# The Architecture of Alignment:

## Quantifying Geoeconomic Fragmentation

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## Introduction

- **The Post-Cold War Paradigm:** The era of hyperglobalization was defined by market efficiency superseding Westphalian security concerns [**?**].
- **Systemic Rupture:** The liberal consensus is destabilized by:
  - **U.S.–China trade war:** Strategic decoupling.
  - **COVID-19 pandemic:** Supply chain brittleness.
  - **Invasion of Ukraine:** Weaponized interdependence.
- **Research Question:** Is the global system structurally bifurcating into rival blocs or merely adapting routes within a singular integrated topology?
- **Approach:** Moving beyond gravity models toward **Network Topology Analysis** to identify shifts from global integration to modular intra-bloc structures.

## Research Hypotheses

**H1: G7–BRICS Strategic Decoupling**

Quantifying the trade relationship using bilateral export data:

$$S_t = \frac{\sum_{i\in\mathcal{G}}\sum_{j\in\mathcal{B}} X_{i,j,t} + \sum_{i\in\mathcal{B}}\sum_{j\in\mathcal{G}} X_{i,j,t}}{\sum_i \sum_j X_{i,j,t}}$$

**H2: Consensus Connector Stability**

Structural influence measured through weighted betweenness centrality:

$$S_i = 1 - \frac{\sigma_{BC}}{\mu_{BC}}$$

**H3: Network Modularity**

Newman-Girvan modularity index to detect systemic fragmentation:

$$Q_t = \frac{1}{2m_t}\sum_{i,j}\left(A^t_{ij} - \frac{k^t_i k^t_j}{2m_t}\right)\delta(c_i, c_j)$$

**H4: Community Alignment**

Validation via Z-scores derived from Monte Carlo permutations:

$$Z = \frac{ARI_{obs} - \mu_{null}}{\sigma_{null}}$$

**H5: Systemic Fragility**

Resilience Loss Index (RLI) based on global network efficiency:

$$\mathrm{RLI}_t = 1 - \frac{E_t(\mathcal{G}_t \setminus \mathcal{C}_t)}{E_t(\mathcal{G}_t)}$$

## The Decline of G7–BRICS+ Trade Interdependence

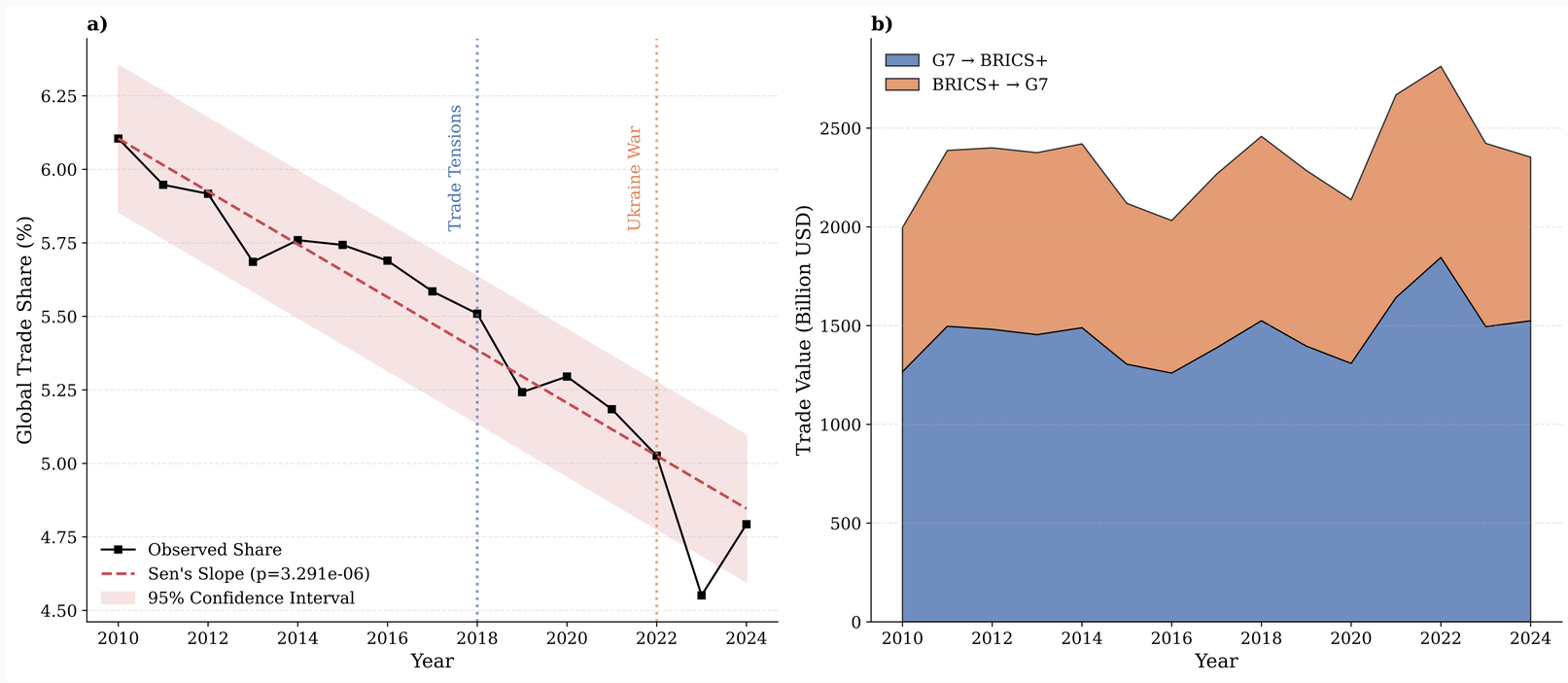


Figure 1: **Declining G7–BRICS+ Trade Integration (2010–2024).** Panel (a) shows trade share $S_t$; Panel (b) shows directional flows. Shaded area highlights post-2018 decoupling.

- **Significant Trade Contraction:** The G7–BRICS+ share of global trade ($S_t$) fell from 6.1% (2010) to 4.8% (2024), marking a 21% reduction in inter-bloc integration.
- **Negative Growth Trend:** Log-linear regression identifies an annual proportional decline of ≈1.8% ($\beta = -0.0177$, $p < 0.001$), indicating a steady erosion of economic ties.
- **Post-2018 Structural Break:** Analysis reveals a significant hiatus coinciding with U.S.-China tensions; the post-2018 average trade share dropped by $\Delta S = -0.72$ percentage points ($p = 0.0006$).
- **Decoupling Toll:** The 2024 trade share is 1.67% lower than levels projected by pre-2018 trajectories, quantifying the cumulative impact of geopolitical decoupling.
- **Increased Volatility:** Post-2018 trade flow variance increased by a factor of 3.60, reflecting the growing influence of non-economic factors like sanctions and supply chain security.
- **Robustness Testing:** Placebo testing (2014) showed minimal impact, confirming that the structural shift is uniquely linked to post-2018 geopolitical fragmentation.

## The Persistence of Strategic Trade Intermediaries

- **The "Stability Triad":** Network centrality analysis identifies the USA, China, and France as the dominant global brokers, consistently maintaining mean betweenness scores $> 0.025$.
- **US Structural Invariance:** The USA remains the primary coordinate for transatlantic and transpacific trade with the highest stability index ($S_i = 0.92$).
- **European Anchors:** France ($S_i = 0.77$) has emerged as a stability anchor, slightly surpassing Germany ($S_i = 0.74$) due to its institutional role in the EU and Francophone networks.
- **Logistical Gatekeepers:** Mid-tier economies like the Netherlands ($S_i = 0.80$) and Spain ($S_i = 0.83$) function as "stabilizing bridges," where port and financial infrastructure protect nodes from geopolitical turmoil.
- **Structural Endpoint Paradox:** Emerging manufacturing hubs like Vietnam ($S_i = -0.66$) and Mexico ($S_i = 0.33$) exhibit near-zero brokerage centrality ($BC < 0.0004$), acting as production endpoints rather than systemic intermediaries.
- **Systemic Influence vs. Volume:** Results indicate that high export volumes do not automatically translate into structural power; systemic influence depends on a state's role as a bridge between disconnected partners.

## The Absence of Network Fragmentation