification	Extends governance theory beyond relational monitoring
Conditional liquidity	Makes transferability subject to embedded rules	Reduces perceived illiquidity while preserving constraints	Thin markets and uncertain price discovery	Extends liquidity theory through rule-bound transferability
Digital re-intermediation	Redistributes coordination to platforms and digital service providers	Creates new venues and processes for ownership mobility	Platform dependency and operational risk	Extends financial innovation theory beyond disintermediation

PBGA mechanism	Governance function	Liquidity implication	Main risk	Theoretical role
Regulatory clarity	Defines enforceability and accountability	Supports confidence in tokenized rights and transfer rules	Jurisdictional ambiguity and inconsistent supervision	Integrates institutional theory into programmable governance

6. Boundary conditions, failure risks, and limitations

A balanced theory of PBGA must explain when the architecture fails. The first failure condition is legal ambiguity. If investors cannot determine whether a tokenized claim represents enforceable equity, debt, revenue participation, or another contractual entitlement, programmable rules can create technological form without legal substance. Any apparent liquidity is then fragile because the rights being transferred remain uncertain.

The second failure condition is thin secondary markets. Tokenization can make ownership technically transferable, but it cannot by itself generate demand, market depth, reliable price discovery, or executable exit opportunities. A claim may therefore trade on a platform in principle while remaining economically illiquid. This distinction is especially important for firm-specific entrepreneurial claims with sparse disclosure and heterogeneous valuation.

The third failure condition is technological and operational fragility (Basel Committee on Banking Supervision 2024; FSB 2024). Smart-contract errors, cybersecurity breaches, oracle failures, custody problems, and platform downtime can undermine the safeguards that PBGA is intended to strengthen. Programmable enforcement can also become rigid when encoded rules cannot accommodate exceptional circumstances or negotiated responses.

The fourth failure condition is platform dependency. Digital reintermediation can improve coordination, but it can also concentrate power in platform operators, compliance providers, custodians, or data-input providers. An operator that controls onboarding, disclosure, voting, transfer approval, and custody interfaces becomes a governance actor with its own incentives, operational risks, and accountability problems.

The fifth failure condition is over-fragmentation. Ownership granularity may broaden access, but excessive fragmentation can weaken voice, dilute monitoring incentives, and create collective-action costs. The framework is also subject to three scope limitations. It applies to tokenized entrepreneurial ownership and investment claims rather than utility tokens or the internal governance of public blockchains; it theorizes perceived and conditional liquidity rather than guaranteeing realized trading liquidity; and it does not estimate the net welfare effects of PBGA across ventures, investors, platforms, and jurisdictions. These limits define a focused domain for empirical testing rather than a universal theory of tokenization.

7. Theoretical contributions

7.1 Contribution to entrepreneurial finance

PBGA contributes to entrepreneurial finance by moving the unit of analysis from a digital funding instrument to the governance configuration of an entrepreneurial ownership claim. Existing work explains who supplies capital and through which channel; PBGA explains how ownership rights, transfer restrictions, monitoring functions, and platform responsibilities are organized when claims become programmable.

This shift matters because access and governance are inseparable. Lower investment thresholds may broaden participation while simultaneously diluting monitoring and voice. PBGA specifies the complementary safeguards required for ownership granularity to improve capital accessibility without converting wider participation into weaker governance.

7.2 Contribution to governance theory

PBGA contributes to governance theory by adding programmable infrastructure as a partial locus of authority. Selected governance functions can be executed through protocols and platforms, but their design, amendment, interpretation, and enforcement remain distributed across technical actors, intermediaries, legal institutions, investors, and entrepreneurs. Governance is therefore infrastructural and hybrid, not autonomous.

The framework also clarifies the boundary between codifiable and non-codifiable governance. Protocols can execute eligibility, transfer, voting, and disclosure rules; they cannot independently supply strategic judgment, relational trust, managerial advice, or legitimate dispute resolution. This boundary prevents the theory from equating automation with governance completeness.

7.3 Contribution to liquidity theory

PBGA extends liquidity theory by separating technical transferability, perceived illiquidity, and realized market liquidity. A programmable claim may be operationally transferable and offer a clearer exit path, thereby reducing perceived illiquidity, while still trading infrequently because demand and price discovery remain weak. Conditional liquidity captures this intermediate state.

The governance-liquidity trade-off is therefore reconfigured rather than eliminated. Embedded restrictions can make selected transfers acceptable without abandoning investor protection, but they cannot create counterparties or fundamental value. Liquidity becomes partly a rule-design outcome and partly a market outcome.

7.4 Contribution to financial innovation and institutional theory

PBGA contributes to financial-innovation theory by replacing a simple disintermediation narrative with governance redistribution. As issuance, compliance, custody, disclosure, and transfer become digitally coordinated, intermediary roles migrate toward platforms and specialized service providers. The framework makes this redistribution measurable through the location and concentration of governance functions.

It contributes to institutional theory by treating regulatory clarity as an active boundary condition. Programmable enforcement creates value only when encoded actions correspond to recognized rights, duties, and remedies. PBGA is therefore an institutional theory of programmable entrepreneurial governance rather than a technology-deterministic account of tokenization.

8. Practical, policy, and managerial implications

The PBGA framework has implications for entrepreneurs, investors, digital platforms, and policymakers. For entrepreneurs, programmable ownership may provide more flexible capital-raising structures. Tokenized ownership can potentially reach a broader investor base, lower investment thresholds, and support more modular capital formation. However, entrepreneurs must recognize that governance design becomes more complex. Poorly designed protocols, unclear rights, weak disclosure, or unreliable platform infrastructure may increase perceived risk rather than reduce financing constraints. Evidence from Jordanian banks also links digital entrepreneurship, when combined with digital marketing capabilities, to sustainable financial growth (Awawdeh et al. 2025).

For investors, PBGA offers a more structured way to evaluate tokenized entrepreneurial opportunities. Investors should examine not only the potential liquidity of a token but also the governance architecture supporting it. Key questions include whether ownership rights are legally recognized, whether transfer restrictions are enforceable, whether compliance procedures are transparent, whether voting and information rights are clear, whether the platform has credible operational safeguards, and whether dispute-resolution arrangements are available. A token that is technically transferable but legally ambiguous may not reduce risk.

For digital platforms, PBGA implies expanded governance responsibility. Platforms that issue, list, custody, or coordinate tokenized entrepreneurial claims become governance actors. Their responsibilities may include onboarding, investor verification, compliance monitoring, record maintenance, disclosure infrastructure, voting administration, and transfer oversight. These functions create opportunities for innovation but also expose platforms to accountability, cybersecurity, operational, and regulatory risks.

For policymakers, the framework highlights the importance of regulatory clarity. Innovation-friendly regulation should not simply permit tokenization; it should define the legal status of tokenized claims, specify investor protections, clarify intermediary obligations, and ensure that programmable rules are consistent with enforceable rights. Without such clarity, tokenization may create the appearance of liquidity and transparency while increasing legal uncertainty.

9. Future research directions

PBGA provides a structured agenda for empirical research. Proposition 1 can be tested using issuer and platform records on minimum investment size, investor composition, and voting concentration. Propositions 2 and 4 lend themselves to process tracing, smart-contract audits, and comparative platform case studies. Proposition 3 can be tested through investor experiments or surveys that independently manipulate transfer-rule transparency, legal enforceability, and expected market depth. Propositions 5 and 6 invite cross-jurisdictional comparisons and event studies of regulatory clarification.

Research should distinguish strong PBGA configurations from symbolic tokenization. Strong configurations combine transparent rights, codifiable governance rules, enforceable transfer restrictions, accountable intermediaries, and credible dispute resolution. Symbolic tokenization digitizes a claim without changing the quality of its governance or the credibility of its exit pathway. Table 3 translates each proposition into observable constructs, indicators, and expected patterns.

Table 3 Empirical operationalization of PBGA propositions

Proposition	Construct	Possible indicators	Potential data source or method	Expected empirical pattern
P1	Ownership granularity and capital accessibility	Minimum investment size; number of investors; investor diversity; fractional ownership structure	Platform archives; issuer records; comparative cases	Capital accessibility rises with granularity when coordination and investor-rights mechanisms are credible
P2	Programmable enforcement	Automated eligibility checks; transfer restrictions; voting execution; compliance triggers; cap-table updates	Platform data; smart-contract audits; expert interviews	Coordination costs fall for codifiable tasks; gains diminish as task discretion rises
P3	Conditional liquidity	Transfer windows; lock-up rules; bid-ask spreads; exit expectations; secondary-market activity	Investor survey; experiment; market data	Enforceable transfer rules reduce perceived illiquidity, not necessarily realized market illiquidity
P4	Digital re-intermediation	Platform roles in issuance, custody, compliance, voting, recordkeeping, and secondary transfer	Process tracing; platform case studies; policy analysis	Governance authority shifts toward digital intermediaries as more functions migrate into infrastructure
P5	Regulatory clarity	Legal classification; licensing rules; enforceability of investor rights; disclosure obligations	Cross-country comparison; legal analysis; investor survey	Regulatory clarity strengthens the association between PBGA design quality and investor confidence
P6	Regulatory uncertainty	Ambiguous claim status; unresolved custody rules; unclear dispute resolution; inconsistent supervision	Policy analysis; event studies; interviews	Regulatory uncertainty weakens perceived liquidity benefits and increases required returns

Additional research should examine technological reliability, cybersecurity, platform concentration, smart-contract amendment, interoperability, jurisdictional conflict, and the endogenous development of secondary-market demand. Failed or stalled tokenization projects are especially valuable because they can reveal which missing layer or mechanism prevents technical transferability from becoming credible conditional liquidity.

Emerging economies are a particularly important empirical setting. Startups and SMEs often face acute capital-access constraints, limited private secondary markets, and uneven legal and supervisory capacity. Comparative research can therefore test whether PBGA broadens inclusion only above minimum thresholds of legal enforceability, investor protection, platform accountability, and market infrastructure.

10. Conclusion

This article developed Protocol-Based Governance Architecture to explain how tokenized ownership may reconfigure the governance-liquidity trade-off in entrepreneurial finance. The central claim is not that tokenization automatically creates liquidity. It is that programmable ownership can make transferability conditional on embedded governance rules and thereby alter how investor protection, ownership mobility, and intermediary responsibility are combined.

PBGA identifies four complementary mechanisms. Ownership granularity modularizes participation but can fragment control. Programmable enforcement reallocates codifiable tasks but cannot replace judgment. Conditional liquidity reduces perceived illiquidity when transfer rules are transparent and enforceable, but it does not guarantee market depth. Digital reintermediation redistributes authority toward platforms and specialized service providers. Regulatory clarity conditions whether these mechanisms create credible rights and accountable governance.

By separating code execution from legal enforcement and technical transferability from realized liquidity, PBGA provides a bounded and testable theory of tokenized entrepreneurial ownership. Its value lies in specifying when programmable infrastructure can complement contracts, institutions, intermediaries, and human oversight; when those complements are absent, tokenization remains only a digital representation of an illiquid and weakly governed claim.

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