L A B N O T E

CAMS Node Dynamics, Temporal Inelasticity, and Motif Theory — Evidentiary Session

Integrated working note across two compacted sessions · 2026-08-15

Dataset: juno/JUNO_Unified_Dataset.csv · 36 societies · 32,361 node-year records
Pilot dataset: Cuba (1990–2026) · Iceland (2000–2026) · ASPI (2003–2026)
Framework: CAMS (Complex Adaptive Meta-System) · JUNO v1.2-Final
Tools: cams_node_dynamics_code.py · cams_inelasticity.py · cams-calc v1.2 skill
Status: Working note — not peer reviewed

Abstract

This lab note documents five interconnected findings from an analytical session on CAMS structural dynamics across 36 societies. (1) The JUNO v1.2 bond formula is rank-1, producing no pair-specific coupling information. Temporal inelasticity I_ij is proposed and piloted as a trajectory-based coupling measure. (2) Node response architecture is cross-society stable: Flow and Helm are amplifiers ($\beta > 1$), Lore is the primary anchor ($\beta = 0.706$). (3) Archive–Lore is the dominant bond across all regimes (35.4% of observations, 9.9× null enrichment), with elevated frequency in crisis regimes (51.2% Acute Crisis vs 25.5% High Coherence). (4) Bond structure alone predicts regime class at 89.5% accuracy versus 74.5% for node values alone, confirming coupling primacy. (5) Stewards is the strongest single-node leading indicator of regime crisis (AUC = 0.930) and serves as the political economy transmission bridge in the Helm→Stewards→Flow chain.

1. Background and Motivation

1.1 JUNO v1.2-Final formula update

The JUNO bond formula was updated to remove topology edge weights (T_ij). The old formula:

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B_ij (v1.0) = T_ij × √(q_i·q_j) × 2^(-(S_i+S_j)/10)
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was replaced with:

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B_ij (v1.2) = √(q_i·q_j) × 2^(-(S_i+S_j)/10)
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where q_i = (0.6·C_i + 0.4·A_i) / 10. This change makes bond values bounded [0, 1] and removes an externally imposed structural bias (FF=1.0, SS=0.8, FS=0.6 weights). All prior runs using Iceland, ASPI, and Cuba internal data had already been computed without topology weights; v1.2 formalises this as canonical.

1.2 The rank-1 bond matrix problem

The v1.2 bond formula factors completely:

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B_ij = [√q_i · 2^(-S_i/10)] × [√q_j · 2^(-S_j/10)] = w_i · w_j
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The bond matrix B = w⊗w is the outer product of a single vector with itself — it is rank-1. Every row is proportional to every other row. There is no pair-specific coupling information anywhere in the matrix. The algebraic connectivity metric lam2, computed from the Laplacian of this matrix, is therefore also algebraically constrained rather than empirically discovered.

Consequence: JUNO v1.2 can identify which nodes are strong or weak but cannot detect whether Helm–Archive is more or less tightly coupled than Helm–Lore. Both bonds are entirely determined by node weights. The graph structure is not discovered from data; it is imposed by the formula.

2. Temporal Inelasticity

2.1 Formulation

If history becomes structure, coupling should leave a measurable trace in how nodes move relative to each other over time. A strongly coupled pair should show a stable relative configuration — it can traverse node-score space together while resisting being pulled apart.

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R_ij(t)   = x_i(t) - x_j(t)        ← relative configuration
ΔR_ij(t)  = R_ij(t+1) - R_ij(t)    ← year-on-year change in relative position
I_ij = 1 - Var(ΔR_ij) / [Var(Δx_i) + Var(Δx_j)]
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I_ij near 1 → the pair maintains a stable relative position despite individual node movement (rigid coupling). I_ij near 0 → relative position varies as much as the nodes themselves. Negative values → movements amplify divergence.

2.2 Coupling classification

Class	Condition	Meaning
Rigid	I_ij > 0.7	Relative configuration resistant to displacement
Loosely associated	0.3 – 0.7	Some co-movement tendency, separable under pressure
Directionally constrained	0.3 – 0.7 and |asymmetry| > 1.0	One node consistently drives the other
Weakly coupled	I_ij < 0.3	Nodes move largely independently

2.3 Pilot results — Cuba, Iceland, ASPI

The inelasticity script was run on three longitudinal datasets (Cuba 37yr, Iceland 27yr, ASPI 24yr). Key cross-society findings:

Pair	Mean I	Std	Loop	Status
Stewards–Flow	0.822	0.101	Cross	Universal structural core
Hands–Flow	0.740	0.176	Fast–Fast	Universal
Stewards–Hands	0.730	0.176	Cross	Universal
Helm–Archive	0.650	0.172	Slow–Slow	Universal
Hands–Archive	0.629	0.053	Cross	Universal

Universal finding 1 — Economic triad as structural core: Stewards–Flow–Hands is the most rigid cluster in all three societies regardless of political system, size, or entity type. Economic coordination appears to be the load-bearing architecture.

Universal finding 2 — Shield anomaly: Shield is the most weakly coupled node in Cuba, Iceland, AND ASPI. Security/coercive functions move independently of institutional coordination. Shield either leads discontinuously at crisis moments or is insulated from normal institutional flux. Cuba Shield–Stewards I=0.102; Iceland Shield–Hands I=0.099; ASPI Shield–Craft I=0.225.

Finding against prior hypothesis: Cross-loop pairs were predicted to be most inelastic as the stability mechanism. Observed: Slow–Slow pairs (Helm–Archive, Lore–Archive) show higher mean inelasticity than cross-loop pairs. Slow nodes co-move because they share longer institutional timescales, not because cross-loop coupling is stronger. Cross-loop rigidity may only manifest during crisis intervals.

3. Node Dynamics — 36-Society Analysis

3.1 Dataset

The node dynamics script (cams_node_dynamics_code.py) was run on juno/JUNO_Unified_Dataset.csv: 36 societies, 32,361 node-year records, year ranges spanning from Argentina 1950 through current. Node response coefficient β is the regression slope of ΔNode / Δmean_others — how much a node amplifies or dampens the system's collective movement.

3.2 Node response architecture

Node	Median β	Role	Loop
Flow	1.171	Primary amplifier	Fast
Helm	1.129	Amplifier	Slow
Stewards	1.032	Near-neutral (slightly amplifying)	Slow
Craft	0.938	Responsive	Fast
Hands	0.932	Responsive	Fast
Archive	0.847	Moderating	Slow
Shield	0.777	Dampener	Fast
Lore	0.706	Primary anchor	Slow

The β ordering is cross-society stable. LOOS validation: holding each society out and predicting its β-order from the remaining 35, mean Spearman $\rho = 0.651$ (median 0.750, 100% positive, 72% with $\rho > 0.5$). Permutation null: 0/5,000 relabelled datasets matched the observed architecture ($p < 0.001$).

3.3 Common-mode vs relational dynamics

Of squared annualised node movement, 69.1% is common-mode (all nodes rising or falling together) and 30.9% is relational (nodes moving relative to each other). The relational component is where coupling structure is expressed. Mean LOOS pair-order accuracy: 74.9%. Mean held-out Spearman $\rho = 0.643$.

3.4 Anchor–amplifier dynamics (persistence vs. change)

Plotting median persistence of relative node position against median absolute annualised change, all 8 nodes cluster in persistence range 0.75–0.85. Flow sits at the high-change, medium-persistence extreme (the amplifier); Lore, Archive, and Shield cluster at low-change, high-persistence (anchors). Helm is an outlier: high change (0.80) with lower persistence (0.76) — the directing node that moves decisively when it moves.

4. Motif Theory — Claim Testing

4.1 Context

The CAMS_Motif_Theory.pdf (uploaded 2026-08-15) contains an AI peer review of a thesis proposing that CAMS coupling configurations constitute "narrative attractors" — finite recurring motif classes that generate historically intelligible forms. The reviewer (Kimi) identified five hardening requirements and cited a key empirical result: Archive–Lore dominance at 48.3% of observations vs 4.6% under label permutation (10.6× enrichment), rising to ~88% in FRACTURE/FREEZE regimes.

These claims were tested against the 36-society dataset (not the 4-society Blind Set 3 used in the review).

4.2 Test results

Claim	Kimi result	Our result (n=36)	Verdict
A–L null enrichment	10.6× (4 societies)	9.9× (35.4% vs 3.6% null)	Validated
A–L in crisis regimes	~88% (FRACTURE/FREEZE)	51.2% (Acute Crisis)	Partial — inflated by extreme cases
A–L in stable regimes	~35%	25.5–31.5%	Confirmed direction
Bonds predict regime > nodes	Proposed, not tested	89.5% vs 74.5% (logistic, 5-fold CV)	Validated
β architecture stable	Not tested	Mean ρ = 0.651, 100% positive	Validated

4.3 Key observations

Archive–Lore dominance gradient: Acute Crisis 51.2% → Fragmentation 48.4% → Moderate Stress 35.8% → Stable Integration 31.5% → Systemic Collapse 28.6% → High Coherence 25.5%. Crisis enrichment ratio vs stable: 1.7× (weaker than claimed 2.5×).

Anomaly — Systemic Collapse: Systemic Collapse shows lower Archive–Lore dominance (28.6%) than Fragmentation (48.4%) and even Moderate Stress (35.8%). At full collapse, the coupling itself decomposes. This is not predicted by current theory and represents a potential new finding: coupling dissolution as a terminal crisis marker.

Structural reframe — Lore centralisation: In crisis regimes, the second and third highest bonds are also Lore-anchored (Lore–Shield, Lore–Helm, Lore–Stewards). The crisis motif is better described as Lore hub formation than Archive–Lore pairing specifically. In stable/coherent regimes, Archive competes with Flow and Shield as the secondary hub. The shift from distributed coupling to Lore-centred topology may be the operationally useful motif.

5. Stewards as Political Economy Marker

5.1 Motivation

Stewards represents economic governance — the stewardship of fiscal, financial, and resource allocation functions. Its position in the CAMS node graph is theoretically ambiguous: it could be primarily a Slow-loop node (anchored to institutional continuity) or a Fast-loop bridge (responsive to market dynamics). Its β value (1.032) is near-neutral, suggesting it neither amplifies nor dampens system movements. These analyses examine its empirical coupling profile, predictive power, and role in the political economy transmission chain.

5.2 Stewards Node Value by regime

Stewards V shows a perfect monotonic gradient across all regime classes:

Regime	Stewards V mean	Stewards V std	Interpretation
High Coherence	13.89	3.77	Strong economic governance capacity
Stable Integration	9.40	2.43	Functional but under constraint
Moderate Stress	7.20	2.46	Declining margin
Fragmentation	4.79	2.04	Near-failure threshold (V_min alarm at 4.0)
Acute Crisis	3.13	2.31	Below alarm threshold
Systemic Collapse	−0.23	2.85	Net disorder-generating

Stewards V crosses the FC2 Tier 1 alarm threshold ($V < 4.0$) between Fragmentation and Acute Crisis. At Systemic Collapse, Stewards V goes negative — the economic governance function is generating more disorder than it contributes capacity.

5.3 Stewards bond profile

Stewards is most tightly bonded to Archive (0.3153) and Lore (0.3110) — both Slow-loop nodes — rather than to its "natural" economic partners Flow (0.3000) or Craft (0.2983). Hands is the weakest Stewards bond (0.2591).

Partner	Mean bond strength	Loop	Rank
Archive	0.3153	Slow	1st
Lore	0.3110	Slow	2nd
Flow	0.3000	Fast	3rd
Craft	0.2983	Fast	4th
Helm	0.2982	Slow	5th
Shield	0.2927	Fast	6th
Hands	0.2591	Fast	7th

Interpretation: Stewards anchors economic activity to institutional memory (Archive) and cultural legitimacy (Lore) before coupling to market dynamics (Flow, Craft). This is the empirical signature of "political economy" — economic governance embedded in and constrained by the Slow-loop structure. Mean bond to Slow nodes: 0.3082 vs Fast nodes: 0.2875 (differential: 0.0207). Stewards is a Slow-loop-adjacent bridge.

5.4 Stewards as leading crisis indicator

Each node was tested as a leading indicator of regime crisis (Acute Crisis, Fragmentation, or Systemic Collapse) one year forward (AUC of low node V predicting next-year crisis):

Node	AUC (crisis t+1)	Rank
Stewards	0.930	1st
Helm	0.928	2nd
Flow	0.918	3rd
Archive	0.911	4th
Craft	0.908	5th
Hands	0.902	6th
Shield	0.894	7th
Lore	0.891	8th

Node	AUC (crisis t+1)	Rank
V_mean (all nodes)	0.951	System baseline

Key finding: Stewards is the strongest single-node leading indicator of regime crisis at AUC = 0.930, marginally ahead of Helm (0.928) and well above Lore (0.891). All individual nodes show high predictive power (AUC 0.89–0.93), confirming that the crisis gradient is embedded across all nodes — but Stewards is the most sensitive single measurement point. The V_mean ensemble is slightly better (0.951) as expected, but Stewards alone captures 97.8% of the ensemble's predictive performance.

5.5 Helm→Stewards→Flow transmission chain

The Helm→Stewards→Flow chain represents the path from political direction (Helm) through economic governance (Stewards) to market activity (Flow). Chain floor = minimum bond strength in the Helm–Stewards / Stewards–Flow pair — the weakest link in the transmission path.

Regime	B(Helm–Stewards)	B(Stewards–Flow)	B(Helm–Flow)	Chain floor
High Coherence	0.4187	0.4266	0.4274	0.4045
Stable Integration	0.2733	0.2728	0.2768	0.2604
Moderate Stress	0.2268	0.2221	0.2240	0.2126
Fragmentation	0.1777	0.1781	0.1766	0.1685
Acute Crisis	0.1502	0.1465	0.1463	0.1388
Systemic Collapse	0.1096	0.1035	0.1084	0.0993

Interpretation: The chain floor decreases monotonically from 0.4045 (High Coherence) to 0.0993 (Systemic Collapse). Notably, B(Helm–Flow) direct is approximately equal to the chain floor — meaning Stewards does not substantially mediate the Helm–Flow relationship under normal conditions. In crisis, all three bonds degrade proportionally. The chain is not a bottleneck but a co-expression of systemic bond coherence.

6. Discussion

6.1 Theoretical synthesis

Across all analyses, three structural facts emerge consistently:

1. System movements are mostly collective (69.1% common-mode). Individual node trajectories are dominated by system-wide rises and falls, with only 30.9% of movement expressing structural differentiation. This means most of what looks like node-specific behaviour is actually the system breathing together.

2. Lore is the crisis attractor. In crisis regimes, coupling concentrates around Lore. The crisis motif is not Archive–Lore pairing per se but Lore hub formation — multiple bonds routing through Lore simultaneously. In stable regimes, coupling is distributed. This suggests Lore functions as the system's last resort anchor: when institutional novelty capacity (Archive) and economic throughput (Flow, Craft) fail, survival cohesion routes through legitimacy and cultural memory (Lore).

3. Stewards is the political economy integration node. It is most tightly coupled to Slow-loop legitimacy nodes (Archive, Lore) rather than its economic partners (Flow, Craft). It is the best single-node leading indicator of crisis. Its V value spans the entire regime range from highly positive to negative. It sits at the junction of the Helm→Stewards→Flow chain that transmits political direction into economic outcomes. These properties together identify Stewards as the CAMS node most directly encoding political economy in the technical sense: the mutual constitution of political authority and economic activity.

6.2 Limitations

LLM circularity: All CAMS scores are LLM-generated. The finding that Archive–Lore bond is strong in crisis may partly reflect a model prior that crises involve institutional memory and cultural legitimacy breakdowns. The ensemble contestation index (inter-scorer disagreement with stable motif structure) would provide evidence against this, but has not been computed in this session.

Rank-1 constraint on bond measures: JUNO v1.2 bond strengths are algebraically derived from node scores and cannot capture pair-specific coupling not already present in the node values. Bond predictions outperforming node predictions in the regime classification test should be treated cautiously — bonds may capture a non-linear transformation of node values rather than genuinely independent structural information.

Regime label circularity: Regime labels are derived from the same CAMS scores that generate node values and bonds. Regime classification accuracy therefore partly measures self-consistency of the derived variables rather than external predictive validity.

Sample sizes: Inelasticity pilot covers only 3 entities. The Shield anomaly, cross-loop prediction failure, and Slow–Slow dominance findings should not be treated as established until run on 10+ societies. Acute Crisis ($n=170$) and Systemic Collapse ($n=343$) are the smallest regime classes.

7. Next Steps

The following actions are pre-registered from this session:

[P1 — Immediate] Run cams_inelasticity.py on USA, Germany, China, Sweden, Thailand to bring n_entities to 8+. Priority: verify Stewards-Flow rigidity holds cross-system and Shield anomaly is not a Cuba/Iceland artifact.

[P2 — Methodological] Design a null model for the inelasticity analysis: permute node labels within each entity, recompute I_{ij}, compare to observed. This tests whether the inelasticity structure exceeds chance.

[P3 — Theory] Test the Systemic Collapse coupling-dissolution anomaly: is Lore–Shield bond rise at Systemic Collapse (24.8%, #2 vs Lore–Archive at 28.6%) a signature of military/cultural consolidation in terminal states? Check against Afghanistan, Iraq, Syria specifically.

[P4 — cams-calc v1.3] Add I_{ij} computation to cams-calc for societies with ≥10 years of data. Output as Block 3.

[P5 — Motif hardening] Implement the formal motif definition per Kimi recommendation: $M_{ij} = (\text{node\_pair}, B_{ij} > \tau_{ij}, \text{attractor\_class } \alpha)$. Run null model test (permute node labels within time slices, $p < 0.05$ threshold). Test cross-attractor distinctiveness (Jaccard index between top-k motif sets < 0.5).

[P6 — Stewards] Test whether Stewards V decline precedes regime transition by more than V_mean decline: does watching Stewards alone provide earlier warning than watching the system average? Run a time-to-event analysis on all regime transitions in the 36-society dataset.