Retail Central Bank Digital Currency as an Institutional Medium in Metaverse Governance

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Abstract: As digital governance expands across algorithmic infrastructures and immersive virtual spaces, retail central bank digital currency (rCBDC) is emerging not merely as a payment instrument but as an institutional medium embedded in metaverse governance. This paper examines the philosophical foundations, governance logic, and ethical constraints of rCBDC through literature analysis, comparative inquiry, normative critique, and corpus-assisted critical discourse analysis. Grounded in institutional economics and media theory, the study argues that rCBDC reconfigures normative order through programmability, identity binding, and algorithmic enforcement. Drawing on Marcuse, Foucault, Habermas, and Scott, it shows that rCBDC may displace public deliberation by converting governance into automated compliance and protocol-based normativity. Analysis of 98 news reports further demonstrates that rCBDCs are framed through institutional authority, efficiency, innovation, and surveillance, while public responses combine cautious acceptance with concerns over privacy and democratic accountability. The paper proposes a three-tier optimization framework centered on ethical thresholds, modular governance interfaces, and deliberative public infrastructures for accountable and pluralistic metaverse governance.

Keywords: rCBDC; Metaverse; Digital Governance; CDA; Institutional Medium; Institutional Optimization

1. Introduction

Over the past two decades, the digital realm has evolved from isolated technological breakthroughs into an integrated, immersive environment supported by information infrastructures. This transformation, catalyzed by developments in cyberspace, big data, and virtual reality, has led to the emergence of the "metaverse"—a conceptual construct that reflects the convergence of these technologies into a new spatial order [1,2]. From early fictional representations to corporate rebranding efforts, the metaverse has gained institutional traction as a symbolic vision of future digital society [3,4].

Rather than a singular technological product, the metaverse is an ongoing process of integration that reshapes the relationship between humans and technology. Its core lies not in technological expansion per se but in a reconfiguration of ontological boundaries. Within this digitally hybridized, identity-malleable, and algorithmically governed environment, the notion of "reality" becomes fluid and constructible, requiring renewed philosophical attention to concepts of subjectivity, agency, and normativity [5].

Amid this transformation, central bank digital currencies (CBDC) have emerged as key institutional instruments linking national governance logic to the evolving architecture of virtual society [6]. Among them, retail CBDC (rCBDC), issued directly to the public, represent a programmable and traceable form of legal tender backed by sovereign credit. These features-programmability and traceability—not only redefine transactional logic but also enable new modes of compliance, surveillance, and institutional embedding, extending far beyond conventional monetary functions [7]. As such, rCBDC are increasingly seen as tools for enhancing monetary policy transmission, improving payment efficiency, and promoting financial inclusion.

The global rollout of rCBDC reflects diverse motivations and operational designs, ranging from improving financial accessibility to validating distributed ledger technologies [8]. Hybrid models have become the norm, combining central bank oversight with commercial intermediary roles, and encompassing both account-based and

token-based architectures that balance regulatory visibility with varying degrees of privacy [9]. In this context, rCBDC are not merely digital extensions of fiat currency, but programmable institutional scripts embedded in emerging systems of algorithmic governance. Their introduction signals a paradigmatic shift toward automated rule enforcement and disintermediated oversight, aligning with a broader technocratic narrative of a "digital governance utopia" - a vision in which algorithmic infrastructures optimize societal coordination [10,11].

However, this vision is not without normative tension. The logic of code-based governance risks recasting social order in ways that prioritize efficiency over deliberation and control over freedom. In the metaverse—an environment characterized by immersive presence, identity plasticity, and systemic opacity—these risks are amplified. The compression of civic agency, the bypassing of public deliberation, and the institutionalization of behavioral governance through programmable protocols raise profound philosophical and ethical questions [12].

This paper constructs an analytical framework centered on the concept of rCBDC as an institutional medium. Drawing on Foucault's disciplinary power [13], Habermas's theory of deliberative legitimacy [14], and critical insights from media theory and institutional economics, it interrogates the ontological shift from discourse-based institutional formation to architecture-based normativity. It argues that rCBDC transform monetary instruments into infrastructures of governance—embedding norms into code, replacing negotiability with automation, and reshaping publicness in digital society. Against this background, the paper proposes a normative model of reflexive governance grounded in ethical minimums, modularity, and participatory structures—offering a philosophical blueprint for building just, accountable, and pluralistic digital governance in the metaverse era.

2. The Functional Positioning of rCBDC in the Governance Structure of the Metaverse

As virtual space increasingly integrates with real-world institutions, the institutional nature of digital currencies is undergoing significant transformation. In the metaverse's complex digital ecology, rCBDC has emerged not only as tools for value transfer but as infrastructures for embedding sovereign governance into decentralized virtual systems. Distinct from the neutrality of traditional payment tools, rCBDC extend state legal logic into digital space through programmable architecture and compliance mechanisms.This evolution reflects a broader shift in metaverse governance: from the ideal of decentralization to a model of co-regulation. While platforms continue to define order via algorithmic protocols, states increasingly seek to embed legal norms and oversight into these systems—addressing the "institutional vacuum" caused by platform autonomy [15]. Positioned at the intersection of law, code, and platform logic, rCBDC act as institutional bridges—reconfiguring relationships between state authority, user behavior, and digital infrastructure.

2.1 Institution is Code: The Governance Embedding of rCBDC in the Metaverse

Institutional economics helps clarify how rCBDC embed governance within virtual financial systems. Their significance extends beyond digital payments, marking a shift toward embedding institutional constraints directly into technical architectures [16]. Unlike traditional monetary systems that allow for interpretive flexibility between rule-setting and enforcement, rCBDC encode compliance, identity verification, and transaction permissions into their core logic—enabling real-time execution and review.This transition transforms governance into an internalized "behavioral restraint system", especially vital in the metaverse where traditional systems face invisibility and enforcement delays [17]. By operationalizing public authority through code, rCBDC offer a technical pathway for reasserting institutional control in virtual spaces [18].

The institutional role of rCBDC has evolved beyond its identity as legal tender backed by sovereign credit, giving rise to a new governance logic rooted in programmable infrastructure—namely, "governance by default". In this paradigm, norms are not externally imposed but embedded into system architecture, where smart contracts predefine transaction boundaries, compliance conditions, and behavioral consequences [19]. When user actions trigger these protocols, governance unfolds automatically, shifting from reactive enforcement to preset discipline. This transformation renders institutional rules

dynamic and executable, enhancing transparency and accountability [20]. Particularly in the metaverse's still-maturing regulatory environment, rCBDC establishes a technical-institutional foundation that integrates seamlessly into platform logic-internalizing rule enforcement into the digital fabric of society. The technology-institutional complexity of rCBDC not only reshapes financial infrastructure governance but also restructures the institutional architecture of metaverse platforms. Through deep integration with platform protocols, smart contracts, and digital identity systems, rCBDC encodes governance norms into the operational fabric of platforms [21].

This embeddedness yields two main effects: it enhances platform standardization-supporting compliance in virtual property protection and anti-money laundering - and catalyzes a shift from algorithmic centralism to hybrid governance models involving both state regulation and platform autonomy [22]. In domains such as asset certification, user access, and accountability allocation, rCBDC enables a reallocation of governance authority and initiates a multi-centered governance consultation. Thus, rCBDC functions not only as a financial instrument but also as a pivotal mechanism for institutional re-embedding in the metaverse.

rCBDC expands governance capacity not only technically but also institutionally by reactivating public authority in platform-dominated governance structures. In algorithm-centric systems, behavioral rules are often unilaterally set by platforms to maximize commercial interests, sidelining transparency and accountability [23]. The deployment of rCBDC introduces state norms via technical means such as identity verification, transaction traceability, and auditability—constituting an "embedded regulatory mechanism". This integration compels platforms to adjust interfaces, improve interoperability, and align with external public regulatory systems in areas like AML compliance and data governance. A hybrid structure thus emerges: rCBDC as the technical fulcrum, public law as normative support, and platform mechanisms as execution paths [24]. This shift marks platform governance's transition from self-contained autonomy to negotiated institutional coordination-laying the foundation for a more legitimate and standardized digital governance paradigm.

2.2 Media Theory and the Social Shaping Power of rCBDC

Understanding the institutional effect of rCBDC through media theory requires recognizing its function as a technical medium. rCBDC is not merely a transactional tool but an embedded structure that encodes institutional logic into programmable mechanisms. Through its verifiability and automation, rCBDC translates norms-once reliant on legislation or discretion-into executable system logic [25], dissolves reliance on traditional governance chains, enabling immediate and scalable rule enforcement across complex virtual scenarios. In the fragmented spatial ecology of the metaverse, rCBDC allows institutional rules to operate as internalized structures—redefining governance boundaries and regulatory paths [26]. This shift transforms media from neutral channels into generative infrastructures of institutional order.

In the metaverse's programmed and heterogeneous space, media structures like rCBDC internalize governance logic. As both technical and institutional mediums, rCBDC enable encoded rule enforcement and restructure virtual discipline pathways. Particularly in transactions, authentication, and behavioral traceability, rCBDC shift governance from reactive intervention to real-time behavioral shaping via structural embedding [27]. Beyond functional execution, rCBDC also constructs a "governance grammar" through compliance language, user interfaces, and standard protocols [28]. This silent grammar frames platform-user obligations and subtly molds user behavior, perception, and institutional cognition. rCBDC thus evolves from a monetary medium into a constitutive force shaping the institutional order of virtual society.

At a deeper level, the institutional function of rCBDC at the media level is particularly reflected in the cross-platform and cross-jurisdical governance capabilities and structural adaptability it carries. As a highly standardized and coded medium form, rCBDC provides a common language for institutionalized coordination mechanisms in the increasingly fragmented and isolated landscape of the metaverse [29]. It makes interoperability among different technical bases and platform architectures possible through unified data interfaces, compliance protocols and interaction templates, thereby breaking through the

boundary restrictions and trust thresholds faced by the monetary system within the traditional jurisdiction. In this medium structure, the flow of value no longer relies on individual connections or commercial negotiations between platforms, but rather on rCBDC as an intermediary, embedding the circulation path of national credit endorsement and regulatory logic. More importantly, this institutional interconnection is not only manifested in the surface data synchronization and technical compatibility, but more deeply in the nesting of normative consensus and governance logic: rCBDC carries specific behavioral norms, audit rules and ownership definitions, and participates in the co-construction of institutional logic and regulatory unification in the virtual space [30]. Its medium status is thus not limited to the infrastructure for value transmission, but also serves as a normative bridge between the technical structure and the institutional logic, thereby promoting the mechanism coordination between platform autonomy and sovereign governance to evolve towards higher-level institutional integration.

Furthermore, Media theory underscores that media are not just channels of communication but infrastructures shaping power, cognition, and social order [31]. As a digitally coded governance medium, rCBDC evolves beyond payment tools into frameworks of social participation. Through repeated use - such as identity checks and transaction verifications-users gradually internalize its institutional logic. This habitual engagement embeds regulatory norms into everyday behavior, fostering a mediatized institutional identity centered on rCBDC. In this process, identity shifts from traditional bases toward alignment with digital institutional frameworks.

2.3 The Embedding of rCBDC as an "Institutional Medium" in Metaverse Governance

Table 1. The Potential of Different Types of Digital Currencies in Metaverse Governance

Feature	rCBDC	Cryptocurrency (e.g., Bitcoin)	Algorithmic Stablecoin	Fiat-collateralized Stablecoin(e.g., USDC)
Issuer	Central Bank	Decentralized network	Private entities/protocols	Private entities
Stability Mechanism	National credit endorsement, legal tender	Market demand, high volatility	Algorithmic mechanisms, potential for de-pegging [32]	Fiat reserve backing, relatively stable, depends on transparency and reserves management [33]
Governance Programmability	High potential (programmable currency/payments)	Limited (basic scripting capability)	Relies on specific protocol design	Limited (primarily for payments)
Traceability and Privacy Balance	High traceability, privacy protection is a core challenge	Pseudonymous, but transactions traceable [34].	Transactions generally publicly traceable on blockchain, privacy features vary	Transactions typically public on blockchain, possibly requiring KYC
Regulatory Interface Strength	Strong (direct integration with regulatory framework as national currency)	Weak/unclear (regulation still developing)	Unclear (regulation still developing)	Medium (facing increasing regulatory scrutiny)
Trust Mechanism	National credit, legal guarantees	Technological consensus (e.g., PoW, PoS), community trust [35]	Algorithm and protocol design, market trust	Issuer creditworthiness, reserve audits, regulatory compliance
Interoperability Potential	Depends on design; open standards promote interoperability [36]	Limited (cross-chain bridging needed)	Relies on specific protocols and technology	Medium (issued across multiple blockchains)

From the intersection of institutional economics and media theory, rCBDC emerges as an

"institutional medium" - not merely a transaction tool, but a core element of institutional construction. As a digital embodiment of sovereign credit, it embeds rules, behavioral constraints, and identity binding into its technical design, making money part of the institutional fabric rather than a neutral vessel. Simultaneously, rCBDC's coded structure and operational logic transform it from an informational channel into a regulatory infrastructure, forming a governance grammar that is both normative and adaptable [37].

Philosophically, rCBDC reflects a shift from text-based to interaction-based institutional paradigms. Institutions are no longer static rule declarations but are reproduced and internalized through mediated interactions [38]. rCBDC embeds legitimacy, compliance, and identity into its media structure, transforming institutionality from external enforcement into behavioral internalization via technical logic. This signifies not just a currency evolution, but a systemic shift: institutional functions are now distributed, activated, and reinforced through media structures. rCBDC thus represents both a technical extension and a spatial reconfiguration of institutional reality—rendering it experiential and embedded.

To compare rCBDC with other major forms of digital currency more systematically, Table 1 summarizes their differences in issuer, stability mechanism, governance programmability, traceability and privacy balance, regulatory interface strength, trust mechanism, and interoperability potential.

As shown in Table 1, rCBDC differs from cryptocurrencies and stablecoins in several important respects. First, it is backed by sovereign credit and legal tender status, which gives it a stronger institutional foundation. Second, it has greater potential for governance programmability and regulatory integration, allowing it to function not only as a medium of exchange but also as a medium of institutional embedding. Third, compared with decentralized cryptocurrencies and privately issued stablecoins, rCBDC demonstrates a higher degree of normativity, traceability, and governance coordination. These differences support the argument that rCBDC should be understood as an institutional medium rather than merely a digital payment instrument [39]. This feature also reinforces the previous assertion of "institutional medium": rCBDC is not merely a tool supplement to the digital financial system, but a key hub in reshaping the relationship between institutional logic and technological practice in the digital governance landscape of the metaverse.

3. Ethical Boundaries of Retail CBDC in the Digital Governance of the Metaverse

In the decentralized and highly programmed environment of the metaverse, retail CBDC (rCBDC) functions not merely as a payment tool but as an embedded institutional medium. With programmability, traceability, and identity binding, rCBDC integrates regulatory logic directly into transactional structures, transforming each unit of circulation into a node of automated governance. This internalization—via smart contracts, identity protocols, and APIs—recasts compliance as a vehicle for normative enforcement, reducing public deliberation and individual agency [40]. What appears as technical infrastructure often enacts structural power. Therefore, a critical ethical inquiry into rCBDC's governance logic is essential—examining its implications for technological rationality, civic autonomy, and democratic legitimacy.

3.1 From Technical Rationality to Institutional Automation: The Code-Based Governance Logic of rCBDC

In the contemporary context of digital governance, technology no longer functions as a neutral tool; it has become a structural condition for the operation of institutional power. As Herbert Marcuse argued that technological rationality has evolved into an ideological apparatus that sustains established order, subtly displacing the space for questioning institutional legitimacy through its prioritization of efficiency, automation, and standardization [41]. James C. Scott, in his critique of "high modernism", further illuminated how state-led governance reduces social complexity through abstraction, simplification, and reordering - rendering society legible as a controllable object [42]. These two lines of critique converge in the case of central bank digital currencies (CBDCs), forming the philosophical foundation for a critical institutional analysis of the governance logic embedded in rCBDC.

rCBDC should not be understood merely as a technological artifact designed to enhance payment efficiency or facilitate regulatory

oversight. Its programmability and traceability give rise to a disciplinary framework mediated by code execution. Institutional power no longer operates through explicit legal commands but is instead embedded in smart contracts, identity-binding protocols, and algorithmic structures, thereby producing an "automated governance" regime. The danger of this configuration lies in its depoliticization of institutional will—recasting rules that should emerge through democratic deliberation as imperatives legitimized solely by technical efficiency [43].

Once embedded in the highly programmable and decentralized architecture of the metaverse, the governance logic of "governance by default" begins to exert tangible effects. On one hand, rCBDC extends the reach of sovereign oversight into autonomous platform spaces through programmable interfaces, thereby rendering identities, behaviors, and financial pathways susceptible to systemic control. On the other hand, rCBDC translates normative reasoning into compliance protocols, bypassing the need for user consent or social feedback by enforcing rules through technical mandates. Governance, in this sense, no longer requires the explicit assertion of sovereign authority; it is achieved through the default settings of programmable structures that shape behavior in advance and confine it within predefined trajectories.

More profoundly, rCBDC operates through a logic that simplifies and flattens social complexity. This optimization is not merely functional - it constitutes an ideological act. It replaces the legitimacy of governance grounded in social consensus or political contestation with a logic rooted in measurability, predictability, and auditability. As Scott noted, the "legible society" is not a neutral representation of reality but a disciplinary reconstruction aligned with state interests. In the metaverse, where platform autonomy and user practices would otherwise remain heterogeneous and elastic, the intervention of rCBDC standardizes and visualizes these dynamics, aligning them with a preformatted institutional architecture.

Ultimately, this model of governance-through-technology enhances efficiency and transparency only superficially. It obscures the fractures in legitimacy and suppresses the conditions necessary for institutional reflection. Technical rationality displaces political judgment; protocol execution conceals value conflict; automated governance eclipses procedural negotiation. rCBDC thus ceases to be a mere financial instrument and becomes an implicit architect of political order [44]. Its logic enacts a shift in legitimacy - from the public sphere to code structure. This is not a neutral evolution in technical infrastructure but a paradigmatic transformation of governance itself. Power now operates in invisibility, institutions take form in non-negotiability, and user agency is sacrificed at the altar of operability.

3.2 Subjectivity Reconstruction under the Digital Discipline Mechanism

In the institutional logic represented by rCBDC, the locus of governance has shifted from the formulation of macro-level rules to the micro-level shaping of behavior and reconstruction of identity. Michel Foucault's theory of power offers a critical framework for interpreting this transformation. He argues that modern governance no longer relies on explicit sovereign coercion but instead operates through a field constituted by knowledge, technology, and institutional arrangements-disciplining individuals into "governable bodies" [45]. In digital environments, this logic of power is systematically activated through rCBDC's identity-binding protocols, transaction traceability, and conditional programming structures, rendering governance increasingly technical, individualized, and continuous.

Through the real-time tracking of transaction flows and the binding of user identities to system architecture, rCBDC subjects individual behavior to a regime of persistent visibility, constructing a digital analogue of the "panopticon" [46]. Power here is not exercised through external repression but through an internalized compliance: users, conscious of constant institutional observability, tend to preemptively self-regulate and avoid risky behaviors. This form of discipline abolishes the protective veil of anonymity in virtual spaces and marks a paradigmatic shift in governance from legal sanction to structural inducement. The individual no longer functions as a legal subject bearing responsibility, but as a programmable node that is pre-defined, triggered, and predicted within an institutional field.

More profoundly, rCBDC enacts what Foucault termed a biopolitical turn in governance—an orientation toward the management of life itself. This logic does not merely constrain the

consequences of actions; it reconstructs a "predictive persona" through behavioral data, credit histories, and interactive patterns [47]. Every transaction, communicative act, and identity exchange within the metaverse is subsumed into a datafied persona, producing a subject who is callable, assessable, and modelable as a governance object. The embedded logic of rCBDC thus constructs not just a transactional infrastructure, but a regime of digital embodiment - transforming the individual from a fluid social presence into an optimized node within a regime of institutional calculation.

The subject shaped by this digital discipline is no longer a full political agent but rather a governable technical entity. Individual actions are reduced to system-triggered responses, while credit scores, behavioral traces, and digital profiles are rendered into quantifiable indicators for institutional calibration. Governance thereby evolves from rule-based constraint to mechanism-based orchestration; from political engagement to algorithmic administration. The underlying philosophical trajectory moves from tolerating uncertainty to eliminating risk through rationalized control. In this context, the embedded architecture of rCBDC not only reshapes modes of governance but redefines what it means to exist as a subject in virtual space. The deeper concern, however, lies in the erosion of the capacity for individuals' express autonomy, and participate in public deliberation. When all behavior becomes a function of compliance architecture, the individual loses the ability to intervene in institutional systems through value-based judgment and instead becomes a passive operator within preconfigured pathways. This substitution of technical rationality for freedom of action exemplifies the culmination of modern governance in Foucauldian terms: power that no longer oppresses externally but governs through the very medium of the self, internalizing and automating control.

3.3 Lack of Publicness in Technological Governance and Crisis of Institutional Legitimacy

When rCBDC becomes deeply embedded in individual identity, behavioral trajectories, and credit structures through its underlying technical logic, the resulting implications extend beyond the compression of subjectivity. More profoundly, it generates a structural crisis of institutional legitimacy. Jürgen Habermas advocates that the legitimacy of modern institutional orders is not grounded in the imperatives of efficiency or sovereign authority, but in the communicative processes of the public sphere. Institutional rationality, in this view, emerges from the deliberative engagement of citizens, and from rule-making processes based on mutual understanding and consensus [14]. This ideal of communicative rationality provides not only procedural legitimacy, but also the normative foundation for the ethical coherence and integrative capacity of modern social systems.

However, the governance logic embedded in rCBDC directly undermines this foundation. In the hyper-mediated governance environment of the metaverse, rCBDC's programmable design and identity-binding mechanisms confine institutional operations within closed technical architectures. Norms no longer exist as objects of discursive negotiation but are encoded into algorithmic protocols, thereby circumventing public deliberation on the legitimacy of power and the boundaries of governance. Such a model, governed by the system logic rather than sustained by the communicative lifeworld, exemplifies what Habermas famously critiques as the colonization of the lifeworld: a condition in which the technical formalization of institutions deprives individuals of the capacity to exercise judgment and engage in reflexive critique of normative structures [48].

This imbalance is most clearly manifested in the simulacrum of deliberation. Within technical systems, governance parameters are often framed as the outcome of risk-optimized design processes-immutable paths conceived by designers, leaving users with nothing more than binary choices: acceptance or rejection. This pseudo-deliberative structure masks the power asymmetries underlying institutional architectures and enables a disciplinary logic to operate under the guise of neutrality. Without dynamic feedback channels and structural correction mechanisms, rCBDC risks not only shrinking the public sphere but also dissolving the very social integration on which institutional legitimacy depends-transforming normative frameworks into tools of instrumental reason detached from the will of the governed.

4. Critical Discourse Analysis of rCBDC in

the Metaverse

Building on the conceptual foundations developed in Chapter 2 and the critical reflections elaborated in Chapter 3, this chapter turns to an empirical investigation of how retail central bank digital currency (rCBDC) is discursively constructed in relation to the metaverse. Chapter 2 conceptualized rCBDC as an institutional medium, embedding monetary functions within the infrastructures of virtual governance. Chapter 3 further examined the normative and philosophical tensions of this embedding, highlighting how discourses of efficiency, innovation, and inclusion coexist with concerns of surveillance, discipline, and democratic deficit. To substantiate and refine these theoretical claims, the present chapter applies a corpus-assisted critical discourse analysis (CDA). By analyzing news coverage, the study traces how rCBDC is named, evaluated, justified, and contested within the emerging metaverse economy. This empirical step ensures that the theoretical insights developed earlier are grounded in actual discursive practices, thereby demonstrating how utopian imaginaries and dystopian anxieties are jointly reproduced in public and institutional discourse.

4.1 Data and Methods

The empirical corpus for this study was constructed using the LexisNexis news database, which provides access to international press coverage. The data collection followed a three-step filtering process. First, an initial query was conducted using the keywords “retail CBDC and metaverse”, which yielded 22 articles. Second, a broader search using “CBDC” and “metaverse” identified 264 articles. Each of these was manually reviewed to determine (a) whether the term “CBDC” referred specifically to retail CBDC (rCBDC) rather than wholesale variants, and (b) whether CBDC was substantively linked to discussions of the metaverse, rather than mentioned in isolation.

After this screening, a total of 76 relevant articles were retained from the second search, which, combined with the initial 22 articles, produced a final dataset of 98 news reports. These items represent a diverse corpus spanning central bank statements, corporate announcements, industry commentary, and media reports. For the textual analysis, the study employed the Chinese open-source platform Weiciyun (https://fenci.weiciyun.com/), which provides tokenization, word frequency analysis, and latent Dirichlet allocation (LDA) topic modeling. The tool was used to extract keyword frequency lists, noun phrase collocations, and thematic clusters, which were then integrated into the CDA framework. The combination of corpus-based quantitative analysis with qualitative CDA interpretation ensured both lexical reliability and contextual depth, following the precedent of discourse-oriented studies.

4.2 Statistics and Analysis

This study follows Fairclough’s three-dimensional model, which treats discourse as a form of social practice [49]. The model integrates three interrelated dimensions: (1) Description (text analysis): Focuses on lexical and structural features, including high-frequency terms and recurring phrases, to capture how rCBDC is linguistically represented. (2) Interpretation (discursive practice): Examines how discourse is produced, distributed, and consumed across institutions. Using LDA topic modeling and qualitative reading, clusters such as retail/payment or privacy/control are linked to central banks, corporations, media, and publics, showing how dominant voices shape, reframe, or contest meanings.(3)Explanation (social practice): Connects these discourses to broader socio-political structures, including the institutionalization of monetary sovereignty, the normalization of surveillance, and the ideological framing of CBDC as both utopian promise and dystopian risk.

4.2.1 Description: text features

The corpus analysis at the textual level examines vocabulary distribution, part-of-speech composition, collocational structures, and syntactic dependencies. This descriptive step establishes the empirical basis for the subsequent analysis of discursive practices.

A keyword cloud (Figure 1) highlights the prominence of terms such as CBDC, digital, bank, payment, metaverse. The visualization confirms the lexical centrality of financial institutions, technological infrastructures, and virtual environments, reinforcing their discursive interdependence. Part-of-speech distribution (figure 2) indicates that nouns account for the largest share (25.44%), followed by proper nouns (12.92%), prepositions (11.9%), verbs (10.92%), and adjectives (10.31%). This suggests a discourse grounded in entities,

institutions, and concepts (e.g., central bank, payment system, metaverse), with frequent reference to specific actors such as Bank Indonesia and technological artifacts like NFTs and blockchain. Analysis of noun phrases shows recurrent collocations such as central bank digital currency, digital payment system, retail CBDC, and virtual economy. These phrases anchor rCBDC in institutional legitimacy and practical application, linking it simultaneously to monetary authority and immersive digital futures. Frequent verbs include enable, regulate, support, provide, integrate. These predications highlight a dual framing: while enable and support signal empowerment and innovation, regulate and control point to surveillance and discipline. This reflects the coexistence of utopian and dystopian orientations even at the linguistic level. Dependency parsing reveals that CBDC, digital, and metaverse often function as grammatical heads, modified by descriptors such as retail, central, programmable. Phrases like "programmable money" embed CBDC in a narrative of futurity, while "central control" positions it within regulatory regimes.

Figure 1. Word Cloud of High-Frequency Terms

As shown in Figure 1, high-frequency terms such as CBDC, digital, bank, payment, and metaverse occupy a prominent position, indicating the discursive centrality of financial institutions, technological infrastructures, and virtual environments.

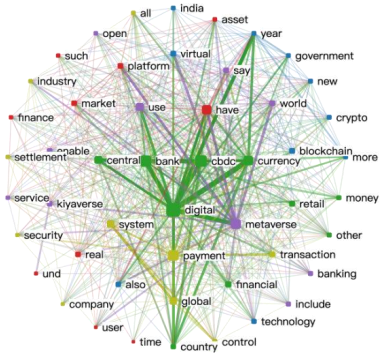

Figure 2. Part-Of-Speech Distribution of the Corpus

Figure 2 presents the part-of-speech distribution generated from automated tagging of the news dataset, showing the proportional distribution of nouns, verbs, adjectives, and other word classes. At the textual level, rCBDC discourse is characterized by: A noun-heavy structure highlighting institutions and technologies; Keyword salience confirming the centrality of CBDC–bank - metaverse relations; Recurrent noun phrases embedding CBDC in authority and application; Dual predications balancing empowerment and surveillance; Dependency structures reinforcing CBDC's institutional and disciplinary identity.

4.2.2 Interpretation: discursive practices

The analysis is grounded in Python-based LDA topic modeling. Specifically, coherence and perplexity scores were first calculated for think tank texts to determine the optimal number of topics. Subsequently, topic modeling was performed to classify texts into thematic categories and calculate their proportional distribution. The according network graph is shown in Figure 3.

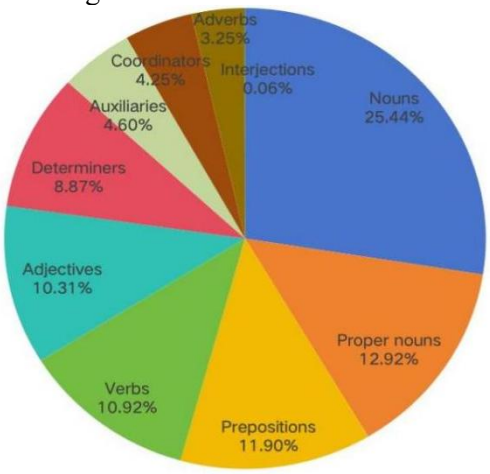

Figure 3. Network Graph of Co-Occurring Keywords in the Corpus

Figure 3 presents the co-occurrence network of keywords, showing how institutional and corporate vocabularies cluster around terms such as "digital," "CBDC," "central," "bank," and "metaverse." The network suggests that discourse on rCBDC is organized around the interconnection of institutional authority, financial infrastructures, and virtual governance.

Production: Institutional and corporate framings. Discourse production is dominated by central banks and corporate actors. Central banks frame rCBDC through the clusters retail and payment, emphasizing inevitability and sovereignty. For

instance, Bank Indonesia's governor asserted: Digital rupiah is inevitable. It's the transaction tool of the future. Corporations appropriate these narratives, particularly within the digital and metaverse clusters. Kiya.ai, for example, announced: Our product roadmap includes integration with CBDC and interoperability with other metaverses to enable open finance.

Distribution: Media amplification and reframing. Media outlets act as intermediaries, redistributing institutional and corporate discourses while adding critical framings. Some reports amplify developmental narratives, e.g., the Indonesian Blockchain Conference, where CBDC and the metaverse were linked to national competitiveness and education. Others highlight disciplinary concerns: There is central control…necessary to be running a business which is safe and regulated. Here, media distribute institutional discourse but simultaneously infuse it with critiques of surveillance.

Consumption: Public reception and contestation. Public voices, as captured in surveys and commentary, show cautious acceptance combined with skepticism. A Chinese news noted: More than three in four consumers expect their countries to become predominantly cashless within the next five years…37% expect their governments to officially make cryptocurrencies legal tender. At the same time, hedged statements such as CBDC may be used in the metaverse for NFTs and beyond highlight hesitation and concern for autonomy and privacy. Table 2 summarizes the sentiment distribution of lexical items in the corpus. Neutral expressions dominate, reflecting a largely descriptive or technical reporting style. Positive terms, such as innovation, future, and inevitable, convey a utopian orientation toward modernization and inevitability. Negative terms, including risk, control, and surveillance, foreground public anxieties about privacy and disciplinary governance. This distribution confirms that while public discourse generally aligns with institutional optimism, concerns over autonomy and freedom remain salient.

Table 2. Sentiment Analysis of Lexical Items in the Corpus

Sentiment category	Proportion in corpus	Typical keywords	Discursive implication
Neutral	70%	transaction, currency, platform	Baseline descriptive reporting; technical focus
Positive	20%	innovation, future, inevitable, enable	Utopian framing of efficiency, modernization
Negative	10%	risk, control, lack, surveillance	Dystopian framing of regulation, privacy loss

4.2.3 Explanation: social practice

At the level of social practice, the discourses surrounding rCBDC in the metaverse reveal how linguistic choices are embedded in broader structures of power, ideology, and governance. These discourses not only reflect institutional agendas but also actively shape how digital money is imagined as part of emerging social orders. Three interrelated dynamics can be identified.

Institutionalization and sovereignty. By nominating rCBDC as a future tool and national currency, state actors reinforce monetary sovereignty in the digital domain. This discursive strategy naturalizes central banks as the sole legitimate providers of money, extending state authority into virtual economies. The social practice at stake is one of institutionalization: rCBDC becomes not just a technical device but a medium through which sovereign legitimacy is reaffirmed and expanded into the metaverse.

Disciplinary governance and surveillance. Predicational choices such as control and regulated construct CBDCs as instruments of order and safety. At the social level, this resonates with Foucault's notion of disciplinary power: CBDC infrastructures enable unprecedented visibility into transactions, embedding surveillance within everyday practices of exchange. The discourse of "necessary control" reflects a normalization of governance through digital money, in which individual freedoms are subordinated to logics of security and regulation.

Utopian promises and democratic deficits. The rhetoric of inevitability (Digital rupiah is inevitable) functions ideologically by closing off public debate. By framing CBDC adoption as destiny rather than choice, these discourses echo Habermas's concern with the colonization of the lifeworld, where technical imperatives overshadow democratic deliberation. While utopian promises of inclusion and innovation circulate widely, they obscure the potential for dystopian consequences, including loss of privacy and concentration of power.

At the social practice level, the CDA findings

show that rCBDC in the metaverse is discursively embedded in three overlapping dynamics: Institutionalization of sovereignty, extending state authority into digital economies; Normalization of discipline, embedding surveillance in the name of safety and order; Ideological closure of debate, where utopian promises legitimize technological adoption while masking democratic risks. Together, these dynamics confirm that rCBDC operates as an institutional medium: a site where discourses of money, power, and governance converge to structure both virtual and real-world social relations.

5. Institutional Optimization of rCBDC Governance Practices in the Metaverse

5.1 Structured Collaborative Path: Breaking Ethical Boundaries

In the governance ecology of the metaverse, the introduction of rCBDC as an institutional medium must satisfy two fundamental imperatives: first, to enable the effective integration of sovereign regulatory authority into the existing autonomous architecture of digital platforms; and second, to accommodate the operational flexibility and technical compatibility required by a heterogeneous platform ecosystem. Achieving this dual objective requires a clear articulation of the ethical boundaries underpinning institutional embedding - namely, the definition of core principles that must remain inviolable under the paradigm of "institution as technology" [50]. These principles extend beyond conventional compliance requirements such as data minimization, purpose limitation, and tiered access control. They must also include structural features that ensure preconfigured transparency and processual feedback rights, thereby embedding openness and responsiveness within the technical architecture of governance [51]. Such design imperatives serve to prevent institutional logic from becoming reified into a closed and non-negotiable order within algorithmic systems. Only by establishing these minimum ethical thresholds can rCBDC realize an embedded governance model that sustains sovereign legitimacy while also securing long-term acceptance and normative recognition within platform ecosystems and user communities alike.

Meanwhile, in a highly dynamic technological environment, the governance structure itself also needs to have institutional flexibility to respond to the heterogeneity of the platform ecosystem and the variability of the behavioral structure. The institutional configuration of rCBDC can no longer follow the logic of traditional "unitary regulation" or "fixed authority", but should build a modular and reconfigurable governance system based on multi-dimensional interfaces: For instance, in various governance scenarios such as DAO autonomy, NFT transactions, and virtual property transfers, the programming logic, compliance templates, and regulatory protocols of rCBDC should possess differentiated adaptability [52]. This adaptation does not imply a compromise on sovereign norms, but rather an institutional reconstruction strategy of "structural flexibility", that is, achieving dynamic tracking of institutional goals through the negotiability of the protocol structure. On this basis, the governance process should introduce the "institutional adjustment layer" as a bridge link, so that the logic of national governance and the logic of platform autonomy can achieve a soft connection structurally. This not only avoids the isolation of rules but also prevents it from evolving into an overarching intervention of power. This institutional flexibility is not only a guarantee of governance stability, but also a key channel for rCBDC to transform from an embedded technology device into a collaborative governance infrastructure.

The most fundamental aspect is to establish an institutional space that is both negotiable and interpretable, so that technical specifications no longer operate in a closed form but can jointly build institutional order within a predictable and feedback rule context [53]. This institutional space needs to go beyond the existing governance logic of commercial platforms and introduce public consultation mechanisms, participatory standard setting and technological transparency structure design. The core objective is to ensure that rCBDC, during its participation in governance, does not disrupt the "open-self-organizing - multi-centered" social texture in the metaverse due to its technical presets and compliance parameters. For example, a "negotiated standard interface" can be established to enable rCBDC to undergo multi-party feedback reviews from technology developers, user groups and regulatory authorities before operating on various platforms. Or through the "governance simulation sandbox"

mechanism, test the behavioral effects of its institutional influence under different platform logics, and adjust the compliance strategy and parameter arrangement accordingly [54]. The establishment of this institutional space not only responds to the consultative demands of the rCBDC governance legitimacy foundation, but also marks the structural transformation of the metaverse governance logic from "sovereign intervention" to "mechanism coordination".

5.2 Reconstruction of Publicness and Realization of Institutional Justice in the Virtual Society

In the virtual society of the metaverse, which is based on algorithmic structures, digital identities and program interactions, the governance logic is no longer established on the institutional consensus of the traditional political space, but shifts to the order construction dominated by technological systems [55]. This shift, on the one hand, enhances governance efficiency; on the other hand, it also poses new ethical challenges to institutional justice and the basis of public nature. As a digital medium with strong institutional embeddability, the governance function of rCBDC is not centrally nested within the virtual ecosystem, but is deeply involved in the generation of norms and the allocation of power in the virtual society. To reflect the governance legitimacy of rCBDC, the following discussion will explore how to reconstruct public nature in the embedded technical structure and respond to the demands of institutional justice.

First of all, the ethical guarantee of governance transparency is a prerequisite for the generation of institutional justice. In the highly mediated digital space, rule enforcement, data processing and power intervention often present the structural feature of "coding invisibility", resulting in individuals having neither the right to know nor the appeal path when facing rules. Although the programmable and traceable features of rCBDC have enhanced governance controllability at the technical level, without corresponding information disclosure mechanisms and process interpretation capabilities, it may instead exacerbate institutional asymmetry and the loss of public trust. Therefore, the construction of institutional transparency should not be limited to the publication of results, but should cover the entire chain links such as institutional design, rule generation and algorithm adjustment, to ensure that public rationality has a real entry point for intervention in the operation of the system. The legitimacy of the rCBDC governance structure does not lie in the efficiency of technical implementation, but in whether it regards "explainability" as part of the institutional responsibility and establishes a public mechanism within the system to respond to user doubts and procedural challenges.

Secondly, the ethical equivalence mechanism among governance subjects is also a key element in constructing publicness. In the governance pattern of the metaverse, where multiple centers and platforms coexist, the state, platforms, technology developers and ordinary users form an interwoven power structure. However, the current governance practices of rCBDC often reflect the interaction between the technical advantages of the platform and the regulatory power of the state, but lack the mechanism design that regards ordinary users as governance co-builders with institutional rights. This structural imbalance not only weakens the initiative of individuals in the process of institutional generation, but also undermines the symmetry principle of institutional ethics. Therefore, it is particularly important to establish a collaborative mechanism of "role equivalence" in the institutional structure, such as setting up review seats for user representatives, introducing a multi-party consultation platform or constructing an institutional compensation mechanism for disadvantaged users [56]. Only in this way can the governance system on which rCBDC relies demonstrate a true "ethical balance" in the allocation of power, thereby avoiding the slide of technical governance into an institutional monopoly dominated by strong entities in a single direction.

Finally, the construction of institutional trust under the digital identity structure is a deep fulcrum in the process of generating publicness. The governance logic of rCBDC is based on strong identity binding and behavioral traceability. Although this design enhances the executability of governance, it may also raise reasonable concerns about privacy leakage, identity abuse and behavioral discrimination. In this context, institutional trust is no longer a projection of an individual's moral expectations, but a rational judgment on the "credible capriciousness" of the institution itself [57]. Therefore, system designers must take "minimum exposure" and "accountability" as the

core principles, define the usage boundaries and circulation paths of identity data in rCBDC, clarify the responsible subjects for data governance, and establish a clear accountability mechanism and complaint process [58]. The construction of such institutional trust does not rely on moral beliefs in the country or the platform itself, but on a verifiable, appealing and modifiable institutional structure.

5.3 Future-oriented Institutional Ethics Construction Path

The future path of institutional ethics reconstruction should start from the philosophical premise of rule generation. In the digital governance system, the generation of rules is often accompanied by the closed nature of the technical structure. This "black box decision-making" weakens institutional identification and user trust. If rCBDC is to be embedded in the complex and heterogeneous fields of the metaverse, its institutional logic must break away from the closed expression of "code as rule" and shift to an open rule-building mechanism based on the interpretability of technology [59]. Specifically, interpretability not only refers to the transparency of the rule execution logic, but also means that users can understand, inquire about and participate in the formation process of the system rules. Rules should not merely be the product of "algorithmic setting", but rather the outcome of "institutional negotiation" [60]. The process of their formulation needs to have ethical self-reflective capabilities and be able to respond to the value demands and risk expectations of different governance subjects.

The construction of institutional ethics is not only the expression of concepts, but also requires a structural realization mechanism. In the digital context of the metaverse, neither a single sovereignty logic nor a platform logic is sufficient to support the generation of institutional justice. Therefore, it is necessary to construct an embedded "review and governance system". This system should be based on the basic framework of digital rule of law and introduce a multi-subject review platform in the institutional design, enabling the state, the platform, users and technology developers to participate in the interpretation, adjustment and revision of the rules as equal subjects [61]. This institutional review space is not only a procedural consultation mechanism, but also should become the generation field of institutional ethics: institutions no longer appear as externally imposed orders, but are embedded into the governance logic through the consensus formation mechanism to achieve the internalization of governance legitimacy.

In the embedded institutional governance structure, rCBDC, as a composite carrier of technical tools and sovereign institutions, its normative boundaries particularly need to be limited. If the functional design of rCBDC is infinitely expanded to areas such as credit scoring, identity verification, and behavior prediction, the power position it occupies in the governance structure will tend to be monopolistic, eventually transforming into a structural imbalance in the governance tension of the digital space. Therefore, one of the core tasks of institutional ethics is to define the boundaries of rCBDC technology expansion and clarify its role positioning and restrictive conditions within the digital rule of law system. It is necessary to establish a "functional constraint framework" through legal systems to ensure that the institutional logic does not exceed the governance boundary between public power and platform autonomy, and to enhance efficiency while retaining social flexibility and user freedom. Governance tension does not have to be avoided. Instead, it should be transformed into a dynamic field of institutional synergy through structural mechanisms, enabling rCBDC to maintain a dual tension balance of standardization and openness during the process of institutional embedding.

6. Conclusion

This study has critically interrogated the normative and structural implications of retail Central Bank Digital Currency (rCBDC) as embedded within the evolving governance architectures of the metaverse. In an era where digital environments are increasingly mediated by algorithmic control, identity-based infrastructures, and programmable protocols, rCBDC emerges not simply as innovations in monetary technology but as powerful instruments of institutional mediation. Their capacity for code-based enforcement, behavioral traceability, and systemic integration positions them at the core of a new form of invisible governance, wherein normative claims are not argued but executed, and political discretion is displaced by procedural automation.

Through a sustained engagement with philosophical and critical theoretical perspectives—ranging from Marcuse's critique of depoliticized technological rationality, to Foucault's analysis of disciplinary power and digital subjectivation, Scott's theory of legibility and high-modernist simplification, and Habermas's ideal of deliberative legitimacy—this paper demonstrates that rCBDC, while operationally efficient, risk reconfiguring governance into a form of pre-emptive normativity. This "governance-by-default" embeds regulatory norms directly into the logic of code, foreclosing political contestation, ethical ambiguity, and civic negotiation. Such a transformation is not merely institutional but ontological: the user becomes a data-subject, a programmable identity within a self-referential institutional structure.

The empirical analysis in Chapter 4 further substantiates these theoretical claims by tracing how rCBDCs are discursively constructed in news media. Using corpus-assisted CDA, the study showed that rCBDCs are consistently represented through noun-heavy institutional framings, predications of efficiency and control, and recurrent collocations linking them to monetary authority and digital innovation. LDA-based topic modeling revealed distinct discursive practices across actors: central banks emphasized inevitability and sovereignty, corporations embedded CBDCs into innovation and metaverse imaginaries, media both amplified official optimism and infused critiques of surveillance, while public voices displayed cautious acceptance tempered by anxieties over autonomy and privacy. At the social practice level, these findings highlight three overlapping dynamics—the institutionalization of sovereignty, the normalization of discipline, and the ideological closure of debate—which together confirm that rCBDCs operate as institutional media, simultaneously legitimized, contested, and reframed across governance domains.

However, the recognition of rCBDC as institutional media also offers an opportunity for normative reconstruction. Their very embeddedness in technical architecture makes them potential vectors for ethical design, provided their implementation is anchored in principles of procedural transparency, reversibility, role pluralism, and institutional reflexivity. This paper therefore calls for a paradigmatic shift from sovereign enforcement to institutional co-construction—a governance model in which rCBDC operate as dynamic interfaces between state norms, platform governance structures, and user agency. Such a shift would not reject the institutional role of the state, but rather recalibrate it within a pluralistic and deliberative architecture that is responsive to the evolving complexity of digital life.

Looking forward, future research should move beyond critiques of technocratic rationality and engage in the constructive design of interoperable, ethically constrained, and participatory governance protocols. Questions of algorithmic accountability, identity sovereignty, cross-jurisdictional legitimacy, and infrastructural inclusivity must form the next frontier of institutional imagination. The governance of the metaverse cannot rely on legacy models of command and control, nor can it defer to platform hegemony or market logic alone. Instead, it requires a new constitutional grammar-one that fuses programmable functionality with democratic openness, and institutional rigor with ethical flexibility. rCBDC, if normatively framed and institutionally disciplined, could contribute to such a horizon-not as instruments of digital domination, but as catalysts for a more just, transparent, and reflexive digital public sphere.

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