



Liquidity Disruption under CBDC Implementation: An Asymmetric Analysis of Stability in Dual Banking Systems

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Abstract:

This study aims to analyze the asymmetric impact of Central Bank Digital Currency (CBDC) implementation on liquidity stability within a dual banking system. CBDC introduces changes to payment systems, accelerating the reallocation of deposits from commercial banks to sovereign digital currency. The magnitude of liquidity disruption differs between conventional and Islamic banking systems due to institutional and contractual differences. This study employs a qualitative exploratory comparative case study design in Probolinggo, Indonesia. Data were collected through semi-structured interviews with regulators, officials, and Islamic experts and analyzed using thematic analysis in NVivo. CBDC drives deposit reallocation through informational asymmetry among efficiency-seeking SMEs in rural areas. This creates a liquidity outflow channel from banking institutions. Conventional banks demonstrate stronger liquidity resilience through interest rate flexibility and pricing adjustments. Islamic banks exhibit delayed stabilization due to contractual constraints in profit-sharing and limited liquidity instruments. A socio-religious buffer in Tapal Kuda mitigates deposit flight through trust in Islamic authority and pesantren networks. Proposes a multi-layered, asymmetric liquidity framework integrating economic, institutional, and socio-religious dimensions for the CBDC literature. Regional heterogeneity and dual banking structures in the design of CBDC implementation strategies.

INTRODUCTION

Central Bank Digital Currency (CBDC) represents a fundamental transformation in modern monetary architecture by redefining sovereign money circulation within a digital financial ecosystem. Its societal relevance emerges from its potential to improve payment efficiency, reduce transaction barriers, and promote financial inclusion, particularly in emerging economies with unequal banking access. However, CBDC also raises systemic concerns related to banking intermediation and liquidity stability because households and firms may transfer deposits from commercial banks to central bank liabilities. This structural transition has been identified as a potential driver of financial fragility and flight-

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to-quality behavior in digital monetary systems (Infante et al., 2024; Wronka, 2023; Fernández-Villaverde et al., 2020; Sarkisyan, 2022). Therefore, CBDC should be understood not only as a payment innovation but also as a macro-financial instrument capable of reshaping liquidity allocation and banking stability.

Recent literature indicates that CBDC may create deposit displacement effects and increase banking vulnerability depending on its design characteristics. Theoretical portfolio models demonstrate that CBDC strengthens substitutability between bank deposits and sovereign digital money, potentially increasing disintermediation risks (Chang, 2023; Whited et al., 2022). Empirical and crisis-oriented studies further reveal that these mechanisms may intensify liquidity pressures and banking fragility during periods of financial stress (Bitter, 2024; Jun & Yeo, 2021). These challenges are particularly significant in banking systems where deposits represent the primary liquidity source. Nevertheless, existing studies frequently assume homogeneous economic agents and overlook differences in institutional behavior. Consequently, CBDC-related challenges involve not only deposit reduction but also variations in resilience capacity among banking institutions facing similar monetary transformations.

From a societal perspective, CBDC-driven transformation can already be observed through expanding digital payment adoption and changing perceptions of financial security. Previous studies suggest that digital currency environments facilitate faster liquidity movement because of lower transaction costs and greater fund mobility (Dong & Xiao, 2024). In Indonesia, discussions surrounding CBDC have influenced expectations regarding Digital Rupiah adoption and strategies for banking sector adaptation (Gunawan et al., 2024; Tavish et al., 2025). Meanwhile, fintech development and regulatory responses continue to increase competitive pressure on conventional banking institutions (Pati et al., 2025). These developments indicate that financial decisions are increasingly shaped by perceived efficiency, technological convenience, and institutional trust rather than solely by interest-based motivations. Thus, CBDC introduces broader behavioral and institutional dimensions within financial transformation.

The existing literature on CBDC and financial stability has extensively explored its implications for bank intermediation, liquidity risk, and systemic resilience. Several studies demonstrate that CBDC may reduce commercial bank deposits and increase funding instability, particularly under highly accessible and convertible CBDC frameworks (Infante et al., 2024; Beckmann et al., 2024). Furthermore, collateral limitations and disruptions in lending channels may amplify systemic vulnerabilities (Chen & Filippin, 2023; Jun & Yeo, 2021). However, many previous studies rely primarily on macroeconomic modeling approaches and provide limited attention to institutional diversity, especially within dual banking environments. Islamic banking remains insufficiently examined despite having distinctive liquidity structures and contractual mechanisms based on Islamic financial principles (Lukonga, 2023; Dong & Xiao, 2024). This limitation creates an important conceptual gap in understanding differentiated banking responses.

Further literature synthesis demonstrates that CBDC impacts are highly dependent on monetary design, market structures, and financial system characteristics. Comparative studies suggest that CBDC may influence capital flow volatility and banking instability under specific implementation conditions

(Popescu, 2022; Ponce & Taroco, 2025). Moreover, experimental and agent-based research reveals that CBDC adoption may generate flight-to-quality tendencies and bank-run dynamics during financial uncertainty (Barucci et al., 2025). Nevertheless, other studies argue that carefully designed CBDC frameworks may contribute to reducing panic-driven banking disruptions and improving financial system resilience (Souissi & Nabi, 2023). Despite these findings, limited attention has been given to integrating macro-financial perspectives with institutional differences, particularly in emerging economies where conventional and Islamic banking systems operate simultaneously.

The state of the art in CBDC research increasingly recognizes that financial architecture diversity and institutional interactions influence monetary transformation outcomes. Recent studies emphasize that CBDC effects are mediated by banking structures, liquidity governance systems, and behavioral responses among financial actors (Wronka, 2023; Fernández-Villaverde et al., 2020). However, an important research gap remains regarding how conventional and Islamic banks differently respond to CBDC-induced liquidity pressures under actual institutional conditions. This issue is particularly relevant in economies where both banking models coexist within the same regulatory environment but function according to fundamentally different contractual principles. Understanding these asymmetric responses is essential for developing a more comprehensive perspective on CBDC implementation and its consequences for banking resilience.

This study addresses the identified gap by examining the asymmetric liquidity effects of CBDC implementation within dual banking systems in an Indonesian regional context. It argues that CBDC-related liquidity disruption is not experienced uniformly but is shaped by differences in institutional design, financial mechanisms, and behavioral adaptation. Furthermore, this research proposes that interactions among economic efficiency, institutional rigidity, and socio-financial trust structures influence banking stability during CBDC adoption. By moving beyond conventional macro-financial equilibrium perspectives, this study contributes a more detailed understanding of CBDC transmission mechanisms and highlights the importance of institutional heterogeneity in assessing future digital monetary transformations.

RESEARCH METHODS

This study employs an exploratory comparative case study design within a qualitative paradigm. Since Indonesia's central bank digital currency (CBDC) framework, particularly Bank Indonesia's Digital Rupiah under Project Garuda, remains in an ex-ante developmental phase, empirical market data on its actual impact are unavailable. Therefore, a qualitative exploratory framework is considered the most rigorous approach for examining contemporary phenomena that cannot yet be manipulated or statistically modeled (do Amaral, 2022; Lee et al., 2023). The comparative design is essential for analyzing potential digital disintermediation across two distinct banking architectures within the same ecosystem: conventional banks relying on interest-rate mechanisms and Islamic banks operating through

profit-and-loss-sharing principles (Lim, 2025). This approach enables a detailed investigation of how both banking systems perceive and prepare for potential liquidity shocks (Manevich & Singer, 2026; Wang et al., 2024).

The empirical setting of this research is located in Probolinggo Regency and City, East Java, Indonesia. Probolinggo serves as a localized “micro-laboratory” offering institutional and sociological insights frequently overlooked in macro-level studies. As part of the “Tapal Kuda” region, it has a predominantly Muslim population and strong traditional Islamic boarding school (*pesantren*) institutions. This socio-religious context provides an opportunity to examine whether religious commitment and institutional loyalty can reduce deposit migration from Islamic banks toward a state-backed CBDC (Athief & Ma’ruf, 2023; Bektas et al., 2022). Furthermore, Probolinggo represents a tier-2/tier-3 regional economy based on agriculture, mariculture, and SMEs, where deposits depend heavily on retail funding. This setting reveals regional vulnerabilities related to digital disintermediation, digital literacy disparities, and information asymmetry (Qiu et al., 2026).

To achieve data triangulation and maintain academic validity, this research applies a dual-method data collection approach involving semi-structured in-depth interviews and structural document analysis. Primary data are obtained through purposive expert sampling involving informants with specific knowledge of the regional banking environment. The informants consist of three strategic groups: regulatory authorities represented by senior officials from the Bank Indonesia Representative Office in Malang (KPw BI Malang), bank practitioners including branch managers and heads of operations from conventional and Islamic banks, and regional experts comprising Islamic economists and representatives of the Indonesian Ulema Council (MUI) of Probolinggo. Interviews focus on deposit migration behavior, liquidity risk management, and operational challenges. These findings are validated through secondary documents, including Project Garuda White Papers, regional financial stability reports, and liquidity indicators such as Loan-to-Deposit Ratios (LDR) and Financing-to-Deposit Ratios (FDR).

The qualitative data are analyzed through comparative thematic analysis using Computer-Assisted Qualitative Data Analysis Software (CAQDAS), specifically NVivo, to ensure transparency and analytical rigor (Braun & Clarke, 2019). The analysis begins with verbatim transcription, followed by data reduction to identify relevant themes concerning CBDC-driven disintermediation and regional liquidity dynamics. Open and axial coding procedures are conducted to develop hierarchical analytical nodes divided into two perspectives. The conventional banking perspective examines interest-rate elasticity, defensive pricing strategies, and interbank market interventions, while the Islamic banking perspective explores *Wadiah* and *Mudharabah* contract rigidity under liquidity pressure and limitations of the Islamic Interbank Money Market (PUAS). Cross-case synthesis identifies asymmetric vulnerabilities between sectors. Trustworthiness, dependability, and credibility are strengthened through peer debriefing and member-checking before developing the final conceptual model of regional liquidity resilience (Ahmed, 2024; Lemon & Hayes, 2020).

RESULTS AND DISCUSSION

Results

Regional Digital Disintermediation Transmission Channels

Regional digital disintermediation transmission channels refer to the emergent pathways through which Central Bank Digital Currency (CBDC) may alter depositor behavior in the Probolinggo banking ecosystem, particularly by shifting liquidity from conventional and Islamic financial institutions toward sovereign digital wallets. In this study, the construct operationally captures behavioral sensitivity to transaction cost efficiency, perceived safety of state-backed digital money, and asymmetries in digital financial literacy across rural and semi-urban populations.

The Head of Operations of a conventional bank branch in Probolinggo emphasized that small business actors demonstrate high elasticity toward transaction costs, indicating that even marginal improvements in efficiency significantly influence their liquidity allocation decisions. The informant stated that if CBDC provides frictionless, real-time settlement with zero transaction fees, business actors are likely to reallocate working capital away from traditional bank accounts toward digital currency wallets. From an interpretive standpoint, this reflects a latent substitution effect driven by utility maximization rather than institutional preference, suggesting that CBDC functions as a high-substitutability liquidity alternative in retail segments.

Similarly, an Islamic bank branch manager highlighted that informational asymmetry in rural Probolinggo may amplify behavioral volatility during CBDC adoption. The informant observed that misinterpretation of CBDCs as fully guaranteed “state deposit” could lead to perceptions of greater safety than commercial banks, thereby increasing withdrawal propensity during rumor-driven episodes. The researcher interprets this as a form of behavioral contagion risk, in which trust is reallocated from banking institutions to sovereign digital infrastructure without a full understanding of the institutional safeguards.

Field observations across banking branches and surrounding SME clusters indicate a dominant reliance on mobile-based financial applications, with informal discussions among merchants frequently centered on transaction speed and liquidity accessibility rather than interest returns or sharia compliance structures. This suggests that the primary cognitive anchor in financial decision-making is operational efficiency. The researcher interprets this as early-stage behavioral alignment with CBDC-like characteristics even before formal implementation, indicating pre-adoption normalization of digital liquidity logic.

The data collectively indicate that CBDC-induced disintermediation in Probolinggo is primarily transmitted through cost sensitivity in retail commerce and amplified by uneven digital literacy, which together reshape depositor perceptions of safety and liquidity efficiency. A consistent pattern emerges in which liquidity migration is not driven by formal financial knowledge but by perceived transactional advantage and informational framing. Two reinforcing mechanisms dominate: (1) efficiency-driven substitution behavior in SMEs, and (2) perception-driven trust reallocation in rural segments.

Table 1. Regional Disintermediation Transmission Indicators

Informant Position	Interview Excerpt	Indicator
Conventional Bank Operations Manager	"SME clients are extremely sensitive to transaction costs; zero-cost instant settlement will likely shift operational funds away from bank accounts."	Transaction cost sensitivity; liquidity substitution
Islamic Bank Branch Manager	"In rural areas, CBDC may be perceived as safer than banks due to a misunderstanding of state guarantees."	Informational asymmetry; trust misallocation

The Table 1 demonstrates that disintermediation pressure originates from two structurally distinct but converging mechanisms. First, SMEs exhibit economically rational but institutionally destabilizing behavior, characterized by high demand elasticity for transaction efficiency. Second, rural depositor behavior is shaped by cognitive framing effects, in which state-backed digital currency is misinterpreted as a superior, risk-free asset.

These findings suggest that liquidity risk is not uniformly distributed but segmented across behavioral archetypes. In urban-commercial nodes, risk is transactional and efficiency-driven, while in rural nodes, risk is epistemic and perception-driven. This duality implies that CBDC does not operate as a neutral monetary innovation but as a behavioral reconfiguration mechanism that differentially affects depositor psychology across spatial contexts.

Asymmetric Liquidity Mitigation Capacity

Asymmetric liquidity mitigation capacity refers to the structural divergence between conventional and Islamic banking systems in responding to sudden liquidity shocks potentially induced by CBDC adoption. The construct captures differences in pricing flexibility, contractual rigidity, and access to interbank liquidity markets under stress conditions.

A conventional bank branch manager explained that liquidity defense mechanisms in conventional banking are highly responsive due to interest rate flexibility. In the event of deposit outflows, banks can immediately increase deposit rates to retain funds, effectively deploying price-based liquidity stabilization. The researcher interprets this as a classical monetary adjustment mechanism, in which interest rate elasticity serves as a first-line defense against liquidity erosion.

In contrast, an Islamic bank manager highlighted structural constraints on adjusting returns on deposits arising from profit-and-loss-sharing contracts and Wadiah-based arrangements. Any modification of depositor returns cannot be executed instantaneously without violating contractual principles. The researcher interprets this as a rigidity constraint embedded in the financial architecture that limits rapid policy responses during liquidity stress episodes.

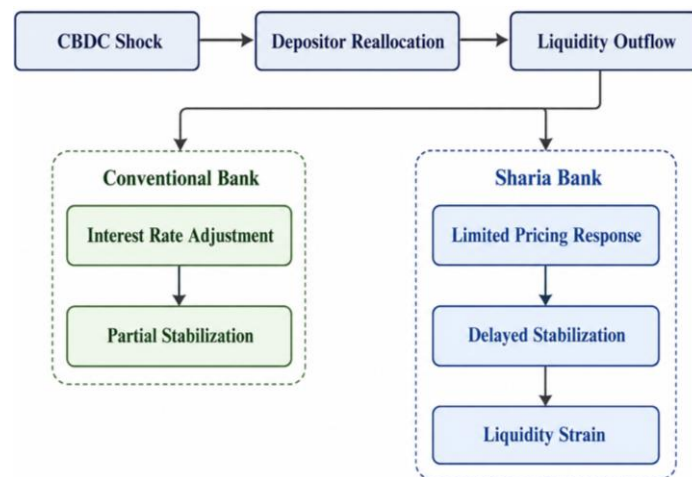


Figure 1. Structural Flow of Mechanism

This flow in Figure 1 illustrates that both systems are exposed to the same external shock but respond through fundamentally different adjustment mechanisms, producing asymmetric stability outcomes.

Observations from branch-level liquidity management practices indicate that conventional banks actively monitor daily liquidity positions and adjust promotional rates in response to competitive pressure. Islamic banks, however, rely more on relationship banking and structural retention strategies than on dynamic pricing. The researcher interprets this as evidence of institutional path dependency in liquidity governance mechanisms.

The findings indicate that conventional banks possess high adaptability in mitigating liquidity shocks through pricing mechanisms. In contrast, Islamic banks face structural limitations that reduce short-term responsiveness to sudden deposit outflows.

A systematic asymmetry is evident: flexibility is institutionally embedded in conventional banking through price mechanisms, while Islamic banking relies on contract stability and relational trust, thereby reducing its elasticity to digital monetary disruption. Table 2 demonstrates the contrasting liquidity mitigation capacities of conventional and Islamic banks, particularly in terms of pricing flexibility and contractual adjustment constraints.

Table 2. Liquidity Mitigation Capacity Comparison

Informant Position	Interview Excerpt	Indicator
Conventional Bank Branch Manager	"We can immediately raise deposit rates to retain liquidity when outflows occur."	Pricing flexibility; liquidity stabilization tool
Islamic Bank Branch Manager	"We cannot adjust returns instantly due to mudharabah and wadiah structures."	Contractual rigidity; delayed adjustment capacity

The comparative evidence indicates a fundamental divergence in liquidity governance architecture. Conventional banking operates under a price-adjustment equilibrium model, enabling rapid response to liquidity shocks through interest rate modulation. Islamic banking, however, operates under contract-based constraints that prioritize stability of compliance over dynamic pricing.

This asymmetry produces a structural vulnerability gap in which Islamic banks may experience sharper liquidity contractions under CBDC-induced disintermediation, particularly in environments where depositor behavior is highly reactive to perceived technological superiority of digital currency systems.

The *Tapal Kuda* Buffering Effect

The *Tapal Kuda* Buffering Effect refers to the socio-religious mechanism through which institutional trust in Islamic boarding schools (*pesantren*) and religious authorities mitigates potential liquidity outflows from Islamic financial institutions during digital currency transitions.

Table 3 presents the interview evidence concerning religious authority and non-economic loyalty as mechanisms of depositor retention.

Table 3. Interview Evidence and Table

Interview Excerpt	Indicator	Informant
"Santri communities tend to maintain deposits in Islamic banks when religious leaders provide guidance."	Religious authority-driven trust retention	MUI Representative
"Customer loyalty is not purely economic; it is strongly influenced by <i>sharia</i> compliance perception."	Non-economic loyalty structure	Islamic Economist

The evidence indicates that depositor behavior in the *Tapal Kuda* region is not exclusively governed by financial optimization logic but is significantly mediated by normative religious authority structures. This introduces a non-market stabilizer into the liquidity system, where *kyai* endorsement serves as a trust anchor that reduces sensitivity to external financial innovations, such as CBDCs.

The buffering mechanism operates by decoupling financial decision-making from pure utility maximization and embedding it within a moral-religious legitimacy framework. This effectively slows down liquidity migration velocity, even in the presence of superior technological alternatives.

Field observations reveal that discussions of financial decisions within *pesantren*-linked communities often reference religious advisories rather than formal banking incentives. This suggests that trust is outsourced institutionally to religious authority structures rather than to financial institutions themselves. The researcher interprets this as a culturally embedded mechanism for liquidity stabilization.

The *Tapal Kuda* region exhibits a unique liquidity-stabilization pattern in which religious authority and institutional trust in Islamic education ecosystems act as natural buffers against CBDC-induced deposit outflows.

A clear socio-financial pattern emerges: liquidity stability is reinforced by non-financial legitimacy structures. Unlike conventional, purely economic systems, this mechanism introduces culturally embedded resistance to digital disintermediation, producing a region-specific damping effect on liquidity volatility.

Discussion

The findings of this study extend the CBDC literature by demonstrating that liquidity disruption is not a uniform systemic shock but a multi-layered, spatially differentiated phenomenon. Prior research suggests that CBDC increases bank disintermediation and enhances flight-to-quality behavior under certain conditions

(Infante et al., 2024; Wronka, 2023; Fernández-Villaverde et al., 2020). However, this study refines these assumptions by showing that, in regional banking ecosystems, disintermediation is shaped by efficiency perceptions, informational asymmetries, and institutional trust rather than purely macroeconomic optimization. This aligns with empirical evidence of liquidity risk transmission in digital monetary environments (Nguyen et al., 2023; Dong & Xiao, 2024), while extending it by introducing behavioral and spatial heterogeneity as key explanatory dimensions.

The first finding confirms that CBDC adoption intensifies substitution effects between bank deposits and sovereign digital money, particularly in SME-dominated economies. This supports Chang (2023) and Whited et al. (2022), who emphasize portfolio reallocation mechanisms under CBDC regimes. However, the evidence diverges from purely rational models by showing that transaction efficiency perception plays a more dominant role than interest-based optimization. This is consistent with Beckmann et al. (2024), who highlight disintermediation pressures in financial markets, and Sarkisyan (2022), who warns of structural threats to banking survival under CBDC. Yet this study extends these findings by demonstrating that informational asymmetry amplifies behavioral volatility, particularly in rural contexts where financial literacy is unevenly distributed.

The second finding highlights a structural asymmetry in liquidity mitigation capacity between conventional and Islamic banking systems. Conventional banks exhibit high adaptability through interest rate adjustments, confirming theoretical expectations in Jun and Yeo (2021) and Chen and Filippin (2023), where pricing flexibility stabilizes loan supply and reduces failure risk. In contrast, Islamic banks face contractual rigidity due to profit-and-loss-sharing mechanisms, as Lukonga (2023) identifies institutional constraints in dual banking systems under CBDC regimes. This asymmetry indicates that CBDC does not affect banking systems uniformly but amplifies pre-existing structural differences in liquidity governance.

The third finding introduces a socio-institutional buffering mechanism that is largely absent in existing CBDC literature. While Barucci et al. (2025) and Popescu (2022) emphasize bank-run dynamics and capital flow volatility under CBDC adoption, this study reveals that religiosity and institutional trust embedded in pesantren networks function as stabilizing forces against liquidity outflows. This aligns partially with Souissi and Nabi (2023), who suggest CBDC may reduce banking panic under certain conditions, but extend their argument by demonstrating that non-economic trust structures can independently stabilize liquidity in Islamic banking ecosystems. This introduces a novel dimension of socio-financial resilience not captured in traditional financial stability models.

Overall, this study contributes to the CBDC literature by proposing a tri-dimensional, asymmetric liquidity framework that integrates economic efficiency, institutional structure, and socio-religious trust mechanisms. It extends prior theoretical models (Ponce & Taroco, 2025; Wronka, 2023; Infante et al., 2024) by demonstrating that CBDC-induced liquidity disruption is not homogeneous but varies across banking architectures and socio-cultural environments. The practical implication is that policymakers should not evaluate CBDC solely through macroprudential indicators; they must also consider institutional heterogeneity

and behavioral segmentation. Theoretically, the study advances financial stability literature by introducing regional liquidity transmission asymmetry as a key explanatory construct in dual banking systems under digital currency transformation.

CONCLUSION

This study concludes that CBDC implementation may generate asymmetric liquidity effects across dual banking systems rather than producing uniform financial disruption. The key lesson is that monetary innovation should be understood not only as a technical policy instrument but also as a behavioral and institutional transformation that can influence liquidity allocation through efficiency perceptions, contractual structures, and trust-based legitimacy. The implication of these findings is that CBDC design and implementation should consider differences in banking models and the institutional and socioeconomic contexts that shape deposit behavior and liquidity adjustment. The main scholarly contribution of this study is the proposed Tri-Layered Asymmetric Liquidity Framework, which integrates economic behavior, banking structure, and socio-religious trust dynamics to extend existing perspectives on CBDC-related disintermediation and financial stability toward a more context-sensitive understanding of dual banking systems. Nevertheless, this study is limited by its qualitative exploratory design and single-regional focus, which constrain the generalizability of the findings and prevent statistical validation of the magnitude of liquidity effects. Future research should employ mixed-method or quantitative panel approaches across multiple regions and banking systems to empirically test the proposed framework under different macro-financial conditions and CBDC design scenarios.

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CONFLICTS OF INTEREST

The author confirms that no conflict of interest exists in relation to the conduct or reporting of this study.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

In preparing this manuscript, the author used AI-assisted technology to facilitate language editing, manuscript organization, and academic writing enhancement. All outputs generated with AI assistance were carefully examined, modified where necessary, and validated by the author. Responsibility for the scientific accuracy, originality, and integrity of the final manuscript remains entirely with the author.

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