Gold, Representation, and the Conditions of Economic Realization

An Analysis of Fungibility, Institutional Eligibility, and State Correspondence in Physical and Tokenized Gold

INDEX

Abstract

Gold combines comparatively stable physical properties with highly developed systems of standardization, verification, custody, settlement, and market acceptance. Within institutional gold markets, materially comparable assets can function as interchangeable settlement material while retaining information concerning provenance, refinery status, production history, custody, and responsible sourcing. Material equivalence and informational indistinguishability are therefore not the same condition.

This distinction becomes economically relevant when institutional conditions change. Gold may remain materially comparable while its eligibility, acceptance conditions, conversion requirements, or available realization paths differ. A reference price consequently does not by itself describe every condition under which a particular gold position can be economically realized.

Tokenized gold extends this problem by introducing a digital representation whose technical state is distinguishable from the physical asset, custody arrangement, claim structure, eligibility conditions, and redemption mechanisms to which its economic meaning refers. These states can be analytically separated without being operationally independent.

This paper examines which distinctions can change while economic realization remains possible and which states or relationships must remain sufficiently intact. Using institutional gold-market structures, recycled gold, changes in Good Delivery eligibility, and existing tokenized-gold implementations as controlled cases, the analysis progresses from material standardization and contextual fungibility to economic realization, layered asset states, and cross-layer state correspondence.

1. Introduction

Gold presents an unusual analytical case because extensive physical standardization coexists with persistent information about individual assets and the institutional conditions under which they circulate. Institutional gold markets define characteristics such as weight, fineness, markings, and refinery status while retaining information capable of distinguishing individual bars, their production histories, and aspects of their provenance. Standardization therefore enables particular forms of interchangeability without requiring the informational elimination of every distinction between the assets being exchanged.

This creates a separation between two questions that can initially appear equivalent. The first concerns what the asset **is** in material terms. The second concerns the conditions under which that asset can be **accepted and economically realized** within a particular market structure. Material properties contribute to the first question, but they do not independently answer the second. Market eligibility, provenance requirements, custody arrangements, conversion requirements, location, liquidity, and other institutional conditions can remain relevant even where the underlying material is substantially comparable.

The distinction becomes especially visible where institutional status changes without a corresponding transformation of the gold itself. A bar can retain its relevant physical characteristics while the conditions governing its acceptance within a particular settlement structure change. Conversely, gold can undergo physical transformation through refining or recycling while subsequently entering a standardized market structure without preserving the identity of the original physical object. These cases indicate that physical continuity, informational continuity, institutional eligibility, and economic realization should not be treated as interchangeable properties.

Tokenization introduces another level of separation. A digital representation of gold can possess a technical state and transfer mechanism of its own, while the represented physical gold remains subject to custody, allocation, legal or economic claims, institutional eligibility, and redemption conditions outside the blockchain environment. Technical transferability of the representation therefore does not by itself establish the conditions under which the underlying economic interest can be exercised or realized. At the same time, separating these states analytically does not imply that they operate independently. Technical, contractual, custodial, and institutional mechanisms can connect them closely.

The resulting research problem is consequently broader than whether gold is physically fungible or whether a token representing gold is technically valid. It concerns the relationship among material properties, retained information, institutional acceptance, representation, and the mechanisms through which an economic position can ultimately be realized. Tokenized gold is useful in this analysis not as a separate asset theory, but as an extension of the physical and institutional gold case in which these relationships become more explicitly observable. This role corresponds to the defined scope: tokenized gold serves as an extension and boundary test rather than as the basis for generalizing the analysis to all tokenized real-world assets.

The paper therefore asks:

What must remain invariant for the economic value of gold to remain realizable when its physical, informational, institutional and digital states can change independently?

The question does not assume that a single invariant exists, that every relevant state can actually vary independently, or that physical and tokenized gold require identical realization conditions. Those limitations are part of the research design itself.

The analysis proceeds incrementally. It first examines whether persistent distinctions are compatible with fungibility in an institutional gold market. It then considers what changes when institutional eligibility affects the conditions of economic realization. Tokenized gold subsequently provides a controlled extension through which representation, backing, custody, claim, eligibility, and redemption can be distinguished without assuming their independence. Finally, the analysis examines how correspondence between these economically relevant states can be established and maintained across physical, institutional, legal, and digital environments.

The first step is therefore not to determine what ultimately preserves economic realization, but to establish a more limited proposition: **whether gold can remain functionally fungible while economically and institutionally relevant information about it continues to exist.**

2. Fungibility Without Information Loss

Fungibility is often associated with the idea that individual units become economically indistinguishable. Institutional gold markets provide a more differentiated case. Standardization allows qualifying gold to perform a common exchange or settlement function while information capable of distinguishing individual bars, their producers, and aspects of their histories continues to exist.

The Good Delivery framework illustrates this coexistence. Gold bars admitted to the relevant market structure must satisfy defined requirements concerning characteristics such as weight, fineness, dimensions, markings, and refinery status. At the same time, qualifying bars remain individually identifiable. Refinery markings, fineness, serial identification, and production information are not eliminated when the gold becomes acceptable as standardized settlement material. The institutional function of fungibility therefore operates alongside, rather than in place of, persistent identification. [1]

This distinction matters because it separates **functional interchangeability** from **informational indistinguishability**. Two bars do not need to become informationally identical for a market to treat them as interchangeable for a defined purpose. Instead, the market establishes which differences are relevant to that purpose and which differences can remain present without preventing exchange.

Responsible-sourcing requirements reinforce this separation. Information concerning origin, counterparties, material type, transport, and supply-chain conditions can remain necessary for due diligence even where physical material is aggregated or transformed. The persistence of such information does not itself prevent the resulting gold from entering standardized market processes. Physical material segregation is not universally required for informational traceability to retain an institutional function. [2]

Recycled gold provides a stronger test because the identity of the original physical object can disappear altogether. Previously refined gold may return through jewellery, bars, industrial material, scrap, or other gold-bearing products and subsequently be melted, combined, refined, and converted into new outputs. The resulting material need not preserve the identity of the object from which it originated. [3]

Yet the disappearance of continuous object identity does not eliminate every relevant form of continuity. Information concerning inputs, counterparties, origin categories, and the conditions of transformation can remain subject to due-diligence and responsible-sourcing requirements. What persists is therefore not necessarily the identity of a particular physical object, but sufficient information and process governance to establish the conditions under which transformed material can subsequently be accepted.

This provides an important boundary for the concept of fungibility. If persistent object identity were necessary for market acceptance, recycled and re-refined material would present a fundamental continuity problem. If complete informational erasure were necessary for fungibility, persistent traceability and due-diligence requirements would present the opposite problem. Institutional gold markets accommodate both phenomena: physical identity can be transformed while relevant information persists, and standardized outputs can remain functionally interchangeable within defined market contexts.

The existence of provenance information, however, cannot itself be treated as evidence that fungibility has been impaired. The counter-test is important here. Good Delivery

procedures permit qualifying material to perform the relevant settlement function without generally allowing a receiving party to require an arbitrary preferred brand in the absence of a separate agreement. At the same time, responsible-sourcing structures preserve information capable of distinguishing origins, counterparties, and processing histories. Persistent provenance and functional interchangeability can therefore coexist. [4]

This prevents a stronger inference. It would be incorrect to conclude that provenance necessarily differentiates otherwise qualifying gold for every economic purpose. A distinction becomes relevant to fungibility only where the institutional structure governing the particular exchange makes that distinction relevant to eligibility or acceptance. Information can consequently remain available without continuously determining the exchange function of the asset.

The resulting form of fungibility is therefore contextual. It is produced neither by physical equivalence alone nor by the removal of all information that could distinguish one unit from another. It operates within an institutional structure that determines which characteristics must satisfy common standards, which distinctions must remain observable, and which persistent differences can remain irrelevant to a particular exchange function.

Fungibility is contextual rather than equivalent to informational indistinguishability.

This conclusion does not establish that provenance is economically irrelevant. Nor does it establish that all qualifying gold must remain interchangeable under every institutional condition. It establishes the narrower point required for the next stage of the analysis: **distinctions can persist without impairing exchange until the applicable market structure makes one of those distinctions relevant.**

That boundary leads directly to the next question. If material equivalence and persistent information can coexist with functional fungibility, what changes when an institutional condition alters whether otherwise comparable gold remains acceptable within a defined market structure?

References

[1] London Bullion Market Association (LBMA), Good Delivery Rules — Technical Specifications; LBMA, About Good Delivery.
[2] London Bullion Market Association (LBMA), Responsible Gold Guidance Version 9, Step 1 and Step 2.
[3] London Bullion Market Association (LBMA), Responsible Gold Guidance Version 9, Definitions and Step 1.
[4] London Bullion Market Association (LBMA), Good Delivery Rules, Annex B: Weighing, Packing and Delivery Procedures.

3. Eligibility and the Conditions of Realization

The coexistence of persistent distinctions and functional fungibility establishes that not every difference associated with gold is economically relevant to every exchange. This changes when an institutional structure makes a particular distinction relevant to acceptance. At that point, materially comparable gold can occupy different positions within the same broader economic environment even though the underlying material has not undergone a corresponding transformation.

Good Delivery eligibility provides a controlled case. Acceptance within the relevant market structure depends not only on the physical characteristics of a bar but also on its relationship to recognized refiners, production requirements, and institutional rules. Gold can therefore retain the material properties associated with standardized bullion while a change in institutional status alters whether it remains acceptable for a particular settlement function.

The suspension of Russian Good Delivery refiners in 2022 illustrates this distinction. The institutional change did not transform the chemical composition of gold produced by the affected refiners. Instead, production timing and refiner status became relevant to the institutional classification of the bars. Qualifying material produced before the applicable suspension retained Good Delivery status, while subsequent production no longer qualified on the same basis. [5]

This separates **material condition** from **institutional eligibility**. The gold remains gold, but its relationship to a defined market structure has changed.

That difference matters because economic realization takes place through particular market mechanisms rather than through material properties in isolation. Where gold is immediately acceptable within a settlement structure, the route to realization differs from a situation in which verification, transport, refining, substitution, or another conversion process is required before the same material can enter that structure.

Institutional ineligibility does not therefore imply the disappearance of economic value. It can instead alter the path through which that value is realized. Material that cannot immediately perform one settlement function may remain saleable elsewhere, may enter another market, or may be converted into an acceptable form. The economic consequence lies initially in the conditions attached to those alternatives.

Those conditions can introduce friction. Additional verification can require time and counterparties. Refining or substitution can create costs. Transport can make location economically relevant. Alternative markets can differ in liquidity or accessibility. The underlying material may remain substantially comparable while the route from possession to realization becomes different. [6]

This is also why a reference price and the realizable economic position of a particular holding should remain analytically separate. A wholesale gold reference price applies within defined conventions concerning quality, form, location, and settlement. A specific holding may nevertheless require additional steps before it can be realized under those conditions. The reference price identifies a market benchmark; it does not by itself describe every friction associated with converting a particular position into that benchmark environment. [7]

The distinction must not be taken too far. Changed eligibility does not establish that the affected gold necessarily acquires a persistent discount or that its economic value changes by a determinate amount. Conversion mechanisms can restore access to a market. Alternative markets may remain available. Frictions can be small relative to the value of the position, temporary, or absorbed through existing market processes.

The Russian-refiner case demonstrates this limit particularly clearly. Different production periods could receive different Good Delivery treatment after the institutional change, but that distinction alone does not establish a corresponding difference in the underlying material value of the gold. The evidence establishes a change in **eligibility**, not a deterministic valuation result.

The relevant relationship is therefore conditional:

material equivalence does not guarantee equivalent realization conditions, but different realization conditions do not necessarily produce materially different realizable values.

What changes first is the path through which the economic position can be accepted, converted, transferred, or otherwise realized.

This produces a second distinction in the analysis. Material properties establish important characteristics of the asset, but economic realization also depends on relationships connecting that asset to the institutional structures through which it can

be used. Those relationships can change while the material remains substantially constant.

Economic realization depends not only on what the material is, but also on the conditions under which the relevant market can accept, convert or realize it.

The physical gold case therefore already separates material state from realization conditions. Tokenization does not create that separation. It makes it structurally more explicit by introducing a digital representation whose technical state can be observed separately from the physical asset and from the institutional relationships through which the represented economic interest is ultimately realized.

References

[5] London Bullion Market Association (LBMA), Russian Good Delivery Bars Information; LBMA, Good Delivery List Update: Gold & Silver Russian Refiners Suspended, 7 March 2022.
[6] London Bullion Market Association (LBMA), Good Delivery Rules, Annex B: Weighing, Packing and Delivery Procedures.
[7] London Bullion Market Association (LBMA), A Guide to the Loco London Precious Metals Market — The Price.

4. Tokenization and the Separation of States

The physical gold market already demonstrates that material condition, institutional eligibility, and economic realization are not identical. Tokenization adds another observable state to this structure. An economic interest in gold can now be represented by a digital object whose technical existence and transfer can be recorded independently of the physical processes through which the underlying gold is held, allocated, accepted, or redeemed.

This does not remove the institutional structure surrounding gold. The physical asset still has to exist under the conditions required by the relevant arrangement. It remains subject to custody. The holder's economic or legal interest must be defined. Eligibility conditions can continue to apply to the underlying gold, and redemption can depend on requirements that are not contained within the technical state of the token itself.

Tokenized gold therefore makes it possible to distinguish several economically relevant states:

representation
↔ backing and allocation
↔ custody
↔ claim

↔ eligibility
↔ redemption and realization

The distinction is analytical. It does not imply that these states form an independent sequence or that each can vary freely without affecting the others.

Existing tokenized-gold structures illustrate why this qualification matters. A token can represent an interest in allocated physical gold without requiring permanent association between each token unit and one unchanged physical bar. Transfers, conversions, redemptions, or other operations can result in changes to physical allocation while continuity of the represented economic interest is maintained. [8]

Specific physical identity is therefore not necessarily what preserves the tokenized interest. The relationship between representation and underlying gold can persist even when the particular bar associated with a holding changes.

This resembles an observation already made in the physical market. Recycled gold demonstrated that continuity of economic usability does not require continuity of the original physical object. Tokenized gold produces a different form of the same analytical separation: the represented interest can persist while physical allocation changes.

The two cases should not, however, be treated as equivalent mechanisms. Refining transforms physical material and can eliminate previous object identity. Tokenization preserves a digital representation while institutional and operational mechanisms maintain its relationship to qualifying underlying assets. What the cases establish jointly is narrower: **persistent economic continuity cannot be reduced to persistent identity of one physical object.**

A second separation appears between **technical transferability** and **economic redeemability.**

A token can be transferable through digital infrastructure while direct access to the represented physical gold remains subject to additional requirements. Verification, account status, minimum redemption quantities, fees, legal restrictions, operational availability, or other contractual conditions can govern whether and how the holder can exercise a particular redemption path. [9]

Technical transfer therefore establishes something important but limited. It establishes that the representation can move according to the rules of the digital system. It does not

independently establish that every economic right associated with the representation can be exercised at the same moment or under the same conditions.

The same analytical discipline applies to backing and custody. Evidence that sufficient physical gold exists addresses the relationship between representation and reserves. It does not, by that fact alone, describe every condition under which those reserves are controlled, accessed, allocated, or made available through a particular claim or redemption process.

Similarly, the existence of a claim and the ability to exercise that claim are distinguishable. Contractual or legal conditions can affect transfer, freezing, access, or redemption while other parts of the asset structure continue to exist. The economic state of the represented interest therefore cannot be inferred completely from any single one of these conditions. [10]

None of this means that representation, backing, custody, claim, eligibility, and redemption should be understood as autonomous layers.

In functioning tokenized-gold structures, mechanisms exist precisely to connect them. Allocation procedures connect token holdings to physical gold. Custody arrangements connect reserves to controlled holdings. Contractual structures connect possession of the representation to defined economic interests. Redemption rules connect those interests to particular realization mechanisms. [11]

The relevant states are consequently **distinct but coupled**.

This distinction is necessary because evidence concerning one state does not automatically establish the state of another. At the same time, the couplings between them are themselves part of the structure being examined. Removing those couplings analytically would misrepresent the system just as much as collapsing all states into the token representation would.

Tokenization therefore does not transform gold into a purely digital economic object. Instead, it introduces a technical representation into an existing set of physical and institutional relationships and makes the connections among those relationships more explicitly observable.

That observation also defines the limit of what technical validity can establish. A valid token state can establish properties of the representation within its technical

environment. It cannot independently establish the complete economic state of the represented interest because parts of that state remain constituted through relationships outside that environment.

Tokenization makes economic integrity observable as a layered and coupled structure rather than reducing the asset relationship to the technical validity of the token.

The analytical problem now changes accordingly. Once representation, backing, custody, claim, eligibility, and redemption can be distinguished without assuming their independence, the central question is no longer merely whether each state exists. It is **how sufficient correspondence among those states is established and maintained as the represented economic interest moves through time and across system boundaries.**

References

[8] Paxos, Pax Gold (PAXG) Transparency / Allocation Information and applicable PAXG Terms and Conditions; Tether, Tether Gold (XAU₮) — Gold Allocation.
[9] Paxos, PAXG Terms and Conditions and applicable redemption documentation; Tether, Tether Gold (XAU₮) — Redemption / Terms.
[10] Paxos, PAXG Terms and Conditions; Tether, Tether Gold (XAU₮) Terms.
[11] Paxos, PAXG Transparency / Allocation Information and PAXG Terms and Conditions; Tether, Tether Gold (XAU₮) — Gold Allocation and applicable terms.

5. Cross-Layer State Correspondence

The separation of representation, backing, custody, claim, eligibility, and redemption creates an informational problem that does not arise entirely within any one of those states. If the economic meaning of a tokenized gold position depends on relationships extending beyond the digital representation, information about those relationships must remain sufficiently connected to the state presented within the digital system.

Blockchain infrastructure can establish properties of the representation itself. It can record token issuance, ownership changes, transfers, and other events governed by the relevant protocol. These records can provide strong evidence concerning what has occurred within that technical environment. They do not, however, independently observe whether physical gold remains in custody, whether an allocation continues to correspond to qualifying reserves, whether a particular claim remains exercisable, or whether redemption conditions outside the blockchain have changed.

This creates a boundary between **represented state** and **externally constituted economic state.**

The boundary does not imply that the two are disconnected. Tokenized-gold structures use external information precisely to maintain relationships across it. Reserve reports, attestations, custody records, allocation information, and related assurance mechanisms provide evidence about conditions that cannot be established from token state alone. [12]

Reserve assurance offers the clearest example. A comparison between issued token supply and physical reserves can establish evidence concerning the backing relationship. That evidence can substantially strengthen the correspondence between what the digital representation implies and what exists outside the digital environment.

Its evidentiary scope nevertheless remains specific. Verification that sufficient reserves exist does not by itself establish every other condition relevant to the economic position. The same observation does not necessarily determine whether custody remains accessible under all circumstances, whether a claim is enforceable for a particular holder, whether physical redemption is currently available, or whether the underlying gold satisfies every relevant institutional condition. [13]

This does not make reserve verification incomplete for the purpose it is designed to serve. It establishes a more limited point: **the validity of an assurance result is bounded by the relationship being assured.**

The distinction becomes particularly important when multiple economically relevant relationships coexist. A tokenized position may simultaneously depend on sufficient reserves, appropriate custody, a defined claim structure, applicable eligibility conditions, and available realization mechanisms. Evidence concerning one relationship can contribute to confidence in the overall structure without logically establishing all of the others.

Assurance can also extend beyond retrospective reporting. External observations can be introduced into digital systems in machine-readable form and connected to protocol controls. Proof-of-Reserve architectures illustrate this possibility by allowing verified reserve information to affect functions such as issuance or other predefined system behavior. [14]

In such a structure, cross-layer assurance does more than report that two states corresponded at an observation point. It can participate in maintaining a defined relationship by constraining digital-system behavior when an externally observed condition no longer satisfies a specified requirement.

This changes the character of the correspondence problem. The boundary between physical and digital states is not necessarily a passive verification gap that can only be inspected after the fact. It can become an actively governed interface through which observations about one environment influence permitted actions in another.

The effectiveness of such a mechanism remains bounded by what it actually observes. A control responding to reserve quantity cannot infer an unobserved change in legal enforceability. A system receiving custody information cannot automatically establish market eligibility. Increasing automation of one assurance relationship does not expand that relationship into evidence concerning every other economically relevant state.

A second limitation is temporal.

A periodic attestation establishes evidence concerning correspondence at a defined observation or reporting point. The represented digital state can continue changing between such points. The existence of different update frequencies therefore creates a distinction between **verified correspondence at time** and **continuous correspondence across an interval**.

This distinction must also be handled carefully. Periodic verification does not imply that correspondence becomes false between reporting events. It means only that the assurance mechanism does not independently establish continuous observation throughout the interval.

More frequent, automated, or event-driven assurance can reduce this temporal distance. It can bring externally observed conditions and digital-system responses into closer temporal alignment. But increased frequency addresses the **timeliness of observed correspondence**, not necessarily the **completeness of the economic state being observed**. **[15]**

Cross-layer assurance therefore has at least two independent boundaries:

coverage — which states and relationships are actually observed;

and

temporality — when and how continuously those observations apply.

Neither boundary implies failure. Both define what can legitimately be inferred from the assurance mechanism.

This produces a more precise understanding of the relationship between representation and underlying economic state. Correspondence is neither guaranteed merely because a token remains technically valid nor necessarily absent because relevant conditions exist outside the blockchain. It can be established, monitored, updated, and in some architectures actively supported through mechanisms connecting different system environments.

The important question is therefore not whether an external component exists, but what relationship that component establishes and how far its evidence extends.

Cross-layer integrity depends on maintained correspondence, but correspondence is only as extensive as the states, relationships and temporal conditions included within the assurance structure.

The four analytical movements have now established the conditions required to return to the original Research Question. Material identity can change. Information can persist without preventing fungibility. Institutional eligibility can change without eliminating material value. Physical allocation can change while a tokenized economic interest continues. Technical representation can remain valid without independently establishing the complete economic state. Assurance mechanisms themselves can also vary.

The remaining task is therefore narrower: **to test whether the evidence identifies any single state that must remain invariant—or whether continuity instead depends on something that persists across changes in those individual states.**

References

[12] Paxos, *PAXG Transparency / Allocation Information* and reserve attestation materials; Tether, *Tether Gold (XAU₮) — Gold Allocation* and applicable assurance materials.
[13] Paxos, PAXG reserve/attestation and applicable custody, claim, and redemption documentation; Tether, applicable XAU₮ assurance and terms documentation.
[14] Chainlink, *Proof of Reserve* documentation.
[15] Chainlink, *Proof of Reserve* documentation; applicable periodic reserve-attestation materials for tokenized-gold implementations.

6. Synthesis — Testing the Invariance Question

The preceding analysis began with a question about continuity:

What must remain invariant for the economic value of gold to remain realizable when its physical, informational, institutional and digital states can change independently?

The evidence does not support the assumption that all of these states are in fact independent. Tokenized-gold structures demonstrate substantial technical, contractual, custodial, and institutional coupling. The question nevertheless remains analytically useful because the relevant states can change differently and because evidence concerning one does not automatically establish the condition of another.

The task is therefore to identify whether any particular state examined in the preceding sections is itself necessary as an invariant for continued economic realization.

6.1 Physical Object Identity

Physical object identity is the first candidate.

A particular gold bar can be individually identified through markings, refinery information, serial identification, and production information. Such identity can matter for verification, provenance, custody, and institutional acceptance.

The recycled-gold case demonstrates, however, that continuity of the original physical object is not necessary for subsequent economic usability. Gold can be melted, combined, refined, and transformed into a new standardized output. The original object's identity can disappear while the resulting material subsequently becomes acceptable within an institutional market structure.

Tokenized gold provides a second, structurally different test. The economic interest represented by a token can continue while the particular physical bars allocated to that interest change through transfers, conversions, redemptions, or reallocation procedures.

These cases do not make physical identity irrelevant. They show that **persistent identity of one specific physical object cannot serve as the required invariant.**

6.2 Complete Informational Identity

A second candidate is continuity of information.

The analysis has established that information can persist even where physical material is transformed. Provenance, counterparty information, production records, input/output references, and other forms of documentation can remain relevant to due diligence and institutional acceptance.

But complete informational identity is not required for fungibility.

Good Delivery gold can remain functionally interchangeable for a defined settlement purpose while asset-specific information continues to distinguish individual bars. Conversely, recycled material can enter a new physical state without preserving every informational property associated with its previous form.

The decisive condition is therefore not preservation of all information without change.

Some information must remain available because a particular institutional process makes it relevant. Other distinctions can remain present without affecting exchange, while still others can cease to describe the transformed asset in the same way.

Complete informational identity cannot therefore serve as the required invariant.

6.3 Institutional Eligibility

Institutional eligibility is a stronger candidate because it can directly affect whether gold is acceptable within a particular market structure.

The Good Delivery case demonstrates that eligibility can change even where the underlying material remains substantially comparable. Such a change can alter settlement access and introduce verification, conversion, transport, liquidity, or other realization frictions.

Yet eligibility within one institutional structure is not identical to the continued existence of economic value.

Gold that is not immediately eligible for one settlement function can remain materially valuable. Alternative markets can exist. Conversion can restore eligibility. Different realization mechanisms can remain available.

The counter-test therefore prevents eligibility from becoming an absolute invariant.

It can be highly relevant to the conditions of realization without being a condition that must remain unchanged under all circumstances.

A particular institutional eligibility state cannot therefore serve as the required invariant.

6.4 Specific Physical Allocation

Tokenized gold makes specific physical allocation independently testable.

If continuity of the represented economic interest required permanent association with one particular bar, changing allocation would interrupt that continuity.

Existing tokenized-gold structures demonstrate the opposite possibility. Physical allocation can change while the represented interest continues under the governing arrangement.

What must persist is therefore not necessarily the same mapping between one token unit and one immutable physical object.

Allocation remains important because it contributes to establishing the relationship between representation and backing. But the particular allocation can change while that relationship is maintained through other qualifying assets.

Specific physical allocation cannot therefore serve as the required invariant.

6.5 Technical Representation State

Technical representation is another possible candidate.

Within a tokenized system, the digital representation provides the mechanism through which holdings and transfers are recorded. Its technical validity is consequently necessary for the representation to perform its intended function within that environment.

But the analysis has shown that technical validity does not independently establish the complete economic state of the represented interest.

A technically valid token state cannot by itself establish physical backing, custody conditions, claim enforceability, market eligibility, or redemption availability. Those conditions depend on relationships extending beyond the representation.

Technical validity is therefore necessary for a functioning tokenized representation but insufficient as an invariant of the underlying economic realization problem.

Technical representation state alone cannot serve as the required invariant.

6.6 A Particular Assurance Mechanism

The final candidate is assurance itself.

Cross-layer systems require mechanisms capable of establishing information about states that cannot be observed from the digital representation alone. Attestations, reserve reports, custody information, allocation records, and automated Proof-of-Reserve mechanisms can all contribute to that function.

No single assurance mechanism, however, is required by the evidence.

Different structures can observe different relationships through different methods and at different temporal resolutions. A periodic attestation and an automated reserve feed do not operate identically, yet both can contribute evidence concerning correspondence between representation and underlying state.

The relevant requirement therefore cannot be the persistence of one specific assurance architecture.

What matters is what the mechanism establishes, which relationship it observes, and whether the resulting information remains sufficient for the function attributed to it.

A particular assurance mechanism cannot therefore serve as the required invariant.

6.7 What Remains After Elimination

The elimination produces a notable result.

The evidence does not identify one physical object, one complete information state, one institutional status, one allocation, one technical representation state, or one assurance mechanism that must remain unchanged across all of the examined cases.

Yet this does not imply that economic realization can survive arbitrary change.

Recycled gold can lose original object identity because processes remain capable of establishing an acceptable resulting material state.

Gold can lose eligibility within one institutional context while retaining alternative realization paths or the possibility of conversion.

A tokenized interest can survive changes in physical allocation because mechanisms continue to connect the representation to qualifying backing.

Technical transfer can remain meaningful because contractual, custodial, and institutional structures continue to define the economic interest to which the representation refers.

Assurance mechanisms can change because their function is not defined by one particular technical form, but by the relationships they are capable of observing and supporting.

Across these cases, continuity therefore appears at a different analytical level from the individual states themselves.

What must remain sufficiently intact is the ability to connect an economic interest to conditions under which it can still be identified, accepted, and realized.

This does not require every relationship to remain unchanged. Conversion itself demonstrates that the path can change. Reallocation demonstrates that the underlying physical mapping can change. Alternative market access demonstrates that the institutional route can change.

The required continuity is therefore not necessarily continuity of a fixed route.

It is continuity of a **viable realization path**.

A viable realization path exists where the economically relevant relationships remain sufficiently coherent for the asset or represented interest to remain identifiable, to satisfy or reach applicable conditions of acceptance, and to provide an available mechanism through which economic realization can occur.

This formulation also preserves the limits established by the counter-tests.

It does not imply that every change in eligibility changes value.

It does not assume that analytically distinguishable states are independent.

It does not require every economically relevant relationship to be separately verified.

It does not imply that assurance establishes more than the states and relationships it actually observes.

And it does not imply that the existence of a viable realization path guarantees a particular price.

The original invariance question can therefore be answered more narrowly than an asset-state interpretation would suggest:
What appears to require continuity is not one specific physical, informational, institutional or digital state, but a sufficiently intact path through which the economic interest remains identifiable, acceptable and realizable under the relevant conditions.

This is the point at which the preceding findings converge. The conclusion can now examine the bounded interpretive implication of that convergence without extending it into a general theory of value.

7. Conclusion

Gold is commonly treated as a comparatively simple economic object because its material properties can be standardized with considerable precision. The analysis in this paper shows that this simplicity does not extend automatically to the conditions under which an economic interest in gold remains realizable.

Within institutional gold markets, standardized material can remain functionally fungible while information concerning individual bars, provenance, production, and

responsible sourcing continues to exist. Fungibility therefore does not require informational indistinguishability. It depends on which distinctions the relevant institutional context makes consequential for a particular exchange function.

The same separation appears when eligibility changes. Materially comparable gold can occupy different institutional states without undergoing a corresponding physical transformation. Such differences can alter settlement access, conversion requirements, liquidity, verification, or other realization conditions. They do not, however, establish a deterministic difference in economic value. Alternative markets and conversion mechanisms can preserve or restore viable realization paths.

Tokenized gold makes these relationships more explicit. The digital representation introduces a technical state that can be distinguished from physical backing, allocation, custody, claim, eligibility, and redemption. None of these distinctions implies that the states are operationally independent. Existing structures instead depend on mechanisms that couple them and maintain economically meaningful relationships across physical, institutional, legal, and digital environments.

Cross-layer assurance addresses part of this problem by providing evidence about states that the digital representation cannot independently observe. Reserve attestations, custody information, allocation records, and automated assurance mechanisms can establish and, in some architectures, actively support defined relationships between external conditions and digital-system behavior. Their evidentiary force nevertheless remains bounded by the states, relationships, and temporal conditions they actually observe.

Taken together, these findings answer the invariance question by shifting the analytical focus away from any single asset state.

The original physical object need not persist.

Complete informational identity need not persist.

A particular institutional eligibility state need not persist.

A particular physical allocation need not persist.

No single assurance mechanism need persist.

And, in a tokenized structure, technical validity of the representation is not sufficient to establish the complete economic state of the represented interest.

Economic realization can nevertheless continue where changes in these individual states do not destroy the relationships required to connect the economic interest to an available realization path.

The relevant continuity can therefore be described as **Relational Value Integrity**:

The continued coherence of the economically relevant relationships through which an asset can be identified, accepted and its economic value realized.

For tokenized gold, this additionally requires sufficiently reliable correspondence between the states represented within the digital system and the physical, custodial, institutional, or contractual states on which the represented economic interest depends.

Relational Value Integrity does not require every relationship to remain unchanged. A physical object can be transformed. Allocation can change. Eligibility can be restored through conversion. One realization route can be replaced by another. Assurance architectures can operate through different mechanisms.

What matters is whether those changes preserve or permit the reconstruction of a sufficiently coherent path from the economic interest to its realization.

This distinction is important because it separates **continued economic realizability** from state persistence. The continued realizability of an economic interest does not require all of the states associated with the asset to remain fixed. Nor does the persistence of one state—such as material composition, technical token validity, or reserve quantity—by itself establish continued economic realizability.

The analysis therefore supports a bounded conclusion:

Economic realization can survive changes in individual physical, informational, institutional or digital states where the relationships required to identify, accept and realize the economic interest remain sufficiently coherent. Tokenization makes this dependence more explicit because technical representation, underlying asset relationships and assurance mechanisms become separately observable parts of the same economic structure.

This conclusion does not establish that relational coherence determines the price of gold, that every relevant relationship contributes equally to economic realization, or that every identified state can vary independently. It also does not establish that assurance mechanisms can provide complete knowledge of an asset's economic condition.

Most importantly, **Relational Value Integrity is not proposed here as a general theory of value**. The analysis concerns the continued realizability of an economic interest in gold under changing physical, informational, institutional, and digital conditions. Tokenized gold functions as an extension and boundary test of that problem.

Whether the same structure applies to other tokenized real-world assets remains outside the scope of this paper.

The narrower result is sufficient: **the continuity relevant to economic realization resides not necessarily in an unchanged asset state, but in the continued coherence of the relationships through which that asset remains identifiable, acceptable and economically realizable.**