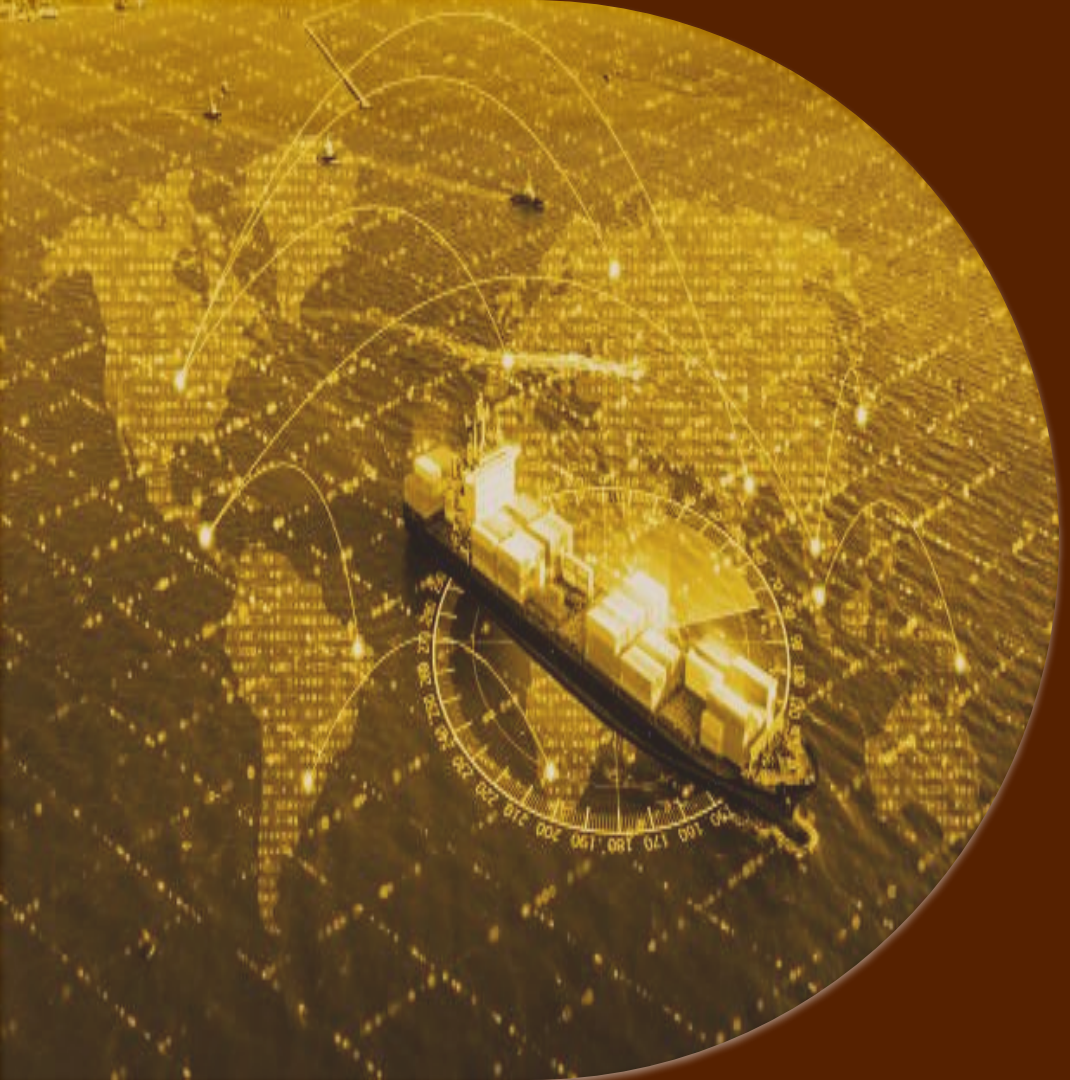

LEHIGH UNIVERSITY

Global Trade & Shipping Inequality

Statistical Analysis of 16 Years of International Commerce

DSCI321-Milestone 02

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Project

This project examines how global trade has changed over the last 16 years, with a focus on **inequality between countries** and the effects of major shocks like the **2008 recession, 2015-2016 commodity shutdown.**

Research Focus

- Structural breaks in trade patterns
- Inequality dynamics
- Network fragmentation
- Sectoral sensitivity

Methodology

- Gini coefficients
- Theil indices
- Kruskal-Wallis tests
- Network correlation analysis
- Pettitt structural break test

Data Source: UN Comtrade Global Trade Database
Methodology: Advanced statistical analysis tool

Comparing Trade Before and After Shocks

Three Distinct Time Periods

2000-2007
Pre-crisis

2008-2012
Crisis years

2013-2016
Recovery

Kruskal-Wallis Test Results

Test Used: Non-parametric Kruskal-Wallis (data not normally distributed)

P-value: $p < 7 \times 10^{-18}$

Extremely strong statistical evidence that the three periods are fundamentally different, not random variation.

Key Finding
Exports before the crisis were distributed more evenly. Post-2008 data show higher concentration among top exporters. **The 2008 financial crisis permanently changed global trade patterns.**

Global export Trends

Growth Trajectory

Global exports showed a general upward trend throughout the early 2000s, accelerating with globalization.

The 2008 Shock: A Regime Change

The financial crisis caused a distinct structural break in trade patterns.

Pettitt Test Result: Structural break identified around **2006–2008**

This confirms the crisis altered fundamental trade behavior, not just a temporary dip.

Post-Crisis Reality

The system did not return to pre-2008 equilibrium but settled into a new pattern defined by **higher concentration and fragmentation**.

When Did the Change Begin?

Structural Break Detection

Pettitt Test Result : Clear turning point detected around **2006**

Two years BEFORE the 2008 global crash

What This Means

Inequality and instability started to build up even before the 2008 crisis.

Possible causes:

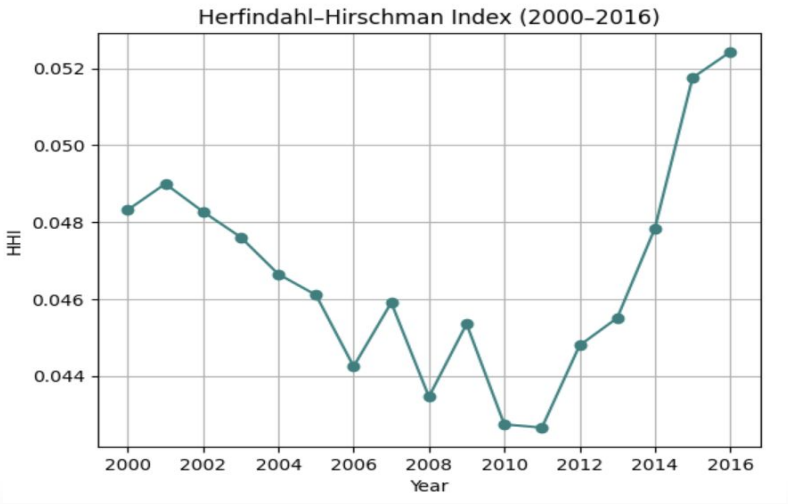
- Mid-2000s commodity boom
- Early signs of financial tightening
- Growing imbalances in global trade

Insight: The crisis didn't create the problem, it **accelerated existing trends** that were already emerging.

Market Concentration: HHI Analysis

Herfindahl-Hirschman Index (HHI)

Measures market concentration - higher values mean fewer countries control more trade



Early 2000s

↓ Slight Decrease

After 2012

↑↑ Sharp Rise

By 2016

PEAK Highest point

What This Shows

By 2016, global exports became dominated by a few powerful economies such as **China, Germany, and the USA**.

Rising Inequality: The Gini Coefficient

Extreme Inequality

~1.0

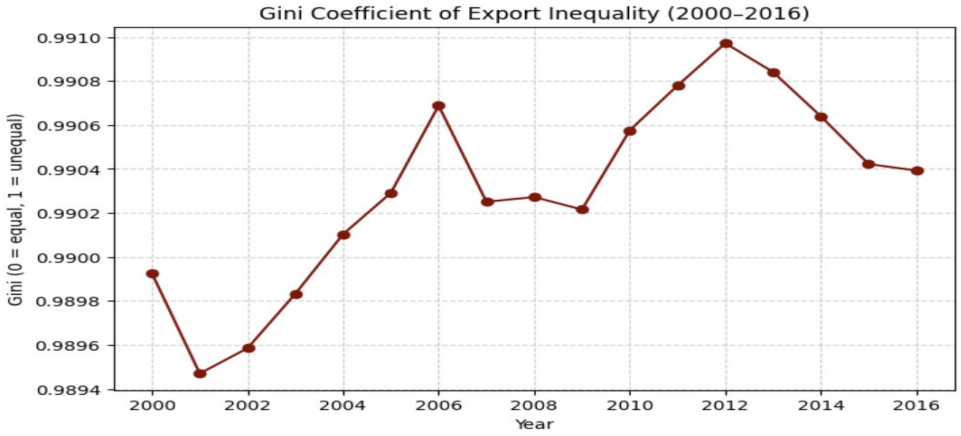
Global Export Gini Coefficient

Indicates extreme inequality where a handful of nations dominate

2013–2014

Peak Inequality Period

Rolling 3-year Gini peaked post-crisis



Post-Crisis Spike

Inequality did not decrease after the financial crisis. Instead, the rolling 3-year Gini coefficient rose noticeably after 2006.

Implication: The recovery from 2008 disproportionately favored **established, large trading nations**, widening the gap between top exporters and the rest of the world

Export Concentration

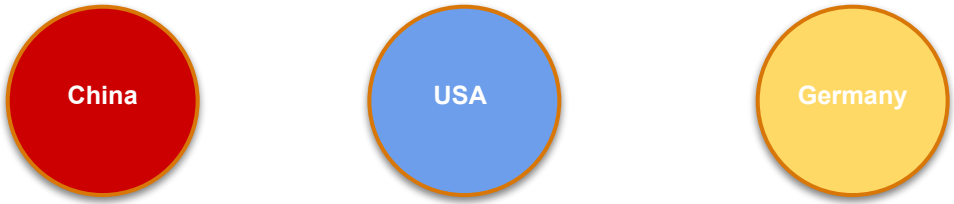
Top 10 Dominance

Direct correlation between rising Gini coefficient and market share held by the top 10 exporting countries.

Key Finding: As inequality rose after 2006, the cumulative share of global exports held by the top 10 countries also increased.

Winner- Takes Most System

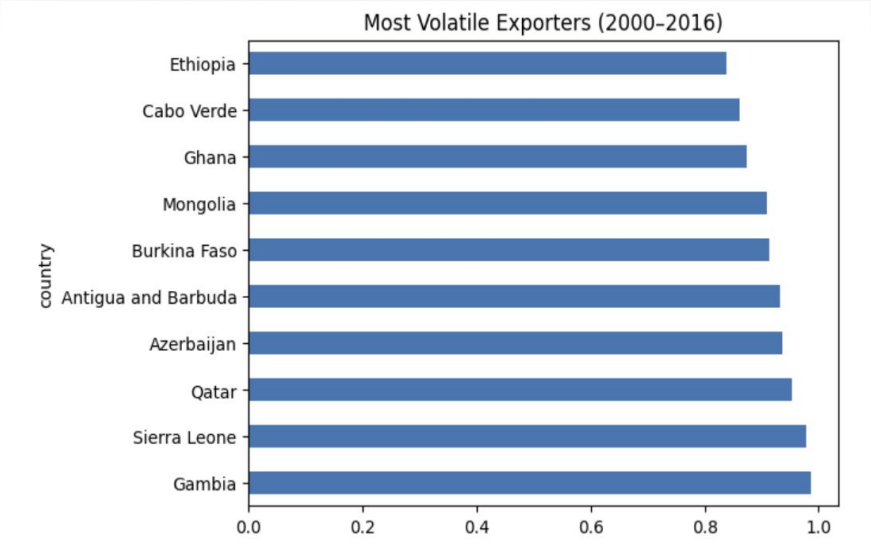
Global trade evolved into a system where dominant economies consolidated their positions following global instability.



Country Volatility Analysis

Coefficient of Variation Analysis

Measures export instability = Standard Deviation / Mean
Higher values = more year-to-year fluctuation



Most Volatile Countries

Qatar: Oil-dependent,extreme fluctuations

Azerbaijan: Energy Sector reliance

Ghana & Gambia: Small Commodity dependent

Most Stable Countries

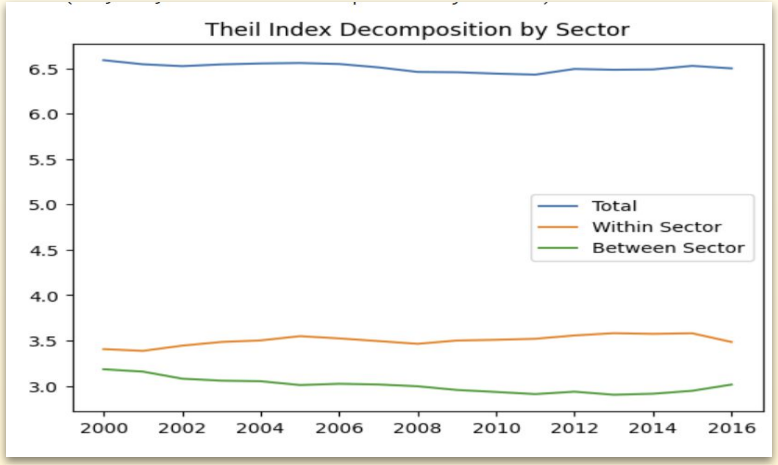
Larger, more diversified economies with:

- ✓ Multiple export sectors
- ✓ Diverse trading partners
- ✓ Service and manufacturing mix
- ✓ Less commodity dependence

Key Insight: Small, resource-dependent economies have exports that are **highly sensitive to global price and demand changes**

Sector-Level Inequality:Theil Index

Theil Index Decomposition -Breaks down inequality into two components



Between- Sector Inequality

Differences across different sectors

Within-Sector Inequality

Differences among countries in the same sector

Key Findings

Primary Source: Within-Sector

Most inequality comes from differences **within sectors** rather than between them.

Example: Even within machinery or chemical exports, a few countries dominate the total trade value

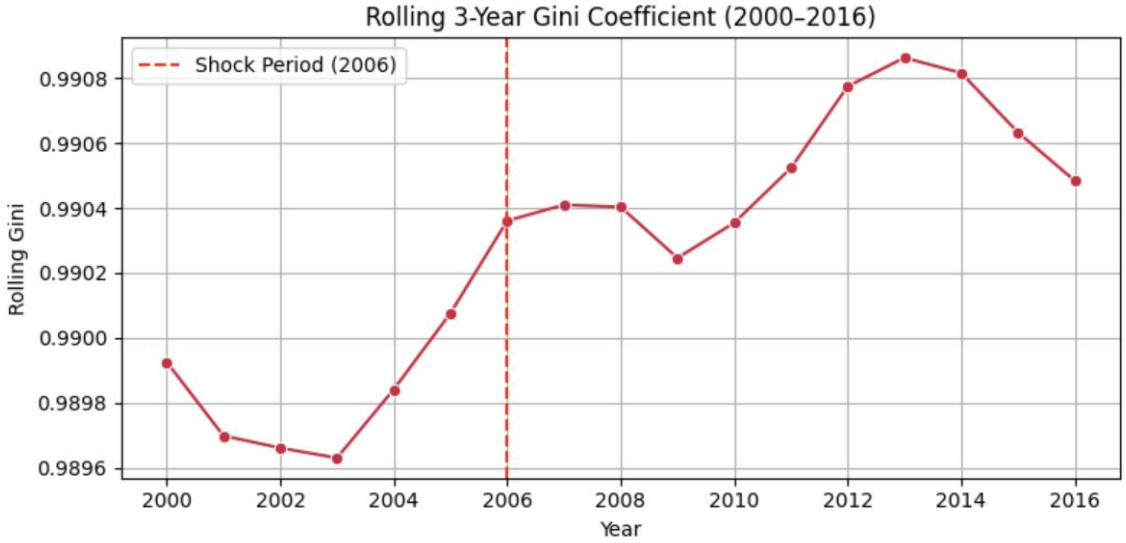
Rising Between-Sector Gap

Between-sector inequality also rose slightly, suggesting growing focus on high-tech and energy sectors after 2008

Rolling Gini: Tracking Inequality Over Time

3-Year Rolling Gini Coefficient

Tracks inequality changes over moving time windows



2000-2016

~1.0 Stayed close to maximum (extreme inequality)

After 2016

Rose noticeably

2013-2014

PEAK Highest point, stayed high after

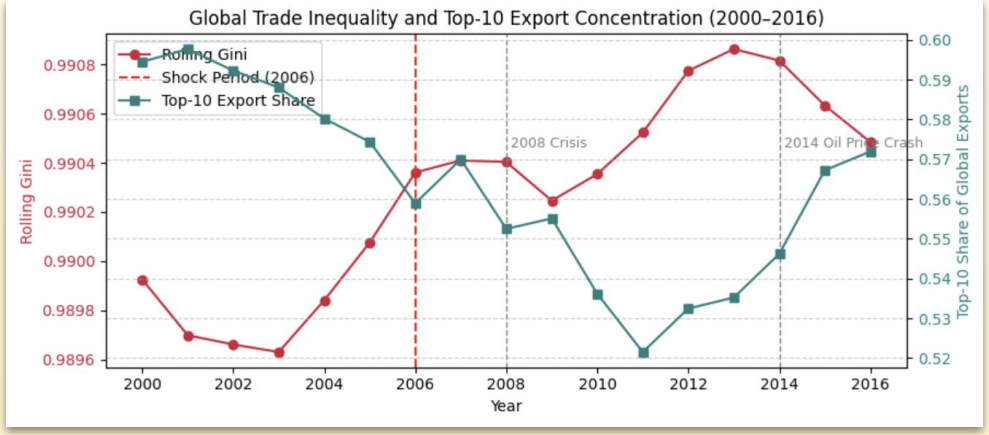
Critical Finding

After the crisis, global trade became **even more unequal** and **did not return to its earlier balance.**

Export Concentration Vs. Inequality

Direct Correlation Analysis

Two metrics tracked together over time:



Top 10 Export Share

% of global exports by top 10 countries

Rolling Gini Coefficient

Measures overall inequality

This demonstrates that increasing inequality is **directly linked** to rising concentration among the largest exporters..

Key Insight: The sharp rise after 2006 shows the growing dominance of top exporters and the **persistence of inequality** even after the 2008 and 2014 shocks.

Sectoral Sensitivity to Shocks

Kruskal-Wallis Test by Sector

Tests whether trade patterns changed significantly across time periods for each export sector

Most Shock-Sensitive Sectors

Energy & Fuels

Highest H-value, smallest p-value

Trade patterns changed the most - extremely sensitive to economic downturns

Machinery & Electronics

Second highest H-value

Capital-intensive and globally integrated - hit hard by global shocks

Most Stable Sectors

Agriculture

Essential goods,stable demand

Textiles

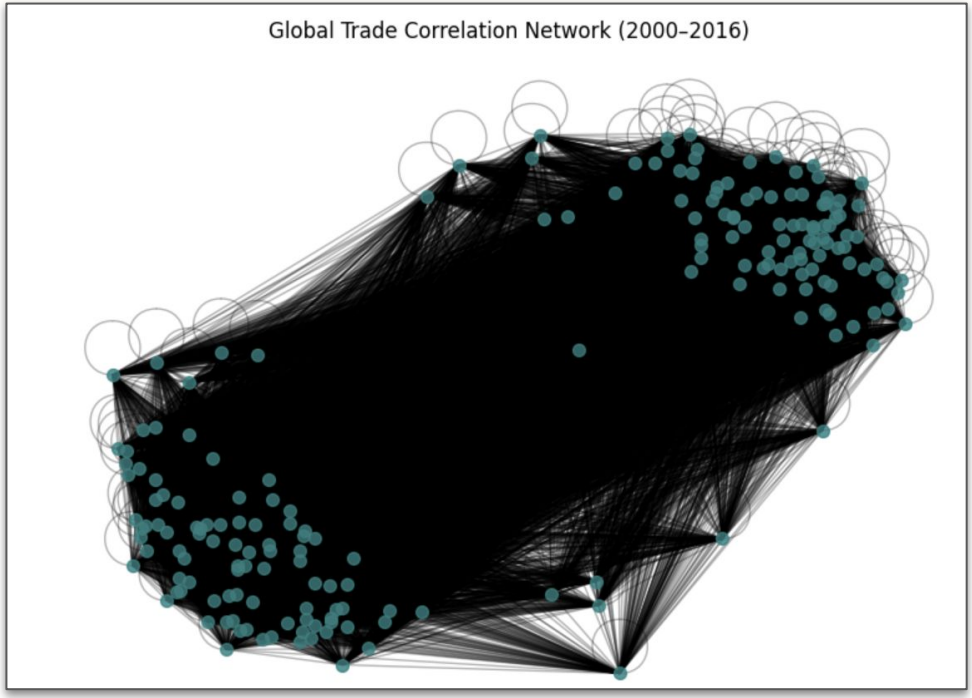
Labor- intensive,Less Cyclical

Conclusion: Complex, capital-intensive industries are the **most shock-sensitive.**

Network Fragmentation

Correlation Network Analysis

Visualizes how countries' exports move together over time
Strong correlations = countries' export trends synchronized



Regional Clusters Emerged

- Asia -Pacific
- Europe
- Oil-Exporters

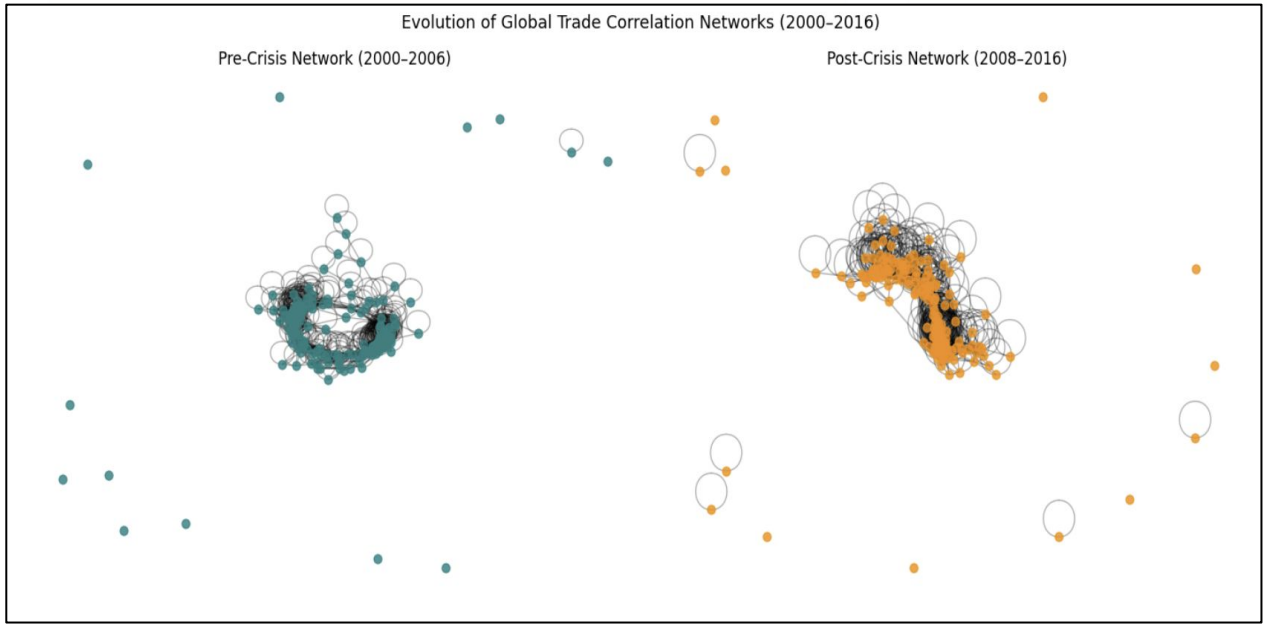
Network Fragmentation

Before 2006(Pre-Crisis)

✓ Dense network
✓ Globally connected
✓ Most countries' export trends moved together
✓ Unified global market

After Crisis (Post-2008)

✗ Sparser network
✗ Fragmented
✗ Breaking into smaller regional clusters
✗ Less global synchronization



Clear Evidence

The global trade system **fragmented after 2008**, shifting from one large, unified market to smaller, **region-based trade blocs.**

Summary of Key Insights

1.Inequality Increased

Trade inequality rose steadily after 2006 and remained high through 2016

2.Power Became Concentrated

A handful of major economies gained more control over total exports (HHI peaked by 2016)

3.Regionalization Replaced Globalization

The crisis weakened global linkages, leading to strong regional clusters

4.Sectors Reacted Differently

Energy and industrial goods were the most disrupted; agriculture was the most stable

5. Fragility in Smaller Nations

Resource-reliant exporters faced the highest volatility and risk

Conclusion

The 2008 crisis was a permanent turning point, not a temporary disruption.

From Connected
Highly synchronized global system

To stratified
Regionally divided clusters

Rising Inequality
Top nations increased dominance

Fragmentation
Less global cohesion

Recommendations

Diversification

Countries must diversify beyond shock-sensitive sectors like Energy & Fuels to ensure stability. Building resilient export portfolios across multiple industries is critical.

Regional Cooperation

With globalization slowing, strengthening regional trading blocs is essential for promoting stability. Regional partnerships can buffer against global shocks.

Resilience Building

Nations should develop flexible export portfolios to absorb future global disruptions. Small economies need particular attention to diversification strategies.

Policy Implications

For Vulnerable Economies

- Reduce dependence on volatile sectors
- Build economic diversification
- Strengthen regional partnerships
- Develop shock-absorption mechanisms

For Policymakers

- Monitor inequality trends
- Support supply chain resilience
- Facilitate regional trade agreements
- Prepare for future structural shocks

Global Perspective

The fragmentation of global trade networks suggests that international cooperation frameworks need redesign to account for the new regionalized reality rather than assuming a return to pre-2008 globalization patterns

Study Limitations

Data Coverage

Missing trade records for some countries may affect comprehensive global analysis

Measurement Scope

Trade value does not equal economic welfare or capture quality of life improvements

Non-Economic Factors

Cannot fully capture political drivers, sanctions, regulatory changes, or geopolitical tensions

Sectoral Granularity

Top-level trade categories may hide important sector-specific differences and nuances

Thank You

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