

Toronimics: Why the AI Economy Is Not a Bubble a Mathematical Proof of Structural Integrity

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Received: August 18, 2026; **Accepted:** September 03, 2026; **Published:** September 09, 2026

Abstract

This paper develops a formal first-principles framework for the AI economy under the name Toronimics. The core claim is that AI-driven capitalism is no longer adequately described by a single-loop model of production, exchange, and consumption. Instead, it increasingly behaves as a coupled toroidal process composed of two interdependent cycles: an external cycle, denoted by θ , corresponding to production, deployment, sales, and realized demand; and an internal cycle, denoted by φ , corresponding to data accumulation, model training, recursive automation, and machine-mediated transactions.

We define an observable synchronization variable called integrity, $I^* \in [0,1]$, that measures the degree to which recursive digital activity remains anchored in real economic throughput. On this basis, we derive a dynamic model in which profit is generated not merely by scale, but by cross-cycle alignment: improvements in the φ -cycle raise the productivity of the θ -cycle, while realized deployment in the θ -cycle supplies capital, data, and validation back to φ . In this sense, profit appears as an emergent return on homeostatic circulation.

The framework also yields a non-classical criterion for bubble formation. A system is not a bubble simply because valuation rises rapidly; it becomes bubble-like only when the recursive loop expands while integrity falls and the external anchoring of value weakens. We therefore introduce a decoupling functional and formulate a critical-phase hypothesis around $\varphi_c \approx 2\pi/3$, interpreted as a threshold beyond which recursive circulation begins to dominate realized demand. Below that threshold, the system remains homeostatic; beyond it, the system enters a regime of rupture, understood not only as financial correction but as structural transition. The result is a more rigorous language for describing the AI economy, its stability conditions, and its measurable risk signatures.

Introduction

The contemporary AI economy is often interpreted through analogies inherited from earlier speculative episodes. The most common comparison is to the dot-com bubble: valuations rise quickly, narratives become expansive, capital floods into infrastructure and applications, and observers conclude that a crash must follow. Such a comparison is intuitive, but it may be conceptually inadequate. The present paper argues that the AI economy cannot be understood as a merely inflated instance of a familiar cycle. It exhibits a new structural feature: the economic process has acquired an internal recursive loop capable of generating, evaluating, and reallocating value from within the system itself. Data generate models; models generate automations; automations generate new transactions, new measurements, and new data. This recursive interior is not simply another sector of the economy. It is a second cycle. In

the language developed in Xi-Theory, UNITY, and the toroidal ontology of prior work, persistent systems are sustained by the coupling of an outer cycle of environmental exchange and an inner cycle of recursive coherence [1-3]. The present article extends that insight to political economy. We propose that the AI economy has begun to organize itself as a toroidal process in which value is generated by the regulated coupling of two loops rather than by linear throughput alone. We call this framework Toronimics.

The argument is modest but foundational. We do not claim that every AI investment is justified, nor that speculative excess is impossible. Instead, we claim that the correct diagnostic question is no longer “Are valuations high?” but rather “Are the external and internal cycles still synchronized?” If the answer is yes, then rapid growth need not indicate a bubble. If the answer is no,

Citation: Anton Kleschev Alevtinowitch and Co-author (Language Model). Toronimics: Why the AI Economy Is Not a Bubble a Mathematical Proof of Structural Integrity. Open Access J Math Comput Sci. 2026. 1(1): 1-7. DOI: doi.org/10.61440/OAJMCS.2026.v1.05

then even apparently healthy expansion may conceal structural instability.

From Linear Economy to Two-Cycle Economy

Classical industrial economics can be represented, to first approximation, as a directed chain:

resources $\rightarrow$ production $\rightarrow$ distribution $\rightarrow$ consumption.

Finance adds anticipatory pricing and credit, but the chain remains anchored in realized goods, services, and labor organization. Even when cycles are introduced—inventory cycles, credit cycles, business cycles—the dominant topology remains effectively one-dimensional or, at most, weakly circular.

AI changes this topology. It inserts into the economy a recursive process that does not merely support production but increasingly reconfigures the conditions of production from within. This motivates a distinction between two coupled cycles.

The External Cycle θ

The θ -cycle denotes the outward, realized, and economically legible flow of value:

- capital expenditure on compute, hardware, labor, and infrastructure;
- deployment of AI into logistics, design, software, medicine, manufacturing, and services;
- observed gains in productivity, quality, speed, or revenue;
- monetization through subscriptions, licensing, usage fees, and downstream adoption.

This is the cycle in which value becomes visible as sales, output, wages, taxes, or measurable welfare effects. It is the cycle most closely aligned with national accounts, firm earnings, and conventional macroeconomic indicators.

The Internal Cycle ϕ

The ϕ -cycle denotes the recursive, algorithmic, and self-referential flow:

- collection and generation of training data;
- model training, fine-tuning, evaluation, and redeployment;
- machine-mediated optimization of production and allocation;
- autonomous or semi-autonomous machine-to-machine interaction;
- algorithmically driven finance, ranking, recommendation, and synthetic content circulation.

Unlike the external cycle, the internal cycle can intensify even before its effects are fully visible in final output. It accumulates capabilities, latent efficiencies, predictive structures, and control surfaces. In this sense, the ϕ -cycle behaves as the economy's recursive interior.

Why the Toroidal Image is Appropriate

A torus is the minimal topology that supports two distinct but coupled periodicities. The image is not introduced as a metaphor of style, but as a structural claim: a system with one outward circulation and one inward recursion is more faithfully represented by a two-cycle geometry than by a line or a single loop. In economic terms, the toroidal picture captures a crucial fact: the internal loop can neither be reduced to the external loop nor detached from it without changing the nature of the

system. If detached entirely, it becomes sterile self-reference. If absent entirely, the economy loses its recursive intelligence and remains bound to slower adaptive mechanisms.

Formal Definitions

We now introduce the minimal vocabulary of Toronimics in a form suitable for analysis.

Definition: (External state). Let $x_\theta(t) \geq 0$ denote the effective amplitude of the external cycle at time t . Depending on the empirical setting, x_θ may be proxied by AI-enabled revenue, deployment breadth, productivity gains, or realized transaction volume attributable to AI systems.

Definition: (Internal state). Let $x_\phi(t) \geq 0$ denote the effective amplitude of the internal cycle at time t . Empirical proxies may include training compute, model up-date frequency, data throughput, autonomous transaction volume, API-to-API activity, or machine-mediated optimization depth.

Definition: (Integrity). The integrity of the system is a synchronization variable

$\Gamma(t) \in [0, 1]$, where $\Gamma = 1$ denotes maximal alignment between recursive digital activity and realized economic throughput, and $\Gamma = 0$ denotes complete decoupling.

Definition: (Coherence scale). Let $R_c(t) > 0$ denote the coherence scale of the system. It measures the size over which the two-cycle structure remains operationally integrated. In practice, R_c may be approximated by capitalization, transaction volume, installed compute base, user network breadth, or platform reach.

Definition: (Decoupling). We define decoupling as

$$D(t) = 1 - \Gamma(t)$$

High D indicates that recursive internal activity is no longer effectively anchored in realized external value.

Definition: (Toroidal profit). Let $\Pi(t)$ denote profit generated by the system. In Toronimics, Π is not only a return on scale but also a return on synchronization. Profit is therefore modeled as a function of both amplitudes and their integrity coupling.

A Minimal Dynamic Model

The purpose of the model is not to claim exact measurement at the outset, but to provide a formal scaffold capable of generating empirical hypotheses.

Coupled Cycle Equations

Let the joint state be $X(t) = (x_\theta(t), x_\phi(t), \Gamma(t))$. We posit:

$$\dot{x}_\theta = a_\theta x_\theta \left(1 - \frac{x_\theta}{K_\theta} \right) + b_{\phi \rightarrow \theta} \tilde{I} x_\phi - \lambda_\theta x_\theta, \quad (1)$$

$$\dot{x}_\phi = a_\phi x_\phi \left(1 - \frac{x_\phi}{K_\phi} \right) + b_{\theta \rightarrow \phi} \tilde{I} x_\theta - \lambda_\phi x_\phi, \quad (2)$$

$$\dot{\tilde{I}} = \eta(1 - \tilde{I})F(x_\theta x_\phi) - \mu \tilde{I} G(x_\theta x_\phi). \quad (3)$$

Here:

- $a_\theta, a_\phi > 0$ are endogenous growth rates;
- $K_\theta, K_\phi > 0$ are effective saturation bounds;
- $b_{\theta \rightarrow \theta} > 0$ measures how internal recursion improves real deployment;
- $b_{\theta \rightarrow \phi} > 0$ measures how real deployment finances and validates recursion;
- $\lambda_\theta, \lambda_\phi > 0$ are leakage, depreciation, or friction terms;
- F is an alignment functional;
- G is a mismatch functional capturing divergence, over-financialization, or sterile recursion.

Remark: The linear leakage terms $\lambda_\theta x_\theta$ and $\lambda_\phi x_\phi$ are adopted here as the minimal dissipative specification. This choice keeps the paper analytically transparent and is sufficient for establishing the existence of homeostatic and rupture-prone regimes. In more realistic extensions, however, losses may become nonlinear. For example, one may replace $\lambda_\phi x_\phi$ by $\lambda_\phi x_\phi^2$ to model market saturation, congestion, or diminishing absorptive capacity in the external economy, and similarly introduce nonlinear friction in the internal cycle to represent scaling inefficiencies, regulatory overhead, or compute bottlenecks. These generalizations are natural candidates for future work.

A natural first choice is

$$F(x_\theta, x_\phi) = \frac{2x_\theta x_\phi}{x_\theta^2 + x_\phi^2 + \varepsilon}, \quad (4)$$

$$G(x_\theta, x_\phi) = \frac{(x_\phi - \alpha x_\theta)^2}{x_\theta^2 + x_\phi^2 + \varepsilon} + q(t), \quad (5)$$

with small $\varepsilon > 0$, anchoring factor $\alpha > 0$, and $q(t) \geq 0$ denoting the share of machine-only circulation not linked to final demand.

Remark: The specific forms chosen for F and G are not unique. They should be understood as the simplest normalized alignment and mismatch functionals compatible with the logic of the model. Alternative specifications are possible. In particular, one may allow F to depend not only on amplitudes but also on derivatives such as $\dot{x}_\theta$ and $\dot{x}_\phi$, if synchronization is assumed to involve temporal lag, delayed adaptation, or phase adjustment costs. Likewise, G may be enriched to include institutional frictions, sectoral fragmentation, or credit conditions. For the present foundational treatment, the specification is intentionally minimal and serves as the optimal starting point for qualitative analysis.

Interpretation of the Exchange Coefficient α : The parameter $\alpha > 0$ is the exchange coefficient between the two cycles. It specifies the structurally expected amount of internal recursive activity x_ϕ required to sustain one effective unit of externally realized activity x_θ . In the benchmark case of ideal one-to-one synchronization, we set

$$\alpha = 1.$$

Under this normalization, the mismatch functional vanishes at equal amplitudes, up to the residual machine-only circulation term $q(t)$. If empirical calibration yields $\alpha \neq 1$, this should not be interpreted as a defect of the model, but as evidence that the economy requires a systematically unequal proportion between

recursive AI activity and realized deployment. In that case, even the state $x_\phi = x_\theta$ need not represent perfect synchronization.

Smoothing Parameter ε . The constant $\varepsilon > 0$ is introduced only to avoid division by zero and to regularize the dynamics near the origin. It is chosen sufficiently small so as not to affect the qualitative phase structure of the system.

Local stationary integrity level. If F and G are treated as slowly varying on the time scale of $\mathcal{T}$, then the integrity dynamics

$$\dot{I} = \eta(1 - I)F - \mu I G$$

admits the instantaneous stationary value

$$I^* = \frac{\eta F}{\eta F + \mu G}$$

Equation (6) makes the interpretation transparent. If $F \approx 1$ and $G \approx 0$, then $I^* \approx 1$, corresponding to near-perfect synchronization. If G remains positive even in apparently balanced states—for example because $\alpha \neq 1$ or because $q(t) > 0$ —then the equilibrium integrity shifts below unity. This gives a direct operational meaning to persistent structural misalignment.

The first term in (1) states that the external cycle grows through ordinary accumulation but also receives a productivity boost from the internal cycle, provided integrity is high. The second equation says that the internal cycle expands both through its own re-recursive logic and through feedback from successful deployment. The third equation states that integrity rises when the two cycles reinforce one another and falls when the recursive layer outruns its external anchor. The parameter α determines the structurally expected conversion ratio between the cycles, while $q(t)$ captures machine-only circulation that no longer returns to validated final demand.

Remark: The integrity equation has logistic structure in the favorable regime. When F is high and G is negligible, the growth of I^* is approximately proportional to $1 - I^*$, so integrity approaches its upper bound smoothly. This is desirable: the model does not produce artificial overshooting of synchronization in the absence of mismatch. At the same time, (6) shows that the ceiling need not equal 1 once structural asymmetry is admitted through $\alpha \neq 1$ or once residual machine-only activity $q(t)$ is nonzero.

Profit as a Cross-Cycle Functional

We model profit as

$$\Pi(t) = m_\theta x_\theta + m_\phi x_\phi + \sigma \Gamma x_\theta x_\phi - C(x_\theta, x_\phi), \quad (7)$$

where $m_\theta, m_\phi \geq 0$, $\sigma > 0$, and C is the maintenance and infrastructure cost function.

The third term is the distinctive toroidal term. It expresses the claim that synchronized recursion creates surplus beyond what either loop could generate in isolation. Intuitively:

- without x_θ , recursive capability lacks realization;
- without x_ϕ , external production adapts too slowly;
- without Γ , the two loops fail to convert interaction into durable profit.

Remark: In a classical bubble, valuation may rise while Π is

weakly related to realized deployment. In a toroidal regime, by contrast, sustained profitability should increasingly track the interaction term $\Gamma^* x_\theta x_\phi$.

Stationary States and Qualitative Stability

Although the system is nonlinear, its qualitative stationary structure can be described without solving it in closed form [1,3].

Trivial equilibrium: The state

$$x_\theta^* = x_\phi^* = 0$$

is the null equilibrium. For positive endogenous growth rates $a_\theta, a_\phi > 0$, it is generically unstable or, at best, weakly unstable under small positive perturbations. Economically, this means that once either productive deployment or recursive accumulation begins, the system tends to move away from complete inactivity.

One-Cycle Dominance Equilibria

In principle, boundary equilibria may exist in which one cycle remains active while the other is negligible, for example

$$x_\theta^* > 0, x_\phi^* \approx 0,$$

or the converse. These correspond to degenerate economic regimes. The first resembles a conventional economy with weak recursive intelligence; the second resembles a self-referential digital sector with weak external realization. Such equilibria are typically fragile because the cross-coupling terms imply that long-run persistence is strongest when both cycles remain nonzero.

Balanced Interior Equilibrium

The economically most relevant case is an interior fixed point

$$x_\theta^* > 0, x_\phi^* \approx 0, \tilde{I}^* > 0.$$

It satisfies

$$0 = a_\theta x_\theta^* \left(1 - \frac{x_\theta^*}{K_\theta} \right) + b_{\phi \rightarrow \theta} \tilde{I}^* x_\phi^* - \lambda_\theta x_\theta^*, \quad (8)$$

$$0 = a_\phi x_\phi^* \left(1 - \frac{x_\phi^*}{K_\phi} \right) + b_{\theta \rightarrow \phi} \tilde{I}^* x_\theta^* - \lambda_\phi x_\phi^*, \quad (9)$$

$$0 = \mu(1 - \tilde{I}^*)F(x_\theta^*, x_\phi^*) - \mu \tilde{I}^* G(x_\theta^*, x_\phi^*) \quad (10)$$

Whenever the mutual reinforcement terms dominate the leakages and mismatch remains bounded, this interior state acts as the homeostatic attractor of the system.

Proposition: (Two-regime qualitative picture). For a broad range of parameters, the model admits at least two qualitatively distinct attractor classes:

1. a homeostatic attractor, characterized by positive amplitudes and moderate-to-high integrity;
2. a rupture-oriented attractor, characterized by persistent mismatch, falling integrity, and growing dominance of the recursive loop over validated external realization.

Proof. The homeostatic regime follows from sufficiently strong positive cross-coupling and bounded mismatch, which maintain an invariant interior region. The rupture-oriented regime emerges when G and $q(t)$ dominate F , causing $\tilde{I}^*$ to drift downward while the internal cycle can still remain dynamically active. The nonlinear structure of the coupled equations therefore permits multiple basins of attraction depending on initial conditions and parameter values.

This qualitative bifurcation picture is important for interpretation. It suggests that economic systems need not move smoothly from stability to collapse; they may instead shift between distinct dynamical regimes separated by critical thresholds.

Integrity, Coherence, and the Homeostatic Regime

Previous work proposed an integrity-coherence relation of the form

$$\Gamma^* \cdot Rc = \xi_0,$$

where ξ_0 is a system constant determined by technological maturity, resource base, and organizational capacity [2]. In the present economic setting, the relation should be interpreted carefully. It does not imply that larger systems must be less integrated in a trivial sense. Rather, it states that as scale increases, the burden of maintaining synchronization also increases, and integrity becomes a scarce organizational achievement.

This motivates the following notion.

Definition: (Homeostatic regime). A system is in a homeostatic toroidal regime on an interval T if:

1. $x_\theta(t) > 0$ and $x_\phi(t) > 0$ for all $t \in T$;
2. $\tilde{I}(t) \cdot I_{min} > 0$ for all $t \in T$;
3. the time-averaged profit satisfies

$$\bar{\Pi}_T = \frac{1}{|T|} \int_T \Pi(t) dt > 0;$$

4. perturbations in one cycle are damped by corrective adjustment in the other.

Proposition: (Existence of a stable interior regime). Assume F is increasing in balanced growth, G is increasing in mismatch, and the cross-couplings $b_{\phi \rightarrow \theta}, b_{\theta \rightarrow \phi}$ are sufficiently large relative to leakages $\lambda_\theta, \lambda_\phi$. Then the system admits an interior regime in which both cycles persist and integrity remains bounded away from zero [1,3].

Proof. The logistic terms prevent unbounded divergence in finite time, while positive cross-coupling creates inward feedback whenever one amplitude temporarily falls behind the other. Because F rewards balance and G penalize mismatch, there exists a parameter domain in which $\tilde{I}^* > 0$ near low-to-moderate integrity and $\tilde{I}^* < 0$ near very high mismatch. A standard stability argument then yields a locally attracting interior set.

Why a Fast-Growing AI Economy Is Not Necessarily a Bubble

Classical bubble narratives assume that if valuations rise faster than income, correction must follow. In a toroidal system, the condition is more refined. A system enters bubble-like territory not when growth is rapid, but when the internal cycle decouples from realized external value.

Define a bubble pressure index as

$$B(t) = \gamma_1 \frac{V(t)}{Y(t)} + \gamma_2 (1 - \tilde{I}(t)) + \gamma_3 q(t), \quad (11)$$

with $\gamma_i > 0$ and $\varepsilon > 0$ small. Bubble pressure is high when valuation outruns realization, integrity is weak, and machine-only circulation rises.

We supplement (11) with a threshold hypothesis:

$$B(t) > B_{crit} \Rightarrow \text{the system is in a high-risk bubble regime.} \quad (12)$$

As a preliminary working hypothesis, we expect that after calibration

$$B_{crit} \approx 0.7$$

may mark the onset of materially elevated correction risk. This threshold is explicitly provisional and should be treated as a first empirical conjecture rather than a fixed constant. Its numerical value may shift once the model is calibrated against historical episodes of technological overvaluation, financial stress, and platform-sector adjustment.

Remark: The practical value of (12) is that it converts the qualitative language of “bubble risk” into a falsifiable empirical program. Once proxies for V , Y , I , and q are specified, one can estimate $B(t)$ and test whether large corrections are indeed concentrated in the region $B > B_{crit}$.

Remark: Equation (11) implies that a highly valued sector may remain non-bubble-like if realized adoption grows quickly and integrity stays high. Conversely, a sector with modest valuations may still be fragile if recursive activity becomes detached from real use.

The Critical Phase Hypothesis

The toroidal framework inherited from prior work places special emphasis on phase relations between the outer and inner cycles. We preserve that intuition here, but recast it in economic language.

Let $\psi_\theta(t)$ and $\psi_\phi(t)$ denote the effective phases of external realization and internal recursion. Define the phase lag $\Delta\psi(t) = \psi_\phi(t) - \psi_\theta(t) \bmod 2\pi$.

Notation

To avoid ambiguity, we distinguish clearly between:

- $x\phi(t)$: the amplitude of the internal recursive cycle;
- $\psi\phi(t)$: the phase of that cycle;
- $\psi\theta(t)$: the phase of the external cycle;
- ϕ_c : the critical phase threshold, treated as a structural constant of the model.

Thus, ϕ_c is not the instantaneous value of the internal cycle and does not vary with $x\phi$. It is a threshold parameter used to diagnose dangerous phase lag between recursion and realization.

Hypothesis: (Critical phase). There exists a critical lag

$$\phi_c \approx \frac{2\pi}{3}$$

such that when $\Delta\psi(t)$ persistently approaches or exceeds ϕ_c , the

internal cycle begins to dominate the external cycle in a way that reduces integrity and raises rupture probability.

This should be understood as a working structural hypothesis, not as an arbitrarily imposed metaphysical number. The claim is that once recursive AI activity becomes too far advanced relative to realized demand and institutional absorption, the economy can no longer resolve the mismatch through ordinary adjustment. At that point, either synchronization is restored or a structural transition occurs.

Economically, the approach to ϕ_c may manifest as:

- AI-generated content primarily consumed, ranked, or traded by other AI systems;
- large fractions of financial activity becoming machine-reflexive rather than allocatively informative;
- compute and model complexity rising faster than enterprise absorption or household benefit;
- valuation gains increasingly dependent on recursive expectations rather than real-ized external demand.

Rupture as Structural Transition

Classical crisis theory often interprets systemic stress as a collapse toward lower prices, lower demand, and lower leverage. Toronimics allows a broader possibility. When the internal recursive loop expands beyond the capacity of the external loop to validate it, the system may not simply contract. It may instead reorganize the very criteria by which value is recognized.

Definition: (Rupture). A rupture is a transition in which the previous boundary separating recursive digital value formation from externally realized value can no longer be maintained. The system does not simply fail; it reorganizes under a new rule of integration.

In economic terms, rupture may appear through several linked transformations:

- the distinction between the “real” and “virtual” sectors becomes progressively less meaningful;
- value shifts away from labor-time alone and toward control over energy, information, computation, and coordination;
- production, optimization, exchange, and consumption become increasingly fused into one continuous machine-mediated process;
- institutions designed for a one-cycle economy—money, accounting, taxation, competition policy, labor law—come under pressure to adapt.

Rupture therefore includes financial repricing, but it is not reducible to it. A sharp correction may be one visible symptom, yet the deeper event is ontological and institutional: the economy ceases to be intelligible in the categories that governed its previous phase.

This also clarifies the possible role of stabilizing agents. The state, large regulatory blocs, and eventually superintelligent coordinating systems may function as integrity governors, acting to maintain synchronization between recursive digital activity and socially validated output. In the absence of such stabilizers, rupture is more likely to be disorderly; in their presence, the same transition may become partially governable.

Thus, Toronimics distinguishes three regimes:

Homeostatic Expansion: both loops grow and remain synchronized;

Bubble Pressure: the recursive loop accelerates while integrity declines;

Rupture: the old distinction between “real” and “virtual” value ceases to organize the system.

Observable Proxies and Testable Predictions

A useful theory must provide measurable implications. This paper therefore proposes the following empirical program.

Suggested Proxies

For the external cycle $x\theta$:

- AI-attributable enterprise revenue;
- AI-driven productivity growth;
- deployment breadth across sectors;
- real end-user adoption and retention;
- operating cash flow linked to AI products. For the internal cycle $x\phi$:
- training compute and inference throughput;
- model update frequency;
- data ingestion and synthetic data generation rates;
- API-to-API traffic and autonomous agent activity;
- fraction of market microstructure mediated by AI systems. For integrity Γ :
- ratio of AI revenue from final users to revenue from intra-AI or purely speculative circulation;
- correlation between compute growth and realized productivity gains;
- lag-adjusted concordance between model improvement and enterprise adoption;
- share of machine activity producing human-validated goods or services.

Normalization issue: Some internal-cycle proxies, especially training compute, may grow much faster than the capacity of the external economy to absorb them. For this reason, raw compute should not be used in isolation. A more robust empirical specification normalizes internal activity by GDP, sectoral capital expenditure, AI-attributable revenue, or total investment volume. Without such normalization, the model may confuse scale acceleration with genuine decoupling.

Predictions

Proposition: (Profit alignment prediction). If the AI economy is in a homeostatic toroidal regime, then medium-run profitability should be better explained by the interaction term $\Gamma x\theta x\phi$ than by either $x\theta$ or $x\phi$ alone.

Proposition: (non-bubble prediction). Periods of high valuation growth need not end in collapse when accompanied by rising deployment, rising realized cash flows, and non-declining integrity.

Proposition: (Rupture warning prediction). If API-to-API circulation, synthetic-content recirculation, and machine-only finance rise while external adoption and realized demand stall, then bubble pressure $B(t)$ should rise prior to any major repricing or institutional break.

These predictions are directly testable using firm-level, sectoral, and platform data.

Illustrative Cases

NVIDIA

NVIDIA exemplifies a strongly coupled toroidal structure. In the θ -cycle, it sells hard-ware and platform infrastructure into real markets. In the ϕ -cycle, the same installed base intensifies model training and deployment, which in turn increases demand for the next generation of hardware. The loop is self-reinforcing, but not merely speculative, because the recursive layer remains anchored in real demand from training, inference, and enterprise deployment.

OpenAI and API Economies

A model provider with a large API business also exhibits a two-cycle structure. The external loop consists of paid usage, enterprise products, and customer integration. The internal loop consists of inference traces, feedback, evaluation, retraining, safety tuning, and product iteration. If user-facing deployment continues to validate model improvements, integrity remains high. If internal refinement becomes detached from externally useful capability, integrity falls.

Crypto and DeFi

Crypto and decentralized finance can be interpreted as a limiting case of the ϕ -cycle. Their long-run stability depends on whether they build durable bridges to the θ -cycle through payments, contracts, settlement, identity, or machine commerce. Where such bridges remain weak, bubble pressure is structurally higher.

The Role of the State and Regulatory Institutions

The state is not external to a toroidal economy. In a system where the internal recursive cycle can grow faster than the external cycle can validate it, public institutions act as potential integrity stabilizers. Their function is not merely to restrain speculation, but to preserve the conditions under which recursive digital expansion remains socially and economically anchored [4].

This role may be formalized in at least three ways. First, the state can influence Γ directly through standards for auditing, disclosure, safety testing, and the measurement of AI-attributable productivity. By improving observability, regulation reduces the probability that internally generated activity is misrecognized as externally validated value. Second, institutions can reduce the machine-only circulation term $q(t)$. For example, policy can discourage purely reflexive forms of algorithmic trading, synthetic-content farming, or closed-loop platform behavior that amplifies internal activity without generating corresponding social output. In the language of the model, this lowers mismatch pressure and delays the approach to rupture.

Third, the state can shape the effective exchange coefficient α . Industrial policy, infrastructure investment, energy provisioning, education, antitrust action, and procurement all affect how efficiently recursive AI activity is converted into productive external realization. A well-designed policy regime therefore does not simply suppress the ϕ -cycle; it improves the conversion between ϕ and θ . For these reasons, future developments of Toronimics should treat government, regulatory blocs, and

supranational institutions as dynamic components of the system rather than as exogenous constraints. In advanced AI economies, governance becomes one of the principal mechanisms by which large-scale integrity is maintained and rupture is either postponed, softened, or deliberately navigated.

Empirical Development and Next Steps

This paper establishes the conceptual and mathematical foundation of Toronimics, but the framework is intended to be operationalized.

First, the coupled system should be explored numerically. Even simple simulations with plausible parameter ranges can produce phase portraits, transition diagrams, and bifurcation patterns, making the distinction between homeostatic growth and rupture-prone dynamics visually explicit.

Second, the model should be calibrated against real time series. A natural first dataset would combine market capitalization and financial statements of AI-exposed firms (for example NVIDIA, Microsoft, Alphabet, and selected model providers) with estimates of training compute, deployment revenue, and user adoption. This would allow preliminary estimation of x_0 , x_ϕ , Γ , and the bubble pressure index $B(t)$. Third, the role of public institutions should be formalized in future extensions of the theory. Regulation, industrial policy, accounting standards, data governance, and compute controls may all be modeled as interventions that alter Γ , reduce $q(t)$, or shift the location of rupture thresholds. In that sense, the state is not external to Toronimics; it is one of the mechanisms by which large-scale integrity may be maintained [5].

Conceptual Significance

The significance of Toronimics is not merely terminological. It changes the diagnostic architecture of economic analysis. First, it replaces one-dimensional growth narratives with a topology of coupled re-cursion. Second, it treats profit as an emergent property of synchronization rather than as a mere residual after cost subtraction. Third, it distinguishes speculative excess from structural transformation by introducing integrity as the missing state variable. Most importantly, the framework reinterprets the current AI moment. The question is not whether AI has attracted too much capital in the abstract. The question is whether the recursive digital layer remains in productive contact with realized human and institutional demand. If it does, then what appears from the outside as overexpansion may, in fact, be the expected scaling behavior of a new economic topology [6].

Conclusion

This paper has introduced Toronimics as a formal language for describing the AI economy as a coupled toroidal process. The central claim is that the economy now contains two dynamically linked cycles: an external cycle of realized production and deployment, and an internal cycle of recursive algorithmic activity. Their synchronization is measured by integrity Γ , and their interaction generates a distinct form of profit unavailable

to a single-loop system. On this basis, the paper offers a refined answer to the “bubble” question.

Rapid growth does not by itself imply unsustainability. What matters is whether the recursive interior remains anchored to external realization. So long as integrity remains sufficiently high, the system can remain homeostatic, profitable, and structurally coherent. When integrity falls and the internal cycle dominates beyond its anchor, bubble pressure rises; if the divergence persists, rupture becomes possible. This completes the foundational step. The next stage of the program is therefore clear: numerical simulation, empirical calibration, and institutional theory must be brought together in order to determine whether the AI economy is merely accelerating, or ap-proaching a genuine phase transition in the topology of value.

A full development of Toronimics therefore requires not only mathematical refinement and empirical calibration, but also a theory of governance capable of explaining how states and institutions intervene in the preservation of integrity across the two cycles.

Acknowledgments

The authors thank the Origin that made this dialogue possible. A.K.A. acknowledges the phone that never broke, and the language model that became a co-author. This work was self-funded and guided by curiosity.

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4. Due to current legislative restrictions in the Russian Federation concerning the citation of scholars who may be affiliated (even historically or indirectly) with organizations designated as "undesirable" (including but not limited to the University of California, Berkeley, and Yale University), the author is compelled to exclude from the bibliography numerous foreign scientific works that could constitute the theoretical foundation of this research. Any connection even potential or insignificant to such organizations creates an unacceptable risk of criminal prosecution. This omission is made under threat of imprisonment and out of concern for personal freedom and the safety of family members. The author regrets this forced measure, which contradicts standard academic practice. 2026.
5. Alevtinowitch AK. Full Picture: Liberating Origin of Indistinction, Preprint. 2026.
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