Economic Relativity Model (ERM) v2.0: Core Framework and Empirical Validation

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Abstract

ERM v2.0 formalizes the economic projection of the Structural Unified Field (SUF) and provides a corrected measurement protocol for F and a. The canonical production function is:

Eq. (ERM-1)

$$Y = \frac{F\left(1 - (c/p)^2\right)^{3/2}}{a}$$

Here Y is realized output, F the potential capacity, c/p the perceived irreducible cost-to-price ratio, and a the structural friction (inverse of efficiency). ERM v2.0 (i) aligns its structure with SUF v2.0 and BBR v2.0, (ii) corrects earlier mis-specification in the empirical treatment of F and a, and (iii) documents a replicable pipeline for cross-country backtests and forecasting.

Keywords: Economic Relativity Model; Structural Unified Field; Incentive Boundaries; Potential Capacity; Efficiency Friction; Crisis Prediction

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Version Note

This version supersedes the 2025-07 ERM draft. **Primary corrections:**
1) **F (potential capacity)** is defined as an exogenous ceiling from primary statistical sources (e.g., potential GDP, capacity/utilization-based ceilings), not smoothed realized GDP.
2) **a (friction/inefficiency)** is a **dynamic, effective parameter** consistent with observed output paths. In public materials we report its interpretation (a = 1/A) but **withhold operational estimation details**; a is not embedded inside the curvature term.
3) **c/p** remains the perceived irreducible cost-to-price ratio; accounting adjustments and survey mappings are discussed conceptually.

Note: Detailed estimation and back-out procedures are intentionally **omitted** in this release to preserve the research program. Earlier versions remain archived in the Zenodo record for provenance.

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1. SUF–ERM Alignment

1.1 Mother Function

Eq. (SUF-1)

$$Y(\beta) = (1 - \beta^2)^{k/2}$$

1.2 Economic Projection

ERM is the economic domain projection of SUF with $\beta \equiv c/p$ and default $k = 3$:

Eq. (PROJ)

$$Y = \frac{F\left(1 - (c/p)^2\right)^{3/2}}{a}$$

This preserves structural curvature while introducing measurable domain parameters F and a.

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2. Measurement Protocol (Corrected)

2.1 Potential Capacity F

Definition: The economy's theoretical ceiling conditional on technology, capital, labor, and policy—independent of current incentive conditions.
Operationalization (hierarchy, choose highest-quality available):
1) Official **Potential GDP** (e.g., national statistical offices / supranational estimates).
2) **Capacity Utilization** U and **Nameplate Capacity** F_{name}: set $F = F_{name}$ or back out from Y/U when consistent.
3) For sectoral studies: engineering capacity or peak sustainable output.

Do NOT: Derive F by smoothing realized GDP; this leaks incentives into the ceiling definition.

2.2 Friction / Inefficiency (a)

Definition: Mapping loss from potential to realized output; conceptually, **a = 1/A** with A as a composite efficiency index.
Public treatment (v2.0): a is **dynamic** and calibrated to remain consistent with observed output, allowing ERM to separate boundary effects from baseline efficiency. Precise estimation methodology is **withheld** in this public version.
Caution: Keep a outside the curvature term; avoid burying it inside $\left(1 - (c/p)^2\right)^{3/2}$.

2.3 Irreducible Cost-to-Price Ratio c/p

Definition: The perceived non-compressible share of cost relative to price—after all optimizations that decision-makers consider credible.
Operationalization:
• Macro proxy from firm reports: average gross margin / operating margin constructs; pair with

survey-based cost stickiness to approximate the irreducible component.
 ・ Correct for taxes/subsidies and for price controls to reflect perception rather than pure accounting.
Behavioral note: Even with positive accounting profit, if **perceived** $c/p \to 1$, investment halts—ERM captures this early.

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3. Properties and Intuition

1) **Boundary extinction:** $c/p \to 1 \Rightarrow Y \to 0$.
2) **Ideal ceiling:** $c/p \to 0 \Rightarrow Y \to F/a$.
3) **Drag effect:** $a \uparrow \Rightarrow Y \downarrow$ (holding $F, c/p$ fixed).
4) **Nonlinear amplification:** small changes in c/p near 1 generate large drops in Y (crisis mechanics).

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4. Empirical Workflow (High-Level Outline)

This section provides only a **non-operational** overview. Implementation specifics, parameter back-out procedures, and data recipes are **withheld** in this public version.

Outline:
 ・ Assemble consistent series for output (Y), potential capacity proxies (F), efficiency indicators (A), and margin-based perceptions for c/p.
 ・ Ensure normalization and identifiability across series; maintain a outside the curvature term.
 ・ Validate that ERM reproduces major inflection episodes when boundary pressure rises (c/p → 1) or effective friction increases.
 ・ Stress-test scenarios by varying c/p, a, F to study boundary sensitivity.

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5. Interpretation and Policy

 ・ **Lowering** c/p (credible cost relief, clarity) yields nonlinear gains near the boundary.
 ・ **Improving** A (hence lowering a) unlocks F without new capital outlays.
 ・ **Expanding** F alone is insufficient when c/p is high; incentives dominate ceilings near the boundary.

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6. Integration with SUF & BBR

 ・ **SUF v2.0 (mother function):** $Y(\beta) = (1 - \beta^2)^{k/2}$, with $\beta \equiv c/p$ under ERM.
 ・ **BBR v2.0 (behavioral projection):** identical structure with β as perceived boundary tension.
 ・ ERM provides the **measurable link** between structure and macro data; BBR explains perception-driven shifts in β .

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7. Conclusion

ERM v2.0 completes the structural alignment with SUF and BBR and corrects the empirical handling of F and a . It offers a compact, testable law that converts incentive boundaries into output dynamics,

enabling early crisis warnings and policy design targeted at the true constraint—**perceived irreducible cost** under structural friction.

Cross-Record References (Version Chain)

- **SUF v2.0 (mother function):** https://zenodo.org/records/17216771
- **ERM record (this domain, prior DOI):** https://zenodo.org/records/16737164
- **BBR v2.0 (behavioral projection):** https://zenodo.org/records/17216789

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