

Coordination Dynamics and Policy Interventions in a Networked Stag-Hunt Model

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Model-Based Decision Making

Motivation

- Coordination problems in technology adoption and infrastructure investment
- Individual incentives depend on others → multiple equilibria
- Systems can become stuck in inefficient outcomes

Goal: When does coordination succeed, and how can policy shift outcomes?

Model Overview

- Evolutionary Stag-Hunt adoption model
- Agents choose **Adopt** or **Not adopt**
- Payoffs depend on neighbors and aggregate infrastructure
- Logit best-response updates (bounded rationality)

Networks: Grid, Small-world, Erdős–Rényi, Barabási–Albert

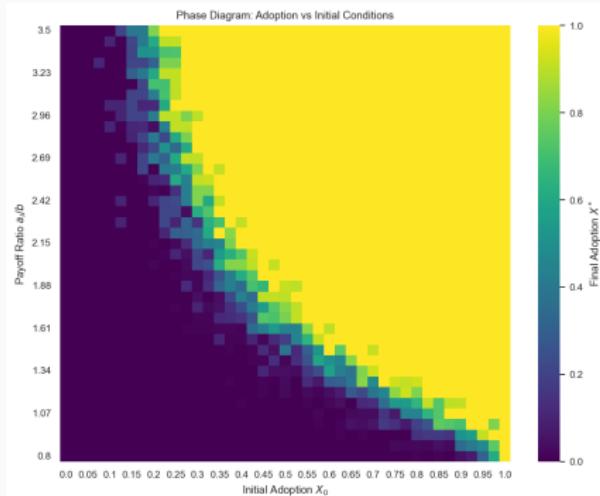
Experimental Design

- $N = 200$, $T = 250$, low initial infrastructure I_0
- Moderate noise ($\tau = 1.0$)
- Near-critical baselines (success possible but uncertain)

Metrics: $P(X(T) \geq 0.8)$, final adoption, time-to-threshold

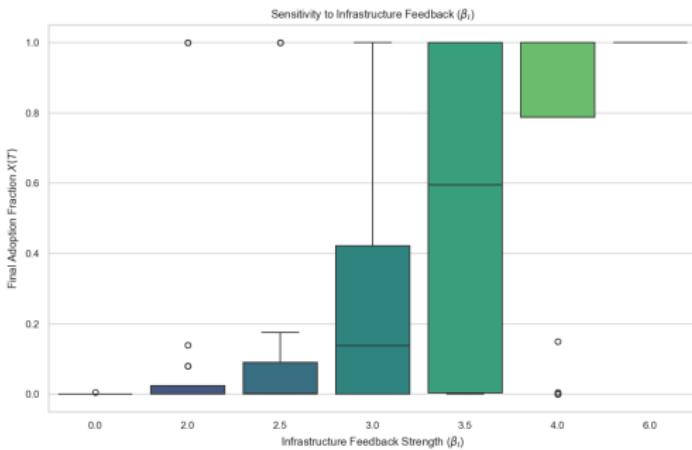
Baseline Dynamics and Tipping

- Sharp transition between non-adoption and high adoption
- Depends on X_0 , payoff ratio a/b , and feedback β_I
- Near tipping: small changes \rightarrow large outcome differences



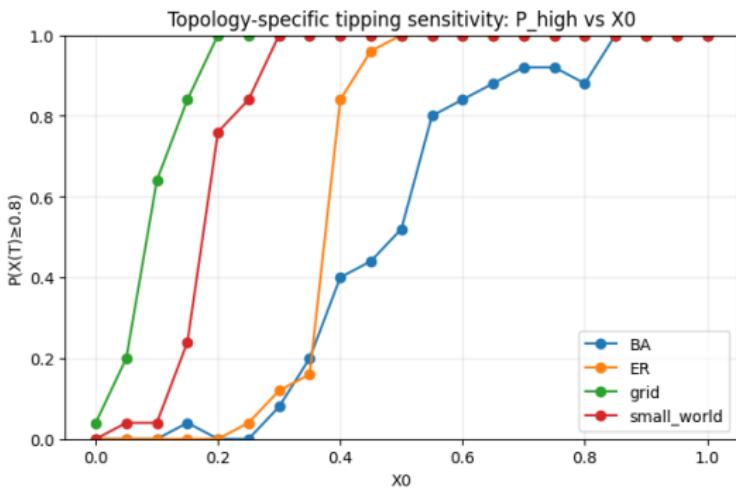
Infrastructure Feedback

- Low β_I : coordination fails
- Intermediate β_I : stochastic tipping
- High β_I : stable high adoption



Network Topology Effects

- Grid: strong local clusters, slow system-wide spread
- Small-world: shortcuts enable rapid cascades
- Erdős–Rényi: harder to start, fast once tipping occurs
- Barabási–Albert: hubs do not reliably accelerate coordination



Policy Interventions

Two policy types:

- **Temporary subsidies:** time-limited payoff increases
- **Targeted seeding:** forcing a fraction of agents to adopt at time t

Policies evaluated relative to near-critical baselines.

Subsidies vs Seeding

Subsidies

- Effective mainly when applied early
- Strongly topology-dependent
- Large gains in Erdős–Rényi networks

Seeding

- Less timing-sensitive
- Highly cost-efficient
- Most effective in heterogeneous networks

Efficiency vs Effectiveness

- Most effective policy \neq most cost-efficient policy
- Subsidies can yield the largest absolute gains
- Seeding dominates in efficiency across networks

Key insight: Small, targeted interventions can outperform broad incentives near tipping points.

Conclusions

- Coordination is nonlinear and path-dependent
- Network structure shapes tipping and policy leverage
- Early, targeted interventions outperform late, broad ones

Takeaway: Timing and structure matter as much as incentives.