Starging
Design and Custody of Value Systems

Economics of Observable Value

EVO | Financial Edition | 01

An Institutional Risk Framework for the Financial Professional

Expanded Edition — Technical Reading for Risk Management, Capital Markets, and Prudential Regulation

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Institutional document — Foundational treatise, edition for the financial professional

Note on this edition

This edition rewrites the foundational treatise of the Economics of Observable Value (EVO) — including the ten evolutions in its expanded edition— from the perspective of a reader with a finance background: risk management (CRO, risk quants), capital markets, investment banking, credit analysis, prudential supervision, or portfolio management. The axiomatic content and the theorems remain unchanged; altering them would produce a different document. Each theoretical block is accompanied by an applied reading that translates EVO's notation into vocabulary already familiar to that reader: collateralization, haircuts, credit ratings, regulatory capital, mark-to-market, counterparty risk, backtesting, and early warning.

The two-part structure is preserved —Part I: Foundations and Part II: Evolutions of the EVO Program— and, immediately after this note, an Executive Summary and an EVO ↔ finance correspondence glossary are added, designed so that a financial professional can decide in five minutes whether the framework is relevant to their role before examining the full formal apparatus.

Executive Summary for the Financial Professional

The question EVO answers, in one sentence: under what conditions does a financial instrument —a security, a position, a token, a credit rating— actually have something real behind it, and how is the gap measured, in continuous time, between what a system claims to have represented and what that system can actually exhibit in the face of a run, an audit, or a default event?

Why this should matter to a financial professional: EVO formalizes, with a single axiomatic apparatus, a problem already familiar to risk practitioners through a range of tools — collateral haircuts, loan-to-value, the quality of underlying assets in securitizations, stablecoin reserves, Basel III regulatory capital— and proposes an aggregate metric, the Representation Gap (BR), directly analogous to an

Executive Summary for the Financial Professional

uncollateralized symbolic leverage ratio, together with a composite index (ICS) explicitly designed to function as an input to an early-warning system.

What EVO is NOT: it is not an asset valuation model, it does not replace CAPM, it does not replace a structural credit-risk model (Merton) or an already-validated *stress testing* model; it is a precondition layer —"is there verified institutional admissibility behind this representation?"— that sits logically *before* any pricing model and that, under the framework's central hypothesis, should improve the predictive power of existing models when incorporated as an additional variable, not replace them.

The four results with the greatest direct operational relevance:

1.**Theorem 1 (No Creation by Representation)** — formalizes why securitizing, tokenizing, or rating an unverified asset does not generate value or reduce real risk; it only shifts the risk toward the mass-verification event (a run, a systemic *margin call*).
2.**Theorem 3 (Systemic Friction, Φ)** — is, in essence, a formal model of why uncollateralized symbolic leverage erodes a system's stability before the market price reflects it — the central thesis behind the EVO reading of 2008 (Chapter XVII).
3.**Representation Gap (BR)** — a candidate macroprudential indicator complementary to already-used capital and liquidity ratios, designed to capture the decoupling between represented volume and verified volume *before* it shows up in spreads or in the instrument's price. 4.**Chapter XX (digital assets)** — applies the framework directly to *stablecoins*, tokenization of real-world assets (RWA), and CBDCs, with an explicit custody-design criterion for reserve schemes and continuous auditing.

How to read the rest of the document if time is limited: Chapter III (notation), Chapter VI (theorems), Chapter VIII (macro-financial implications), Chapter XIV (quantitative indices), Chapter XVI (econometric specification), and Chapter XX (digital assets) concentrate the material most directly applicable to risk, treasury, structuring, or supervisory functions.

Starging
Design and Custody of Value Systems

EVO and Finance: Correspondence Glossary

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EVO and Finance: Correspondence Glossary

EVO concept	Notation	Equivalent or analogue in financial practice
Observable reality	R	A real asset or economic flow, prior to any instrument representing it
Observation system	Ω = (P, I, τ)	Audit/verification function: rating agency, external auditor, custody oracle, appraiser, KYC/AML
Economic observation	O_Ω(x)	Asset effectively audited/verified by a recognized source
Admissibility	A(x)	Asset eligible as collateral, asset fit for regulatory balance-sheet treatment, security with approved due diligence
Observable Value	V(x)	The basis on which a pricing model (DCF, comparables, CAPM) can validly be applied
Representation	Rep(x)	The financial instrument itself: bond, security, ABS/MBS, token, rating, accounting entry
Custody	C(x,t)	Custody function, periodic reconciliation, proof of reserves, recurring audit
Systemic friction	Φ(S,t)	Uncollateralized symbolic leverage / unaudited-reserve gap
Representation Gap	BR(t)	Ratio: (representation issued − verified underlying asset) / representation issued
Stability	Estab(S,t)	Proxy for systemic resilience in a stress event or run
Systemic Coherence Index	ICS(t)	Composite indicator; candidate early-warning indicator

PART I — FOUNDATIONS

PART I — FOUNDATIONS

I. Introduction and Motivation

Every economic theory, from its classical formulations to contemporary ones, faces a question that precedes any model of prices, equilibrium, or distribution: what enables a good, a right, or a promise to be treated as economic value? Adam Smith answered by appealing to embodied labor and exchange in free markets; Léon Walras, to a system of simultaneous supply-and- demand equations; Alfred Marshall, to the intersection of partial curves under the *ceteris paribus* assumption; Friedrich Hayek, to the dispersed knowledge aggregated by the price system; John Maynard Keynes, to effective demand and expectations; Ronald Coase, to transaction costs and the allocation of property rights; Douglass North, to the institutional framework that reduces uncertainty; Elinor Ostrom, to the polycentric governance arrangements over common-pool resources.

The Economics of Observable Value (EVO) does not aim to replace these frameworks, but to identify and formalize a condition that logically precedes them and that, to a large extent, remains implicit in all of them: for any of these mechanisms —labor, equilibrium, prices, dispersed knowledge, expectations, transaction costs, institutions, or communal governance— to operate on an object, that object must first have been observed and admitted by an institutional system capable of recognizing it as such. EVO calls this prior condition *institutional observability*, and holds that the absence of admissible observability is the structural cause behind phenomena as diverse as economic informality, the illiquidity of unregistered assets, the failure of digital custody systems, and the fragility of financial representations disconnected from their real substrate.

This treatise develops EVO from its original conceptual manifesto —five axioms, six definitions, one fundamental law, and four theorems stated without proof— toward a formulation with explicit mathematical notation, formal proofs, an operationalizable institutional architecture, testable macroeconomic implications, and an empirical validation methodology. The goal is to develop EVO to a level of formal rigor comparable to that of the traditions critically discussed here, without claiming the same historical breadth or the same volume of accumulated evidence.

A clarification about epistemic status is necessary: EVO is, at this stage of development, an emerging institutional theory, not a consolidated theory with decades of empirical testing like those of Smith, Walras, or Keynes. Its current value

lies in the axiomatic clarity of its starting point and in the possibility of deriving falsifiable propositions from it. The treatise that follows seeks to honor that distinction: it formalizes without overstating the theory's epistemic status, and devotes an entire chapter to examining, without concessions, where EVO coincides, where it overlaps, and where it genuinely diverges from the eight selected traditions.

II. Philosophical and Epistemological Foundations

EVO rests on an institutional realism: observable reality (R) exists independently of any system of economic representation (Axiom 1), but the economic recognition of that reality —its transition from "fact" to "value"— depends on institutional acts of observation (Axiom 2). This distinction echoes, without identifying itself with, the Humean separation between "what is" and "what ought to be": EVO does not derive normative value from brute facts, but describes the institutional mechanism by which a brute fact becomes an economically admissible fact — that is, one susceptible to being represented, transferred, guaranteed, or litigated.

The underlying epistemology is fallibilist and procedural: no observation system captures the totality of reality (hence the Observability Expansion Theorem, which treats observability as a cumulative and unfinished process, not a terminal state). Economic admissibility is not an intrinsic property of objects, but a relation between an object, an observation system, and a set of recognition rules in force within a given jurisdiction or institution. This brings EVO close to North's institutionalism in its emphasis on the rules of the game, while distinguishing EVO from that tradition in that North treats institutions as reducers of uncertainty about other agents' behavior, whereas EVO treats institutions as producers of admissibility over objects and states of affairs.

A second epistemological commitment is the strong anti-representationism expressed in Axiom 4 ("representation never creates value"): financial instruments, securities, accounting records, and digital assets are not sources of value but vehicles for a value whose existence depends on the prior chain observation → admissibility → conversion. This principle is EVO's normative core and the one that generates its most direct implications about representation bubbles, symbolic over-leverage, and the fragility of digital custody systems, developed in Chapter VIII.

Notation and Formal Definitions

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III. Notation and Formal Definitions

The notational apparatus used throughout the rest of the treatise is introduced below. Let U be the universe of possible states of affairs (physical objects, rights, promises, information flows). The following sets and functions are defined:

- **R ⊆ U:** the subset of states of affairs that constitute observable reality at a given moment — facts that exist independently of any system of economic representation (Axiom 1).
- **Ω:** an institutional observation system, understood as a triple Ω = (P, I, τ), where P is a capture protocol (sensors, audits, records, verifiable testimony), I is the institution that operates P (a public registry, a court, a regulated market, a certified accounting system), and τ is the reliability threshold required for an observation to be valid.
- **O:** O_Ω(x) → {0,1}, the Economic Observation function, which returns 1 if the state of affairs x ∈ R has been effectively captured by system Ω according to its protocol P and its threshold τ, and 0 otherwise.
- **A:** the Economic Admissibility function, A(x) = 1 if and only if O_Ω(x) = 1 for at least one system Ω recognized by the prevailing institutional framework J (a jurisdiction, a regulatory regime, a set of contractual norms). A(x) = 0 in any other case, including the case where x ∈ R but no admitted Ω has observed it.
- **V(x):** the Observable Value of x, defined only over the domain {x ∈ U : A(x) = 1}. V is not a pricing function; it is a domain condition: V(x) is defined if and only if A(x)=1, and undefined (⊥) otherwise.
- **Rep(x):** the Economic Representation function, which maps x to a symbolic instrument r such that r “represents” x. EVO requires, by Axiom 4, that Rep(x) be well-defined only if V(x) ≠ ⊥, i.e., only if A(x) = 1.
- **C(x):** the Economic Custody function, which measures the temporal persistence of the link between Rep(x) and x — the degree to which, over time t, Rep_t(x) continues to correspond to the same x originally observed.

IV. Formalized Axioms

- **Axiom 1 (Ontological independence):** ∃ R ⊆ U such that R is non-empty and its membership does not depend on any Rep, O, or A.

The Fundamental Law

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- **Axiom 2 (Precedence of observability):** ∀x, A(x) = 1 → ∃Ω recognized by J such that O_Ω(x) = 1. There is no admissibility without prior observation.
- **Axiom 3 (Constitutive conversion of status):** the transition of x ∈ R from A(x)=0 to A(x)=1 —conversion— is a discrete institutional act, not a gradual one: A: U → {0,1} is a binary function, not a continuous one.
- **Axiom 4 (No creation through representation):** ∀x, ∀r = Rep(x), r adds no content to x; formally, κ(Rep(x)) = κ(x) for every x with A(x)=1, where κ is a function of substantive content.
- **Axiom 5 (Systemic coherence):** the stability of an economic system S, Estab(S), is a decreasing function of systemic friction Φ(S), and depends on there being sustained correspondence between {Rep(x)} and the set of objects with A(x)=1 effectively in force.

> **Reading for the financial professional — Axioms.** Axiom 4 (no creation through representation) is, in origination-desk terms, the claim that securitizing or rating an asset does not improve the real credit quality of the underlying asset: it only moves it into a tradeable instrument. Axiom 2 (precedence of observability) is the formal equivalent of the *"no collateral without verification* principle: no asset can enter a regulatory capital or *loan-to-value* calculation base without having been effectively verified by an audit function recognized by the applicable regulatory framework (Basel, SEC, BCRA, depending on jurisdiction). Axiom 3 (discrete conversion) is relevant for understanding why enabling an asset as eligible collateral is not a continuous process but a discrete approval event —a rating, a regulatory homologation— with the operational-risk implications that entails (the exact moment of conversion concentrates the risk of error).

V. The Fundamental Law

EVO's Fundamental Law: ∀r belonging to the set of legitimate economic representations of a system S, ∃x ∈ U such that r = Rep(x) and A(x) = 1.

In plain language: every legitimate economic representation presupposes the prior existence of an admissible observable value. A representation without an underlying admissible object is, by definition within EVO, an unfounded representation — not necessarily fraudulent in a legal sense, but structurally fragile, in the sense formalized by Theorem 3.

Theorems and Proofs

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VI. Theorems and Proofs

Theorem 1 — No Creation by Representation. For every $x \in U$, if $A(x) = 0$, then there exists no sequence of representation operations $\{Rep_1, \ldots, Rep_n\}$ such that, after applying them, $A(x) = 1$.

Proof: By Axiom 2, $A(x)=1$ requires $\exists\Omega$ such that $O_\Omega(x)=1$. Rep is a function whose domain is $\{x : A(x)=1\}$; therefore Rep(x) is undefined when $A(x)=0$, and no composition can be applied to an x outside that domain. No representation operation can alter $O_\Omega(x)$, which is a function of the pair (x, Ω) and not of the space of representations. Hence A(x) remains 0. ∎

Corollary 1.1: creating financial instruments over unobserved objects does not turn those objects into observable value; it constitutes Rep(x) for $x \notin dom(A)$, with no substantive content (Axiom 4) and incapable of generating retroactive admissibility (Theorem 1).

Theorem 2 — Expansion of Observability. The set of recognized observation systems $\{\Omega_1, \ldots, \Omega_k\}$ within an institutional framework J can increase monotonically over time ($\forall t, K(t+1) \geq K(t)$), and consequently $|A^{-1}(1)|$ is a non-decreasing function of K(t).

Proof (sketch): If at t+1 a system $\Omega_{K(t)+1}$ is added without removing any prior Ω, the set of sufficient conditions for $A(x)=1$ can only expand (union of events), so that $A_t(x)=1 \Rightarrow A_{t+1}(x)=1$. Therefore $|A_{t+1}^{-1}(1)| \geq |A_t^{-1}(1)|$. ∎

This theorem formalizes a central intuition: financial inclusion, the formalization of informal property, and the digitization of public registries are particular cases of the expansion of K(t), and predict increases in the volume of admissible observable value without this implying the creation of new substantive wealth.

Theorem 3 — Systemic Friction. Define $\Phi(S,t) = |\{r \in Rep_t(S) : \nexists x, A_t(x)=1 \wedge r=Rep(x)\}| / |Rep_t(S)|$, the proportion of active representations with no correspondence to an admissible object. Then Estab(S,t) is a decreasing function of $\Phi(S,t)$: $d\Phi/dt > 0$ over an interval implies $dEstab/dt < 0$, *ceteris paribus*.

Proof (sketch): Faced with a mass-verification event that requires exhibiting x for each r, the system cannot satisfy the fraction $\Phi(S,t)$ of demands. The probability of aggregate default grows with Φ, and Estab decreases with that probability. ∎

Institutional Architecture

Theorem 4 — Custodial Stability. If ∀x ∈ dom(A_0), C(x,t) remains above a critical threshold γ for all t ∈ [0,T], then Φ(S,t) remains bounded by Φ_max < 1 over that interval, and Estab(S,t) remains bounded below.

Proof (sketch): Φ(S,t) grows when a representation loses correspondence with its original x, which occurs when C(x,t) falls below γ. If C(x,t) ≥ γ for all x and t ∈ [0,T], no representation active at t=0 transitions into "no correspondence" over that interval. ∎

Theorem 4 is the formal basis of EVO's central institutional recommendation: investment in custody functions is not an accessory administrative cost but the direct control variable over a system's long-run systemic stability.

> **Reading for the financial professional — Theorems. Theorem 1** is the direct formalization of securitization risk on unverified assets: issuing an ABS/MBS or a token on an unaudited asset pool does not reduce the pool's risk, it only packages and distributes it —the error the 2008 literature already documented extensively, here derived as a corollary of an axiom, not as an isolated empirical observation. **Theorem 2** is the formal basis for why financial inclusion and the digitization of property registries expand the universe of eligible collateral without, by themselves, creating new wealth: they expand K(t), the number of recognized verifiers, not the underlying asset. **Theorem 3 (Φ)** is, in risk practice, a formal analogue of a symbolic-leverage indicator: it measures what proportion of a system's active representations (deposits, securities, tokens) lack verified correspondence with an admissible asset, and predicts —under the same logic as a Diamond–Dybvig-type bank-run model— that fragility accumulates silently until a mass-verification event (a run, a forced audit, a systemic *margin call*). **Theorem 4** formalizes the intuition already present in *proof of reserves* design and in periodic custodian-audit requirements: long-run stability depends on reconciliation frequency, not only on asset soundness at the moment of issuance.

VII. Institutional Architecture

EVO posits five universal institutional functions: **Observation** (Ω), **Admissibility** (A), **Conversion** (the discrete act by which A(x) moves from 0 to 1), **Representation** (Rep), and **Custody** (C). These functions need not be exercised by a single institution; in modern economies they tend to be distributed among public registries, regulatory agencies, private auditors, courts, and markets.

Macroeconomic Implications

EVO’s institutional architecture does not prescribe a single organizational form (state, private, or hybrid) for each function; it prescribes that the five functions exist and be verifiably coupled. The absence or weakness of any of them is, within the framework, the identifiable structural cause of the systemic friction formalized in Theorem 3.

VIII. Macroeconomic Implications

8.1 Monetary policy and anchoring. Under EVO, monetary issuance is a case of Rep(x) where x is an economy’s productive capacity and admissible reserves. Expansion of the monetary base with no correlate in A(x) increases Φ(S,t), with the falsifiable prediction that, beyond a certain threshold and without custodial correction, system stability deteriorates.

8.2 Financial systems and digital assets. Any r=Rep(x) issued without A(x)=1 being verified increases Φ(S,t) of the financial system, even if the instrument circulates normally in the short run. EVO predicts that the early-warning signal is the gap between $|Rep_t(S)|$ and $|A_t^{-1}(1)|$.

8.3 Informal economy and formalization. Formalizing informal assets is an expansion of K(t) that increases $|A^{-1}(1)|$ without creating new substantive value, but enables Rep(x) over objects previously not representable.

> **Reading for the financial professional — Macro-financial implications.** Section 8.2 is, strictly speaking, a thesis about early-warning signals for systemic risk: it proposes monitoring the **gap between issued representation and verified underlying asset** as a leading indicator, rather than depending exclusively on the instrument’s market price —which, as 2008 showed, can remain stable long after the gap has already become material. For a risk desk or an investment committee, this suggests incorporating, alongside conventional leverage indicators (debt/equity ratio, regulatory *leverage ratio*), an indicator of “verified quality of aggregate collateral” as an independent monitoring variable.

IX. Empirical Validation Methodology

- **Observability Index (IO):** $IO = |\{x \in R_{relevant} : \exists \Omega, O_\Omega(x)=1\}| / |R_{relevant}|$.
- **Admissibility Index (IA):** the proportion of the observed universe that also satisfies A(x)=1 within J.
- **Representation Gap (BR):** $BR(t) = (|Rep_t(S)| - |A_t^{-1}(1)|) / |Rep_t(S)|$, an operational estimate of Φ(S,t).

Comparative Critical Analysis

- **Systemic Coherence Index (ICS):** a composite function of IO, IA, and (1−BR), a leading predictor of instability episodes.

The validation design is explicitly fallibilist: it specifies in advance what the framework would observe if it were wrong. This falsifiability clause distinguishes, within EVO's own program, a theoretical treatise from an economic theory in the fullest sense.

X. Comparative Critical Analysis

10.1 Adam Smith. EVO sits one logical level before labor-value theory: in the condition of admissibility prior to any exchange. Divergence: EVO does not explain the formation of relative prices.

10.2 Léon Walras. Both traditions treat systemic coherence as a formalizable property. Divergence: EVO is a theory of preconditions, not of price equilibrium.

10.3 Alfred Marshall. EVO would delimit the domain over which supply-and-demand curves apply. Divergence: EVO offers no comparable welfare results.

10.4 Friedrich Hayek. Deep convergence: Ω partially formalizes the problem of dispersed knowledge. Divergence: EVO is more institutionalist and less spontaneist.

10.5 John Maynard Keynes. Indirect convergence between Φ(S,t) and the collapse of confidence / animal spirits. Divergence: EVO is static and structural, with no theory of adjustment time.

10.6 Ronald Coase. Strong convergence: A(x) formalizes the institutional definition of rights;

Φ is analogous to an aggregate transaction cost. Divergence: EVO does not model bargaining or allocative efficiency between parties.

10.7 Douglass North. The tradition closest in spirit. Explicit convergence in the Institutional Architecture of Chapter VII. Divergence: EVO lacks a dynamic theory of its own institutional change — a gap Part II of this treatise begins to close.

10.8 Elinor Ostrom. Convergence in Theorem 4: Custody is analogous to the monitoring Ostrom identifies in commons management. Divergence: EVO lacks its own case studies — a gap Part II also addresses.

Research Agenda (original)

10.9 Synthesis. EVO's greatest formal originality lies in the precondition of admissibility; its greatest relative weakness lies in the absence (until this edition) of a dynamic apparatus of prices, business cycles, and institutional change over time.

XI. Research Agenda (original)

Six future lines of research were proposed in the original version of the treatise: retrospective validation of the ICS; case studies on the formalization of informal property; a dynamic theory of Admissibility in dialogue with North; a stochastic extension of Theorem 3; Custody mechanisms inspired by Ostrom applied to digital assets; and the relationship between institutional observability and monetary policy. Part II of this treatise systematically develops and extends those six lines.

PART II — EVOLUTIONS OF THE EVO PROGRAM

XIII. Evolution 1 — Dynamic Mathematical Formalization

13.1 Institutional time

Institutional time $t \in T$, $T \subseteq \mathbb{R}_{\geq 0}$, is introduced, distinct from calendar time: t advances with each conversion event, not with the physical clock. Formally, T is a filtration generated by the sequence of institutional events $\{e_1, e_2, \ldots\}$ (registrations, homologations, audits, revocations), such that t_n is the instant immediately following the n-th relevant institutional event. This distinction is necessary because the rate of change of A, O, and C does not depend on the calendar but on the operational capacity of institutions J — two jurisdictions with the same calendar time may have radically different institutional times.

13.2 Time-dependent functions

All functions of the original apparatus are rewritten as functions of t: Ω_t, $O_\Omega(x,t)$, $A(x,t)$, $Rep_t(x)$, $C(x,t)$, $\Phi(S,t)$, and $Estab(S,t)$. $K(t) = |\{\Omega \text{ recognized by J at t}\}|$ is also defined (already introduced in the original Theorem 2), and **N(t)** $= |\{x \in U : A(x,t)=1\}|$ is added, the total admissibility stock of the system at t.

13.3 Differential equations

A system of ordinary differential equations is postulated to govern the joint evolution of N(t), $|Rep_t(S)|$ (denoted R(t) in this section), and $\Phi(t)$:

$$dN/dt = \alpha \cdot K(t) \cdot (|R_{relevant}| - N(t)) - \delta \cdot N(t)$$

where $\alpha > 0$ is the effective conversion rate (the speed at which recognized systems Ω convert observed reality into admissibility) and $\delta \geq 0$ is the rate of admissibility loss (revocations, registry expirations). The first term is logistic: conversion accelerates with more recognized observation systems, but saturates as the remaining unadmitted portion of reality ($|R_{relevant}| - N(t)$) is exhausted.

$$dR/dt = \beta \cdot N(t) - \mu \cdot R(t)$$

where $\beta > 0$ is the rate of issuance of representations over admissible objects and $\mu \geq 0$ is the rate of amortization/cancellation of representations (maturities, redemptions). Note that, by Axiom 4 and Theorem 1, β operates only on $N(t)$ — the system admits no term for direct issuance over ($|R_{relevant}| - N(t)$); this structural restriction is the dynamic version of Theorem 1.

$$d\Phi/dt = \lambda \cdot \max(0, R(t) - N(t))/R(t) - \rho \cdot (\gamma - C(t))^{+}$$

where $C(t)$ is the system's average custody, γ is Theorem 4's critical threshold, $\lambda > 0$ measures the sensitivity of friction to the representation gap, and $\rho \geq 0$ is the corrective capacity of the custody function when $C(t)$ falls below γ (the operator $(\cdot)^{+}$ denotes the positive part).

13.4 Dynamic stability and institutional equilibrium

An **institutional equilibrium** (N, R, Φ) *is a stationary point of the system above:* $dN/dt = dR/dt = d\Phi/dt = 0$. *From the system one obtains* $N = \alpha K|R_{relevant}|/(\alpha K + \delta)$ and $R^* = \beta N / \mu$, *and therefore* $R/N^* = \beta/\mu$ — the long-run ratio between representation and admissibility depends solely on the relationship between the issuance rate and the amortization rate, not on the absolute size of the system.

Proposition 5 (Local dynamic stability). The equilibrium (N, R, Φ) *is locally asymptotically stable if the system's Jacobian matrix evaluated at the stationary point has all eigenvalues with negative real part. A* sufficient *condition, given the partial decoupling of the system (N and R do not depend on* Φ*), is* $\alpha K + \delta > 0$, $\mu > 0$, *and* $\lambda \cdot (R - N)^{+}/R < \rho \cdot \gamma$ in the neighborhood of the equilibrium — that is, that custodial corrective capacity (ρ) dominates the friction pressure generated by the steady-state deviation between representation and admissibility.

Corollary 5.1: if $\beta/\mu > 1$ sustainably (issuance systematically above amortization relative to N), the system converges to a structural $\Phi^* > 0$, not a transitory one — a regime friction, not an episode. This dynamically formalizes the static intuition of

Quantitative Formalization

Theorem 3: instability is not merely a state, but a trajectory the system can converge toward if its flow parameters are not coupled.

13.5 Evolution of admissibility, observability, and custody

The custody trajectory is additionally defined as a decay process with institutional reversion: $dC(x,t)/dt = -\eta \cdot C(x,t) + \kappa_{aud} \cdot \mathbf{1}[\text{audit at } t]$, where $\eta > 0$ is the natural rate of deterioration of the Rep(x)↔x link (registry obsolescence, undeclared physical changes) and κ_{aud} is the discrete jump produced by each audit or reconciliation event. This formulation makes the original (static) Theorem 4 a special case: the condition $C(x,t) \geq \gamma$ for all t now translates into a minimum audit frequency $f_{min} = \eta \cdot \gamma / \kappa_{aud}$ below which the system cannot sustain custodial stability in the long run, even if each individual audit is effective.

XIV. Evolution 2 — Quantitative Formalization

14.1 Observability Index (IO)

Over a finite relevant universe $U_r \subset U$ of size n, with weights $w_i \geq 0$, $\Sigma w_i = 1$, reflecting the economic importance of each x_i (e.g., share of GDP, of the asset stock, or of the household population):

$IO(t) = \Sigma_i \, w_i \cdot O_{\Omega}(x_i, t)$, *where* $O_{\Omega}(x_i,t) = \max_{\Omega} O_{\Omega}(x_i,t)$

$IO(t) \in [0,1]$. An IO=1 indicates that the entire weighted relevant universe has been captured by at least one recognized system Ω, regardless of whether that capture also satisfies the normative admissibility criteria.

14.2 Admissibility Index (IA)

$IA(t) = \Sigma_i \, w_i \cdot A(x_i, t)$

By Axiom 2, $IA(t) \leq IO(t)$ always: nothing can be admissible without having been observed. The **regulatory gap** $GR(t) = IO(t) - IA(t)$ measures technical observability without effective institutional recognition — discretion, registry backlog, or deliberate normative exclusion.

14.3 Custody Index (IC)

$IC(t) = \Sigma_i \, w_i \cdot A(x_i,t) \cdot \mathbf{1}[C(x_i,t) \geq \gamma] \, / \, \Sigma_i \, w_i \cdot A(x_i,t)$

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IC(t) measures, among admissible objects, the proportion whose custody remains above Theorem 4's critical threshold γ. IC(t) ∈ [0,1]; IC(t)=1 indicates full custody over the admissible stock.

14.4 Representation Gap (BR)

$$BR(t) = (|Rep_t(S)| - |A_t^{-1}(1)|)^{+} / |Rep_t(S)|$$

normalized to [0,1) by construction (truncated to 0 when representation does not exceed admissibility). BR(t) is the direct operational estimate of Φ(S,t).

14.5 Systemic Coherence Index (ICS)

$$ICS(t) = w_{IO}\cdot IO(t) + w_{IA}\cdot IA(t) + w_{IC}\cdot IC(t) + w_{BR}\cdot(1 - BR(t))$$

with Σw = 1 and weights w_IO, w_IA, w_IC, w_BR ≥ 0 calibrated by sector (Section 14.6). ICS(t) ∈ [0,1], with 1 representing full systemic coherence (total observation, total admissibility, total custody, and zero representation gap).

14.6 Scales, normalization and calibration

All indices are normalized to [0,1] by construction, allowing comparability across sectors and jurisdictions without requiring a common unit of account. Calibration of the weights w_IO, w_IA, w_IC, w_BR is proposed in two stages: (i) an **a priori** stage, with equal weights (0.25 each) as a neutral baseline; (ii) an **empirical** stage, in which weights are adjusted via logistic regression or a principal-components method against an observed binary crisis variable (Evolution 4, Chapter XVI), so that the final weights maximize the ICS's predictive power over historical instability episodes, subject to the constraint Σw=1 and w≥0. Reporting both versions —the neutral calibration and the adjusted calibration— is always recommended, in order to avoid retrospective overfitting (*data snooping*) presented as validation.

> **Reading for the financial professional — Indices.** For anyone already working with regulatory ratios, the correspondence is direct: **IO** is analogous to the coverage of an asset universe by a *reporting*/audit system (think of the coverage of a market index by quality *research*); **IA** is analogous to the proportion of that universe effectively eligible as collateral or fit for regulatory balance-sheet treatment; IC is analogous to the frequency and quality of proof of reserves or custody reconciliation; and BR, the most directly actionable, is formally equivalent to an uncollateralized leverage ratio: total representation issued minus verified asset, over total representation issued. A CRO or an

Evolution 3 — International Empirical Validation

asset-liability committee (ALCO) could, in principle, calculate a sectoral BR for their own portfolio of securitized or tokenized assets using the same inputs already used to calculate collateral- coverage ratios, with no additional infrastructure beyond what already supports their due diligence processes.

XV. Evolution 3 — International Empirical Validation

15.1 Methodological caveat

The IO, IA, IC, and BR indices require, in their full form, cadastral and regulatory microdata rarely available in harmonized form across countries. This section therefore proposes an illustrative application exercise, based on publicly available observable proxies, not a definitive estimate of the formal indices. The goal is to show the framework’s practical applicability, not to present conclusive results — a distinction Section IX of the original treatise requires maintaining.

15.2 Proposed proxies by index

- **IO (proxy):** formalized cadastral coverage and banking penetration rate, as an approximation of the fraction of relevant assets effectively captured by some system Ω.
- **IA (proxy):** a regulatory-quality index and property-rights strength (e.g., the corresponding components of governance indicators already published by multilateral organizations), as an approximation of effective $A(x)=1$.
- **IC (proxy):** frequency of public audits and average registry-update age, as an approximation of $C(x,t) \geq \gamma$.
- **BR (proxy):** the ratio between market capitalization of financial instruments and audited real assets of the corresponding sector, as a direct approximation of $\Phi(S,t)$.

Evolution 3 — International Empirical Validation

15.3 Comparison between developed and emerging economies

The qualitative pattern expected under EVO —and consistent with the literature already cited on informality and institutional development (De Soto and the North tradition)— is that developed economies exhibit high and relatively close IO and IA values (low regulatory gap GR), while emerging economies tend to show moderate IO with substantially lower IA — that is, a larger regulatory gap: technically observable assets (occupied land, visible economic activity) that remain outside the domain of formal admissibility due to institutional weakness, not technical invisibility. This pattern, if confirmed with harmonized data, would be consistent with Theorem 2 and Section 8.3 of the original treatise, and constitutes a specific falsifiable EVO prediction: the GR gap, not IO's absolute level, should correlate more strongly with informal-to-formal credit access indicators than IO alone.

15.4 Institutional ranking (methodological proposal)

An **EVO institutional ranking** is proposed, ordering jurisdictions by their estimated ICS, published together with its four disaggregated components —so that two countries with the same ICS but different component profiles (one with high IO/IA and low IC, another with the inverse pattern) are differentiated in the policy diagnosis, something a single aggregate index would obscure. The ranking does not aim to replace already- existing governance or ease-of-doing- business indices, but to offer a complementary reading specifically centered on the observation→admissibility→custody chain.

15.5 Comparative statistical analysis and interpretation of results

For the panel of proxies described, the appropriate statistical analysis is a comparison of means and variances between groups (developed vs. emerging) using non-parametric tests (given the typical sample size of a country panel), complemented by a correlation analysis between GR and outcome variables (sovereign risk premium, credit-market depth). The correct interpretation of any positive result at this stage is associative, not causal: this section's design does not identify the direction of causality between institutional weakness and observed macrofinancial outcomes, a task that belongs to Evolution 4 (Chapter XVI) through panel and time-series methods with appropriate controls.

Econometrics and Predictive Power

XVI. Evolution 4 — Econometrics and Predictive Power

16.1 Cross-sectional and panel regression specification

For a panel of jurisdictions i over periods t, the following base specification is proposed:

$$Crisis_{i,t+1} = \beta_0 + \beta_1 \cdot ICS_{i,t} + \beta_2 \cdot BR_{i,t} + \beta_3 \cdot GR_{i,t} + \gamma \cdot X_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t}$$

where $Crisis_{i,t+1}$ is a binary variable (a financial-crisis episode, sovereign default, or hyperinflation at t+1, per the standard early-warning-literature definition), $X_{i,t}$ is a vector of conventional macroeconomic controls (debt/GDP, current account, reserves), μ_i are country fixed effects, and λ_t are time fixed effects. EVO's central hypothesis is $\beta_2 > 0$ and $\beta_3 > 0$, and $\beta_1 < 0$ (greater systemic coherence, lower probability of subsequent crisis), conditional on controls X.

16.2 Panel data: fixed- and random-effects models

Estimating both a fixed-effects model (which absorbs unobserved, time-invariant country heterogeneity) and a random-effects model is recommended, contrasted via the Hausman test; the fixed-effects model is *a priori* preferable given that structural institutional traits (e.g., legal tradition) are plausibly correlated with each country's average ICS level.

16.3 Time series and VAR/VECM models

For country pairs or regional aggregates, a low-order **VAR** is proposed over the vector [ICS_t, BR_t, risk_premium_t, inflation_t], with lag selection by information criterion (AIC/BIC) and stationarity checks (ADF-type unit-root tests) prior to specification. If the ICS and BR series turn out to be integrated of order 1 and cointegrated with the macrofinancial variables, a **VECM** is recommended instead of a VAR in levels, so as not to lose Theorem 3's implicit long-run equilibrium relationship ($dEstab/dt < 0$ when $d\Phi/dt > 0$) when differencing the series.

Historical Applications

16.4 Robustness tests

At minimum, the following are proposed: (i) substituting alternative proxies for each index; (ii) sequential exclusion of influential countries (*jackknife* by country); (iii) alternative time windows for the definition of "subsequent crisis" (t+1, t+2, t+3); (iv) inclusion of additional controls suggested by the existing early-warning literature, to verify that β_2 and β_3 are not merely a redundant proxy for already-established conventional leverage indicators.

16.5 Predictive capacity against crises: evaluation criterion

Predictive capacity is evaluated using ROC curves and the area under the curve (AUC) of the model with and without the EVO components, comparing incremental AUC. The explicit success criterion, in line with the falsifiability clause of Chapter IX of the original treatise, is: if the incremental AUC from adding ICS/BR/GR to an already-established early-warning model is not statistically distinguishable from zero in an out-of-sample validation window, the hypothesis that EVO adds incremental predictive power —beyond a reformulation of already- known indicators— is weakened, and must be reported as such.

> **Reading for the financial professional — Econometrics.** Chapter XVI's specification is deliberately compatible with instruments already standard in a quantitative risk team: a panel model with country/entity fixed effects is directly comparable to sovereign or corporate risk-scoring models already used on credit desks; the VAR/VECM over ICS, BR, risk premium, and inflation is the same family of models already used for macrofinancial *stress testing*; and the incremental-AUC evaluation criterion (Section 16.5) is exactly the standard a credit-scoring team would apply to decide whether a new variable deserves incorporation into an already- validated *default* model — including the same discipline of reporting when the result is negative.

XVII. Evolution 5 — Historical Applications

This section reinterprets four widely documented types of historical episode through EVO's vocabulary, in order to illustrate, rather than statistically validate (the task of Evolution 4), the framework's narrative coherence against the existing literature on each episode. In each case, the EVO reading is contrasted with the dominant traditional reading of that episode.

Historical Applications

17.1 Financial crises: 2008

The conventional reading (based on leverage models, systemic risk, and bank-capital regulation) emphasizes leverage growth and the underestimation of tail risk. The EVO reading is complementary: structured instruments over subprime mortgages constitute, in the vocabulary of Chapter VIII (Section 8.2), cases of Rep(x) issued over x whose A(x)=1 —the underlying asset's real credit quality— had not been effectively verified by an independent Ω (rating agencies operated, in many documented cases, with conflicts of interest that undermine their status as a reliable Ω system in the sense of the threshold τ defined in Section III). Theorem 3 would correctly predict, in this case, that the warning signal was not the price of the instruments —which remained stable until very late— but the growing gap between the volume of securitizations (R(t)) and the volume of mortgages effectively verified as solvent (N(t)) — that is, a growing BR not observed by conventional market indicators of the time.

Illustrative numerical example (stylized, not a precise historical estimate). Suppose, for pedagogical purposes only, a securitization system with Rep_t(S) = USD 1,000,000 million in structured instruments over subprime mortgages outstanding by 2007, of which an independent *ex post* audit would have verified that only USD 650,000 million corresponded to mortgages with effectively sustainable repayment capacity (A(x)=1 under a reasonable τ threshold). Under the definition in Section 14.4: BR = (1,000,000 − 650,000) / 1,000,000 = **0.35**. A BR of 0.35 —35% of active representations with no verified correspondence— is, under Theorem 3, a systemic friction large enough that, faced with a mass-verification event (the 2007-2008 housing-price collapse that forced the revaluation of the underlying pools), the probability of aggregate default spikes, even though the BR was not observable in real time by the market indicators of the era (CDS *spreads* on these instruments stayed compressed well into 2007).

Historical Applications

17.2 Hyperinflations: Weimar Germany and Latin American cases

The traditional quantity-theory reading attributes hyperinflation to monetary-supply expansion with no productive correlate. EVO reformulates this in terms of Section 8.1: monetary issuance is Rep(x) over an economy's productive capacity and reserves; when that issuance is sustained without verifiable expansion of A(x) —without expansion of the productive base or of effectively audited reserves— the monetary system's Φ(S,t) grows until the point where the loss of confidence (Estab(S,t) collapse) feeds back into the expansion itself, in a pattern consistent with Theorem 3. The difference in emphasis versus a pure quantity-theory reading is that EVO locates the ultimate cause not in the quantity of money *per se*, but in the decoupling between that quantity and the verified admissibility of the substrate it is supposed to back.

Illustrative numerical example. Applying the equation from Sections 13.3 and 19.2 with stylized parameters: let β/ μ (relative monetary-issuance rate) equal 1.40 monthly —the monetary base grows 40% faster than its amortization— while dN/N dt (verified expansion of productive capacity and admissible reserves) is only 0.01 monthly (1%). The gap β/ μ − dN/N dt ≈ 1.39 monthly is of the order of magnitude observed in documented hyperinflation episodes (Germany 1923, with monthly price-growth rates exceeding 300%; Latin American cases of the 1980s-90s with monthly peaks of two and three digits). Under Section 13.3, dΦ/dt is proportional to that gap: with λ=1 and no custodial correction (ρ· (γ−C)⁺ ≈0, i.e., no reserve auditing offsetting the issuance), Φ(t) grows approximately linearly in institutional time, which in the model translates into an accelerated collapse of Estab(S,t) — qualitatively consistent with the final acceleration characteristic of a hyperinflation (the so-called "flight to real goods" in the existing literature).

17.3 Banking crises: runs and panics (Diamond–Dybvig tradition)

Theorem 3 was explicitly presented in the original treatise as a generalized analogue of bank- run models. Historical banking crises (from the 1907 panic to more recent runs in emerging- market banking systems) share, under this reading, the same formal mechanism: a fraction Φ of represented deposits (Rep) has, at a moment of mass verification, no immediate correspondence with admissible liquid reserves (A(x)=1 with effective liquidity), and the mass- verification event (the run) reveals that fraction all at once, rather than allowing its gradual correction via custody (Theorem 4).

Historical Applications

Illustrative numerical example. A stylized bank holds represented deposits Rep(S) = USD 100 million, with effectively verified liquid reserves (A(x)=1, immediately available) of only USD 10 million —a 10% fractional-reserve ratio, typical of commercial banking under standard fractional reserve. Under normal conditions (no mass-verification event), Φ(S,t) does not manifest because daily withdrawals are a small, random fraction of the total, covered by available reserves and access to interbank lines. But if a loss-of-confidence event triggers a simultaneous conversion demand for 25% of deposits (USD 25 million), the bank can honor only USD 10 million immediately: the fraction actually in default against that particular demand is (25−10)/25 = **0.60**, i.e., an effective Φ of 60% against the verification event, even though the bank was solvent on the basis of its total longer-run assets. This is the formal mechanism —and order of magnitude— that distinguishes a **solvency** crisis (Φ structurally high across the entire balance sheet) from a **liquidity** crisis (Φ high only against a verification event concentrated in time), a distinction the dynamic apparatus of Chapter XIII allows one to formalize but that static Theorem 3 does not separate explicitly.

17.4 Institutional collapses: hyperconcentration of discretionary admissibility

Cases of institutional collapse associated with arbitrary expropriations, reversal of recognized property rights, or extreme regulatory discretion can be read, under EVO, as a reverse-direction rupture of Axiom 3: a discrete conversion of A(x)=1 to A(x)=0 with no cause in R (the object's physical or economic nature did not change; only its institutional recognition did). Theorem 2 predicts that such episodes reverse the expected monotonicity of K(t) and $|A^{-1}(1)|$, and should therefore be associated, in a panel analysis (Chapter XVI), with abrupt, non-gradual drops in the ICS —a pattern statistically distinguishable from the gradual erosion typical of ordinary systemic friction.

Illustrative numerical example. Take a sector with N(t) = 800 (a stylized count of recognized property titles) over a relevant universe of 1,000, i.e., IA(t)=0.80, before an episode of regulatory discretion (e.g., a mass reversal of already-homologated concessions or titles). If the episode discretely reverts 300 of those 800 titles from A(x)=1 to A(x)=0 —not due to physical deterioration of the object, but due to an administrative decision— the new IA(t+1) = 500/1,000 = 0.50, a 30-percentage-point drop in a single institutional event. If the other ICS components (IO, IC, 1−BR) remained unchanged at, say, 0.85 each, and equal weights are used (Section 14.6),

Historical Cases: Comparative Summary

the ICS would move from approximately 0.84 to 0.79 —a visible but moderate drop in the aggregate— which numerically illustrates why Chapter XVI recommends monitoring IA disaggregated and not only the composite ICS: a discrete, severe drop in one component can be diluted in the aggregate average if the other components are not simultaneously affected.

Historical Cases: Comparative Summary

Episode	EVO metric illustrated	Stylized value	Financial-risk analogue
2008 financial crisis	BR(t)	0.35	Uncollateralized symbolic leverage of the securitized pool
Hyperinflation	$\beta/\mu - dN/N\,dt$	≈1.39 monthly	Monetary-base issuance far above verified backing
Bank run	Φ against verification event	0.60	Insufficient liquidity coverage against concentrated withdrawal stress
Institutional collapse	ΔIA (discrete drop)	−0.30 (30 p.p.)	Discrete loss of collateral eligibility by regulatory decision, not asset deterioration

These four magnitudes are not comparable to one another on a common scale —they measure different phenomena with different units— and are presented solely to show that EVO's apparatus admits, in each case, a concrete quantification and not merely a qualitative narrative. For a risk team, the replicable exercise is the same with its own data: calculate BR or Φ over a real portfolio using the same formula, in place of the stylized parameters used here for purely pedagogical purposes.

Evolution 6 — Institutional Microfoundations

17.5 Comparison between EVO's prediction and traditional theories

Across the four types of historical episode reviewed, EVO does not offer an alternative causal explanation to the ones already established, but an additional formalization layer centered on the observation- admissibility-representation-custody relationship, which in some cases (2008, hyperinflations) is consistent with and complementary to the dominant literature, and in others (institutional collapses due to regulatory discretion) offers a more precise term—the discrete reversal of A(x)—for a mechanism treated less formally in the conventional literature. The honesty required by Chapter IX obliges one to note that this section is a post-hoc narrative reinterpretation of already-known episodes, and that its value as evidence depends entirely on the formal predictions suggested here —a growing representation gap before a price collapse, discrete ICS drops in episodes of discretion— being subjected to the ex-ante econometric test of Evolution 4, rather than being fitted narratively ex post, which would, strictly speaking, be unfalsifiable.

XVIII. Evolution 6 — Institutional Microfoundations

18.1 Agents and their decision functions

Five types of agents are incorporated, each with an objective function defined over the variables of the EVO apparatus:

- **Households (h):** maximize expected utility $E[u(c_h)]$ subject to their effectively tradeable wealth being bounded by the subset of their assets with $A(x)=1$; a household with assets in R but outside dom(A) faces a structural liquidity constraint independent of its physical wealth, formalizing the financial exclusion of informal assets.
- **Firms (f):** choose how much to invest in their own observation function (e.g., voluntary audits, certifications) to raise the probability that their assets reach $A(x)=1$, comparing the marginal cost of that investment against the cost-of-capital differential between financing over admissible and non-admissible assets.
- **Banks (b):** intermediaries whose profit function depends on keeping $\Phi(S_{b,t})$ low — a bank maximizes intermediation profit subject to a solvency constraint that, in EVO's vocabulary, amounts to keeping $|Rep_t(b)|$ close to $|A_t^{-1}(1) \cap$ bank assets$|$.
- **The State:** an agent with a dual role, as an issuer of Rep(x) (public debt, currency) and as a component of J that defines which systems Ω are recognized — a structural

Evolution 6 — Institutional Microfoundations

conflict of interest the framework makes explicit: the State can, in principle, expand its own representation capacity by relaxing the admissibility criteria it itself defines, the formal mechanism behind Section 8.1's unanchored monetary issuance.

- **Regulators:** agents whose objective function is modeled as minimizing expected $\Phi(S,t)$ subject to a supervision cost increasing in τ (the reliability threshold required of Ω systems) — a more demanding τ reduces the risk of spurious admissibility but increases the cost and slowness of $K(t)$, generating an explicit trade-off between rigor and the expansion of observability (Theorem 2).

18.2 Incentives and asymmetric information

The central point of this evolution is that the observation→admissibility chain is not neutral with respect to the incentives of whoever passes through it: an issuer of $Rep(x)$ generally has private information about whether $A(x)=1$ is genuinely verified or merely simulated (a captured audit, a formally recognized but effectively low-quality Ω system). This introduces a problem of **institutional adverse selection**: issuers with underlying low-quality assets have an incentive to seek the Ω with the lowest effective τ available among those recognized by J, a phenomenon formally analogous to the regulatory *forum shopping* already documented in the financial-regulation literature, but here derived directly from EVO's structure: the heterogeneity of τ among the Ω systems recognized within a single jurisdiction is, by itself, an endogenous source of $\Phi(S,t)$.

Macroeconomics of Observable Value

18.3 Institutional game theory

A signaling game is proposed between an **issuer** agent (firm or State) and a **regulator** agent, in which the issuer chooses a level of investment in verifiable observation (costly, but visible) and the regulator chooses a level of scrutiny. A **separating signaling equilibrium** exists when the marginal cost of simulating observation (falsifying $O_\Omega(x)=1$ without x genuinely satisfying the criteria) is sufficiently high for low-quality issuers, so that only high underlying-quality issuers invest in the required level of verifiable observation; a **pooling equilibrium**, instead, arises when that simulation cost is low relative to the benefit of accessing Rep(x) without the corresponding x, a situation Theorem 3 predicts generates growing $\Phi(S,t)$ not observable by the regulator until the mass-verification event. The policy recommendation that follows from this game is direct: the Custody function (Chapter VII) should be designed to raise the long-run cost of simulation (recurring, unpredictably timed audits, cf. Section 13.5), not only the cost of initial observation, precisely because the single-period game underestimates the incentive to simulate when verification is a one-time event.

XIX. Evolution 7 — Macroeconomics of Observable Value

19.1 Economic growth

An augmented production function $Y = F(K_{adm}, L, TFP)$ is proposed, where $K_{adm} = K_{total} \cdot IA_k$ is the effectively admissible capital (weighted by the capital sector's admissibility index), not total physical capital. The implication is that two economies with the same physical capital stock can exhibit different growth paths if they differ in IA_k: non-admissible capital cannot be fully used as collateral, which raises its effective financing cost and reduces the investment that capital can leverage — an additional channel, distinct from the total-factor-productivity channel, through which institutional weakness depresses observed growth.

19.2 Inflation

In line with Section 8.1 and its dynamic version (Section 13.3), long-run inflation is modeled as increasing in the sustained gap between the monetary-issuance rate β and the verified expansion rate of N(t) (productive capacity and admissible reserves): $\pi_\infty \approx f(\beta/\mu - dN/N\,dt)$, with f increasing. This formulation is consistent with the quantity-theory tradition but explicitly conditions it on institutional verification of the substrate, not on the nominal quantity of money alone.

Macroeconomics of Observable Value

19.3 Employment and productivity

Formal employment requires, in most jurisdictions, that the labor relationship itself have A(x)=1 (labor registration, verifiable contributions); informal employment is, in EVO's vocabulary, labor in R with no conversion to admissibility. Measured aggregate productivity systematically underestimates output in the A(x)=0 sector, consistent with the existing literature on measuring informal GDP, but EVO adds the prediction that the gap between measured and real productivity decreases monotonically with K(t) (Theorem 2), i.e., with the expansion of recognized labor-observation systems.

19.4 Fiscal and monetary policy under EVO

Fiscal policy, under this framework, has an additional channel of effectiveness: spending to strengthen the Observation and Admissibility functions (cadastres, digital registries, courts for resolving property disputes) acts as an expansion of K(t) with effects on N(t) and, per Section 19.1, on the leveraging capacity of existing capital — an institutional multiplier distinct from the conventional fiscal multiplier, operating via credit enablement rather than direct aggregate demand. Monetary policy, in turn, should —under Theorem 4's logic— accompany any expansion of the monetary base with proportional investment in the Custody function over the reserves and assets that back it, to prevent the expansion from raising the monetary system's

Φ(S,t) in the sense formalized in Section 13.3.

19.5 Macroeconomic equilibrium under EVO

The long-run macroeconomic equilibrium under EVO is characterized by the coexistence of three conditions: (i) the institutional equilibrium (N*, R*, Φ**) of Section 13.4; (ii) a goods-and- factors market that operates on K_adm, not K_total, in the sense of Section 19.1; and (iii) a price path consistent with the gap β/ μ − dN/N dt of Section 19.2. EVO does not replace the already- established Walrasian general-equilibrium apparatus or DSGE models; it conditions them, adding admissibility and custody restrictions as additional structural parameters that conventional macroeconomics typically treats as exogenous or not explicitly modeled.

Digital Economy and Tokenized Assets

XX. Evolution 8 — Digital Economy and Tokenized Assets

Reading for the financial professional. Of the ten, this chapter has the most immediate application for structuring desks and digital-asset risk committees: it maps directly onto the already-ongoing regulatory debate over *proof of reserves* for *stablecoins*, tokenization of real-world assets (RWA), and the prudential treatment of crypto exposures (in line with the Basel Committee's SCO60 standard). Section 14.4's BR(t), applied to a *stablecoin* issuer, is literally the gap between the token in circulation and the audited reserve backing it — the same metric already required by the most demanding *full reserve* regimes, here generalized to any tokenization scheme, not only stablecoins.

20.1 Blockchain as a candidate Ω system

A blockchain registry can be read, within EVO, as a candidate observation system $\Omega = (P, I, \tau)$, where P is the consensus protocol (proof of work, proof of stake) and I is the validator network. The critical point EVO contributes is that the registry's cryptographic immutability guarantees the integrity of $O_\Omega(x)=1$ *once recorded*, but does not by itself guarantee that $x \in R$ —that the referenced object exists and corresponds to observable reality— nor that the record has been recognized by the corresponding institutional framework J. A blockchain lacking a trustworthy input oracle (the *oracle problem*, already documented in the technical literature) is, in Axiom 2's vocabulary, a technically robust Ω system but epistemically isolated from R: it can certify with very high reliability that "claim x was recorded," without being able to certify that x is true.

20.2 Tokenization

Tokenizing an asset is, formally, Rep(x) via a token $t = Rep_{blockchain}(x)$. By Theorem 1, tokenizing an asset with $A(x)=0$ —e.g., real estate without a clean registered title, or an unaudited commodity reserve— generates no retroactive admissibility: the token can trade with high technical liquidity while the $\Phi(S,t)$ friction of the system sustaining it grows silently, exactly the mechanism described in Section 8.2 regarding digital assets lacking verifiable reserves, now formalized with the dynamic apparatus of Chapter XIII. The institutional-design recommendation EVO derives from this is that any tokenization scheme should, as a condition of legitimacy in the sense of the Fundamental Law, incorporate a mechanism of continuous Custody (Section 13.5) —not only a verification at issuance time— over the correspondence between the token and the underlying x.

Digital Economy and Tokenized Assets

20.3 Central bank digital currencies (CBDC)

A CBDC is, within EVO, Rep(x) where x is the issuing central bank's productive capacity and reserves, exactly like traditional fiat currency (Section 8.1), but with a relevant structural difference: a well-designed CBDC can, in principle, act simultaneously as Rep(x) *and* as a component of the Observation function Ω over the economic activity flowing through it (transaction traceability), which —under Theorem 2— could expand K(t) for the rest of the financial system. This dual capacity also introduces a distinct, not purely economic, risk: concentrating both the Observation function and the Issuance function in a single agent (the State) reduces the independence between Ω and J implicitly required by Section III, in the same sense of structural conflict of interest noted in Section 18.1 for the State as an agent.

20.4 Smart contracts

A smart contract automatically executes a state transition conditioned on a verifiable on-chain event. Within EVO, a smart contract is an automated Conversion function (Axiom 3): it conditionally converts A(x)=0 into A(x)=1 (e.g., collateral release) with no discretionary human intervention at execution time. This reduces the regulatory discretion flagged as a risk in Section 17.4, but shifts the critical fragility point further back in the chain: the quality of the triggering condition (does the event that fires the contract faithfully reflect a real change in R?) depends entirely on the quality of the Ω system providing that condition —again, the oracle problem from Section 20.1.

20.5 Digital identity

The digital identity of a person or entity is, in itself, a case of A(x)=1 over x = "this person is who they claim to be" — a prerequisite of admissibility for any other Rep(x') associated with that person (an account, a title, a contract) to be considered legitimate under the Fundamental Law. Fragmented or non-interoperable digital identity systems across jurisdictions are, under this reading, a direct limitation on K(t) for any cross-border transaction, and digital-identity interoperability becomes a precondition for the expansion of global observability discussed in Chapter XXI.

Institutional Governance

20.6 Artificial intelligence and digital financial infrastructure

Artificial-intelligence systems can operate, within this framework, in two distinct roles that should not be conflated: as a **component of the protocol P** of a system Ω (e.g., automated document verification, anomaly detection in registries), potentially raising τ at lower marginal cost; or as an **issuer of Rep(x)** (e.g., a model generating credit ratings or automated valuations). In the second role, Theorem 1's warning applies without exception: a rating generated by AI over an asset whose A(x) has not been verified by an independent Ω does not turn that rating into admissibility, however sophisticated the model — a particularly relevant point given the growing use of language models and automated scoring in digital financial infrastructure, which EVO would treat as a powerful new potential source of Rep(x) decoupled from A(x) if not subjected to the same Custody and independent-verification requirements demanded of any other representation system.

XXI. Evolution 9 — Institutional Governance

21.1 From descriptive theory to design framework

Up to this evolution, EVO was presented primarily as a descriptive and predictive framework. This section reformulates it as a **normative institutional-design framework**: given the apparatus of Chapters XIII and XIV, an institutional designer (a regulator, a central bank, a multilateral organization) can use EVO not only to diagnose Φ(S,t) ex post, but to specify, ex ante, the minimum governance requirements an economic system —traditional or digital— must satisfy to remain within the dynamic-stability region characterized in Proposition 5.

21.2 Economic governance and auditing

A direct design principle derived from Theorem 4 and its dynamic version (Section 13.5) is proposed: every system that issues Rep(x) at scale must specify, in an externally verifiable way, (i) the τ threshold required of its originating Ω systems, (ii) the minimum audit frequency f_min derived from its own parameters η and γ, and (iii) a public reporting mechanism for its estimated BR(t). This principle does not depend on whether the audit is public, private, or hybrid —EVO is agnostic about organizational form, as already established in Chapter VII— but requires that the three conditions be auditable by a third party independent of the issuer.

Institutional Governance

21.3 Institutional custody and transparency

Transparency, under EVO, is not a generic value but a specific operational condition: the periodic publication of IO, IA, IC, and BR (or their proxies, Section 15.2) for a given system. A system that reports only its volume of Rep(x) —the datum markets typically observe most easily— without reporting its corresponding N(t) is, in this section's terms, exhibiting transparency of representation without transparency of admissibility, the precise information asymmetry Chapter XVIII identifies as a source of institutional adverse selection.

21.4 Interoperability and international standards

Interoperability among Ω systems across different jurisdictions —necessary, as noted in Section 20.5, for expanding K(t) globally— requires common τ threshold standards, or at least mutually recognized equivalence tables across jurisdictions (in the spirit of the mutual- recognition agreements already existing in other areas of financial regulation). EVO proposes no specific technical standard, but does propose an evaluation criterion for any proposed standard: an interoperability standard is adequate, in this theory's sense, if and only if it preserves the property that A(x)=1 in one jurisdiction implies that x satisfies a verifiable τ no lower in the receiving jurisdiction — otherwise, interoperability becomes a channel for *regulatory arbitrage* that reintroduces, at international scale, the same institutional adverse- selection problem described at domestic scale in Section 18.2.

21.5 Regulation and institutional architecture at system scale

Returning to the Institutional Architecture of Chapter VII, this evolution proposes that any regulatory reform of a sector —financial, cadastral, digital— can be evaluated by explicitly mapping it against the five functions (Observation, Admissibility, Conversion, Representation, Custody): a reform that strengthens Representation without proportionally strengthening Custody is, under Theorem 3 and its dynamic version, a reform likely to raise medium-run

Φ(S,t) even if it improves short-run indicators such as transaction volume or nominal credit access — a public-policy distinction directly derivable from the formal apparatus and not merely rhetorical.

Evolution 10 — The EVO Scientific Program

XXII. Evolution 10 — The EVO Scientific Program

22.1 EVO as a school of thought: conditions for consolidation

For EVO to move from an axiomatic treatise to a school of economic thought in the full sense, three conditions must be met; this expanded edition advances progress toward them without fully satisfying them: (i) a body of empirical evidence accumulated and replicated by researchers external to the original program (beyond Chapter XV's illustrative application); (ii) a research community that subjects Chapter XIII's dynamic theorems to review and eventual refutation; (iii) adoption, even if partial, of the vocabulary and indices proposed by institutions with the capacity to generate the required microdata.

22.2 Comparison with contemporary literature

EVO shares ground with at least three active contemporary research programs: the law and finance literature (institutional quality and financial development), the early warning systems literature for financial crises, and the recent literature on the economics of tokenization and decentralized finance. The differential contribution EVO claims relative to these three programs is the unification, under a single axiomatic apparatus, of phenomena that the literature typically treats separately — informality, financial fragility, and digital assets— a unification whose ultimate usefulness depends entirely on the results of Evolution 4 (Chapter XVI): if the ICS adds no incremental predictive power over the models already established in each of those three fields separately, the unification would be conceptually interesting but empirically redundant, and this edition does not hide that possibility.

22.3 New open problems

Among the problems this edition explicitly leaves open: the endogeneity of τ (who audits the auditor, and how does EVO avoid an infinite regress in defining what constitutes a reliable Ω?); the possibility of multiple institutional equilibria in Chapter XIII's dynamic system when the constant-parameter assumption is relaxed; and the extension of the framework to non-rival or open-source goods, where the very notion of exclusive Rep(x) loses part of its usual economic meaning.

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22.4 Consolidated empirical agenda

Integrating the previous sections, the program's empirical priorities are consolidated here: building a harmonized panel of IO/IA/IC/BR proxies for at least thirty jurisdictions with series of at least twenty years (Chapter XV); out-of-sample estimation and validation of Chapter XVI's econometric model; and a set of already-operating tokenization and CBDC case studies, evaluated retrospectively against the framework of Chapter XX.

22.5 Implications for central banks

A central bank adopting EVO's vocabulary would treat monitoring the BR(t) of the financial system under its supervision as a routine macroprudential indicator, complementary to those already used (capital, liquidity ratios), with the specific advantage of capturing the decoupling between representation and admissibility *before* it shows up in market prices, in line with the reading of the 2008 crisis proposed in Section 17.1.

22.6 Implications for the IMF and multilateral organizations

For the International Monetary Fund and comparable organizations, Chapter XV's institutional ranking and the GR regulatory gap would offer an additional input, rather than a substitute, to those already used in financial-stability assessments and in designing assistance-program conditionality, with the particularity that GR explicitly distinguishes between technical observation weakness (a statistical- and cadastral-capacity problem) and normative admissibility weakness (a regulatory-will problem), a diagnosis that can steer the type of recommended technical assistance differently in each case.

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22.7 Twenty-year development roadmap

An indicative roadmap is proposed across four horizons: years 1–5, building the harmonized empirical panel and first out-of-sample econometric validations (Chapters XV–XVI); years 5– 10, incorporating additional historical case studies (Chapter XVII) and refining the dynamic system against structural shocks (stochastic extension of Theorem 3, already flagged in the original research agenda of Chapter XI); years 10–15, institutional-governance pilots (Chapter XXI) with at least one jurisdiction and one digital-asset infrastructure consortium willing to publicly report their EVO indices; years 15–20, a complete retrospective evaluation of the program against its own falsifiability clause, with the explicit possibility —consistent with the epistemological commitment of Chapter II— that the program may need to be substantially revised or abandoned with respect to propositions that the accumulated evidence does not support.

XXIII. Institutional Declaration and Conclusion (Edition for the Financial Professional)

The original treatise developed the Economics of Observable Value from a five-axiom manifesto toward a framework with formal notation, proofs, an operationalizable institutional architecture, testable macroeconomic implications, and an explicit empirical-validation methodology. This expanded edition advances one further step: it turns that static framework into a dynamic system with differential equations and stability conditions (Chapter XIII); it translates its concepts into quantifiable, calibratable indices (Chapter XIV); it proposes — without overstating its evidentiary status— an illustrative application to real economies (Chapter XV); it specifies the econometric program needed to rigorously test it (Chapter XVI); it puts it to a narrative test against already-documented historical episodes (Chapter XVII); it incorporates behavioral and incentive microfoundations (Chapter XVIII); it integrates it with the macroeconomics of growth, inflation, and employment (Chapter XIX); it extends it to blockchain, tokenization, CBDCs, smart contracts, and artificial intelligence (Chapter XX); it reformulates it as a normative institutional-governance framework (Chapter XXI); and it consolidates a scientific agenda with implications for central banks and multilateral organizations, plus a twenty-year roadmap (Chapter XXII).

This edition should close with the same intellectual honesty with which the original treatise opened. None of the ten evolutions developed here substitutes for the empirical testing still pending: Chapter XIII’s dynamic models have not been estimated

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against real data; Chapter XIV’s indices require harmonized microdata that do not yet exist at the necessary scale; Chapter XV’s international application is illustrative, not probative; and Chapter XVI’s econometric program is specified, not executed. Unlike Smith, Walras, Marshall, Hayek, Keynes, Coase, North, or Ostrom, EVO —even in this expanded version— does not yet have decades of empirical testing or a research community that has subjected its dynamic theorems to sustained review and refutation.

What this edition does establish is that the program is now fully specifiable: every requested evolution —dynamic, quantitative, empirical, econometric, historical, microfounded, macroeconomic, digital, governance-oriented, and scientific— has an explicit formulation, with its own falsifiability criteria. That is the function of an expanded foundational treatise: not to replace the empirical work still missing, but to leave it fully defined, so that implementing Chapter XVI, populating Chapter XV’s panel, or piloting Chapter XXI’s governance becomes a matter of data and time rather than unresolved theoretical specification.

For the financial reader specifically, the entry point offering the lowest cost and greatest immediate value is not to adopt the full axiomatic apparatus, but to calculate one’s own BR for an existing portfolio or balance sheet —the gap between what is issued/represented and what is verified— and observe whether its evolution over time anticipates movements in already- monitored indicators (spreads, credit ratings, funding costs). That is, in essence, the minimal usefulness test Chapter XVI formally proposes, one that any risk team with internal data could run before the full empirical program (Chapter XV) becomes available at jurisdictional scale.

Starging
Design and Custody of Value Systems

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Institutional Declaration (edition for the financial professional): the Economics of Observable Value establishes a general theoretical framework —dynamic, quantifiable, and extended to the digital economy— for understanding value as an institutional consequence of observable reality, and provides a formal vocabulary directly translatable into the practice of risk management, structuring, and prudential supervision, subject in its entirety to the empirical testing its own methodology demands. Its usefulness for the financial professional does not lie in replacing already-validated risk models, but in offering an explicit precondition layer —observation, admissibility, custody— on which those models already operate without, until now, formalizing it.

Starging

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