Structural Reorganization of ASEAN Price Transmission Networks

A Network Perspective on Global Shock Propagation
(Preliminary Findings)

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Motivation and Background

Global trade disruptions, COVID-19, and geopolitical tensions have fueled global inflation (IMF, 2023). Understanding how these shocks spread through international networks has become critical.

Differential Price Impacts

- The degree and pattern of price changes vary widely across countries.
- These differences reveal how international linkages shape the pathways and intensity of global shock transmission.

Research Gap

- Many studies focus on production linkages and global value-chain.
- But regional propagation of prices—within ASEAN—remains unexplored.
- This is crucial given ASEAN's growing role in global trade.

Study Objective

- Reveal how global shocks reshape price transmission networks in ASEAN.
- Combining **international input–output modeling + network analysis.**
- Visualize how and through which channels price change propagate across counties.

Data Overview

Data Source

Asian Development Bank (ADB) Multi-Regional Input-Output (MRIO) tables

Coverage

- 62 economies aggregated into 17 economies plus the Rest of the World.
- 35 industrial sectors aggregated into 8 sectors, and finally into a single macro-level result, focusing on the key global economies centered around Asia.

Time Periods

- **2007 – 2023**, using both current and constant prices

Data Construction

- Price tables are derived from nominal and real MRIOs using the formula:

Deflator = Nominal/Real

	Country		Country
1	Australia (AUS)	10	United States (USA)
2	China (CHN)	11	Malaysia (MYS)
3	Germany (DEU)	12	Philippine (PHL)
4	Indonesia (IDN)	13	Thailand (THA)
5	India (IND)	14	Vietnam (VNM)
6	Japan (JPN)	15	Laos (LAO)
7	Korea (KOR)	16	Cambodia (KHM)
8	Russia (RUS)	17	Singapore (SGP)
9	Taiwan (TWN)	18	Rest of the World (RoW)

Methodology (1): From Factor Decomposition to Network Construction

Tracing international price transmission from the input–output model to network representation

Step 1

Price Model Extension

Extend the IO price model into an international Input-Output (MRIO) framework to analyze cross-country cost transmission.

Step 2

Factor Decomposition

Decompose price changes into contributing factors to trace their sources over time.

Step 3

External Components Focus

Focus on two key external components:

(1) changes in import prices: pm_j^k

(2) changes in trade coefficients: mx_{ij}^{hk}

Step 4

Network Construction

The top 20 most influential cross-country linkages are extracted for each driver contributions. Their impact magnitudes are used as weights to construct the network.

Decomposition (Intuitive Version)

$$\Delta p_j^k = \sum_{h,i} \Delta mx_{ij}^{hk} + \sum_{h,i} \Delta pm_{ij}^{hk} + \Delta ax_j^k + \Delta va_j^k + \Delta bx_j^k$$

Indices

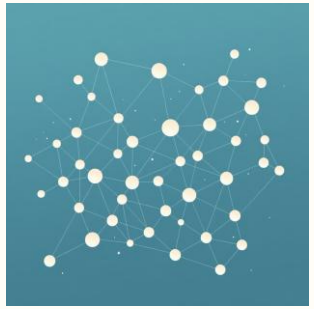
- h: source of country
- k: destination country
- i: input sector
- j: output sector

Components

- pm_j^k: imported-price contribution
- mx_{ij}^{hk}: import-share effect
- ax_j^k: domestic technology coefficient contribution
- va_j^k: value-added contribution
- bx_j^k: Leontief-inverse contribution

Methodology (2): Network Analysis

Measuring the structure and evolution of ASEAN's trade–price networks



- Moves beyond tracking who trades with whom to show how price shocks actually transmit across countries.
- Reveals causal pathways of inflation, not just trade flows.
- Enables us to track how transmission structures evolve before and after major global shocks.

Key Network Indicators

Betweenness Centrality

Captures a country's mediating role in connecting trade–price channels —identifying **key intermediaries** in international price transmission.

Eigenvector Centrality

Identifies influential countries connected to other major economies —showing who remains **structurally central** in the network.

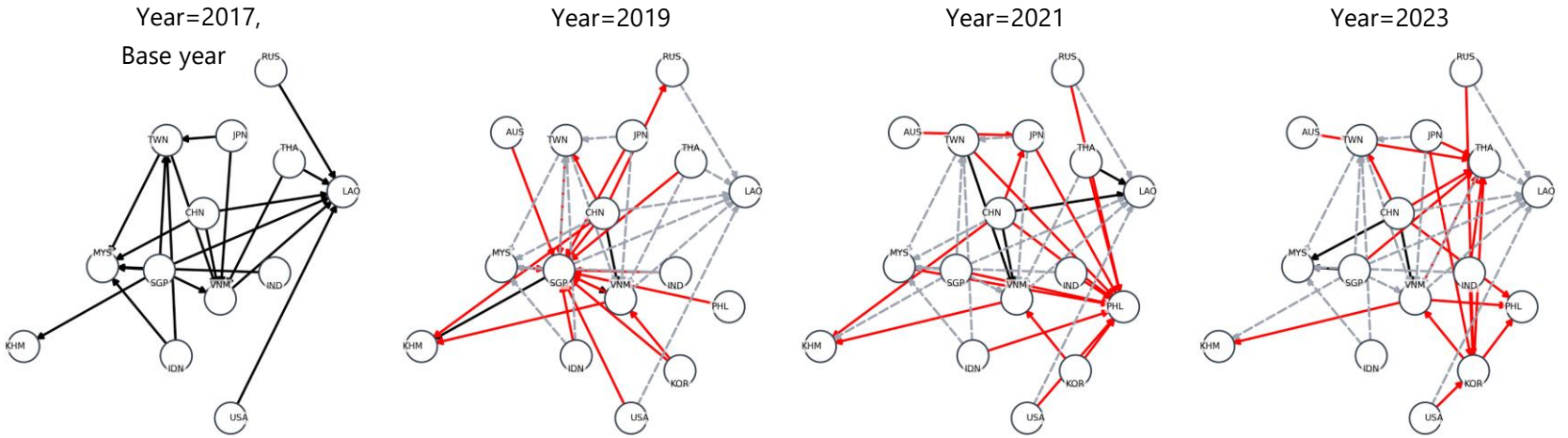
Clustering Coefficient

Measures regional cohesion — the degree to which tightly connected trade–price groups are formed.

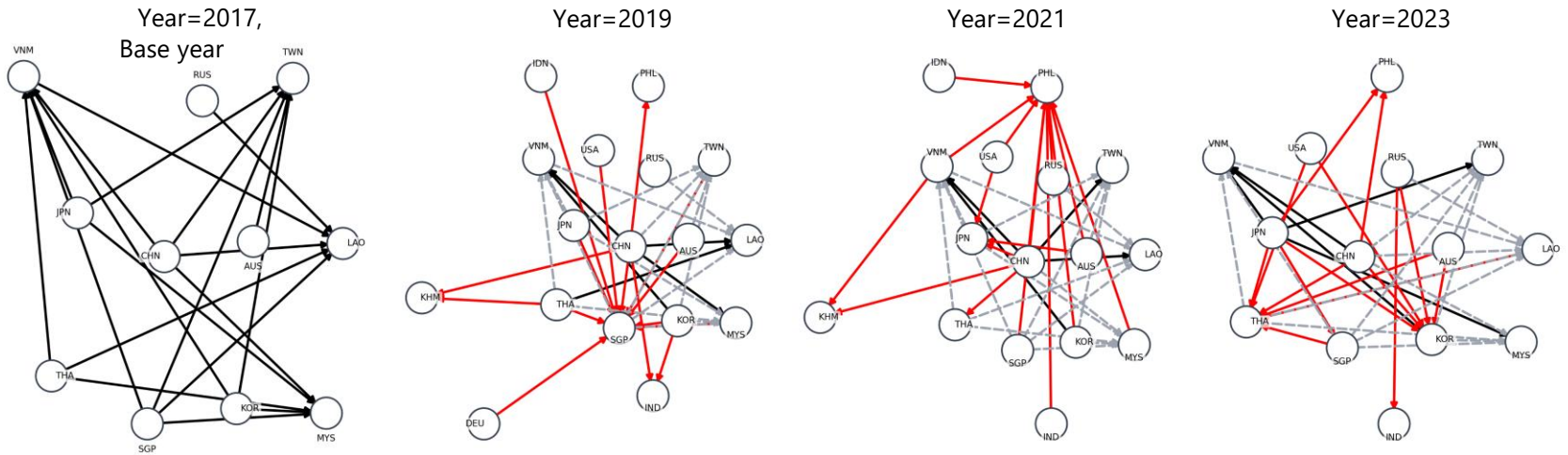
Empirical Findings (1): Network Reorganization

Structural reorganization of international price linkages (2017-2023)

a) Trade Linkages –Top 20 changes vs 2017



b) Import Price Linkages –Top 20 changes vs 2017

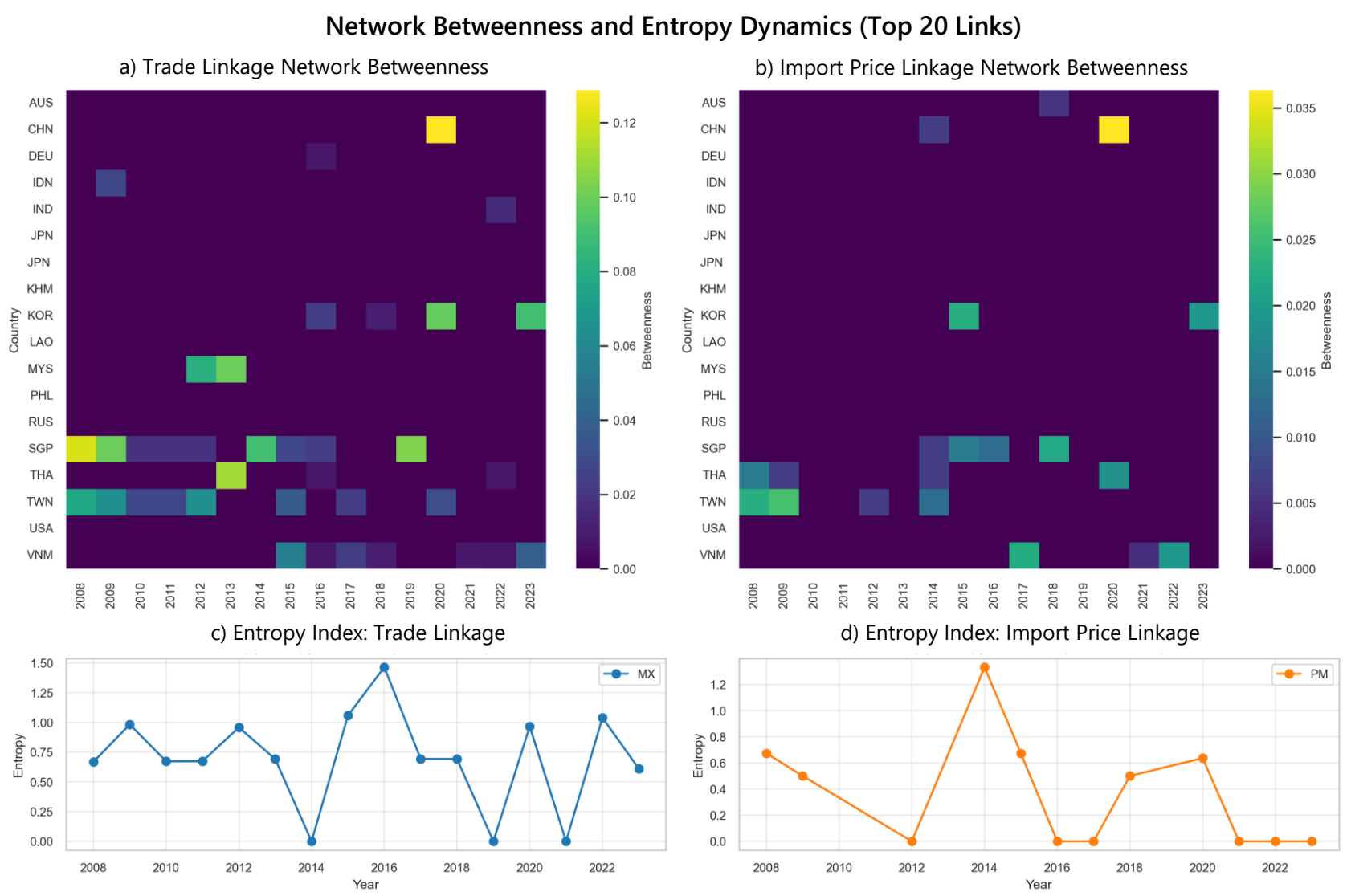


— kept (in base year) — added (new in year) --- dropped (baseline only)

Key Observation

- **2017:** Polycentric structure —widely connected and mutually influencing several countries.
- **2019:** Link density declined, showing fragmentation. SGP and VNM remained active as local cores.
- **2021:** Partial reorganization, with PHL and CHN strengthening central roles.
- **2023:** More distributed network structure with CHN and VNM taking central roles; THA, KOR, and IND also increasing their influences.
- **Overall**: the ASEAN-centered network adapted through contraction, partial reconnection, and a distributed pattern of linkages.

Empirical Findings (2): Structural Shifts in Trade vs Price Networks



Trade Network

- **Key Finding**: A trend toward diversification. Multipolar.
- **Centrality**: Betweenness highlights SGP and TWN until 2012, followed by THA, MYS, and VNM; CHN temporally dominated in 2020.
- **Diversity**: Entropy peaks in 2016, declines during global shocks, then slightly rises again—indicating recovery of multi-path linkages.

Import Price Network

- **Key Finding**: Greater concentration. Bridging roles were limited to a few players.
- **Centrality**: Betweenness is concentrated; China surged in 2020 but wasn't consistent. Others appear sporadically.
- **Diversity**: Entropy is lower and declines after 2020, suggesting more vulnerable, less adaptive structure.

Dynamics of Eigenvector Centrality, 2008–2023

Who Played Central Roles in the Global Price Network (with an Asian Focus)?

Table. Evolution of Structural Centrality in the Trade Linkage/Import Price Network

	Trade Linkage			Import Prices		
	1	2	3	1	2	3
2008	JPN (0.78)	DEU (0.42)	SGP (0.26)	JPN (0.78)	CHN (0.52)	KOR (0.30)
2009	JPN (0.75)	AUS (0.40)	TWN (0.26)	JPN (0.97)	AUS (0.20)	KOR (0.12)
2011	USA (0.79)	JPN (0.62)		CHN (1.00)		
2012	JPN (0.63)	USA (0.46)	SGP (0.42)	AUS (0.89)	SGP (0.34)	IDN (0.31)
2013	IDN (0.55)	TWN (0.44)	CHN (0.41)	JPN (1.00)		
2014	IDN (0.75)	JPN (0.44)	MYS (0.29)	JPN (0.80)	AUS (0.58)	IDN (0.14)
2015	MYS (0.56)	JPN (0.52)	KOR (0.48)	JPN (0.54)	MYS (0.49)	AUS (0.45)
2016	JPN (0.77)	CHN (0.49)	USA (0.40)	JPN (0.79)	CHN (0.48)	USA (0.38)
2017	IDN (0.76)	SGP (0.47)	JPN (0.45)	CHN (0.73)	KOR (0.46)	THA (0.34)
2018	USA (0.97)	CHN (0.26)		CHN (0.95)	TWN (0.31)	
2019	CHN (0.58)	MYS (0.48)	USA (0.40)	CHN (1.00)		
2020	USA (0.77)	JPN (0.37)	CHN (0.34)	JPN (0.73)	RUS (0.55)	AUS (0.40)
2021	CHN (0.70)	KOR (0.67)	TWN (0.26)	CHN (0.98)	KOR (0.21)	
2022	KOR (0.56)	RUS (0.48)	JPN (0.44)	KOR (0.78)	JPN (0.50)	USA (0.37)
2023	USA (0.68)	RUS (0.61)	JPN (0.34)	JPN (0.83)	CHN (0.32)	AUS (0.30)

1 **Japan, Korea, and Taiwan**

These economies consistently remained close to the core.
They form a stable foundation for international price formation.

2 **China**

China increased a steady after 2016, reaching the top position by 2019.
This marks a clear structural increase in China's influence in import price.

3 **United States**

It experienced fluctuations— it rises and falls over time.
It regained prominence after 2018, especially in trade linkages.

4 **ASEAN (Singapore. Malaysia, Indonesia, Thailand, Vietnam)**

They remained moderate centrality in the early 2010s
They have largely disappeared from the top ranks since 2017–2019, indicating a shift toward a more peripheral position.

5 **Emerging Nodes (Russia, Australia)**

Since 2020, Russia in particular has shown rising centrality, emerging as a newly prominent node in the global network.

Price Link Structures: Power-Law vs. Exponential Patterns

Understanding how prices propagate across countries through network structure.

I. Key Idea & Distribution Patterns

Characteristic	Exponential Distribution	Power-Law Distribution
Type & Equation	$S(x) \propto e^{-\lambda x}$	$S(x) \propto x^{-\alpha}$
Key Idea	**Diversified** — price spreads widely.	**Concentrated** — price relies on hubs.
Structure	**Flexible network**	**Fragile network**
Analogy	City with many roads → rerouting possible.	City with a few major roads → one blockage stalls system.

II. Analysis Methodology

1. Construct the distribution

We take all link strengths, sort them from strongest to weakest, and look at how quickly they decline.

2. Estimate the survival function

The survival function S(x) = P(X > x) was calculated to capture how link strengths decay across the network.

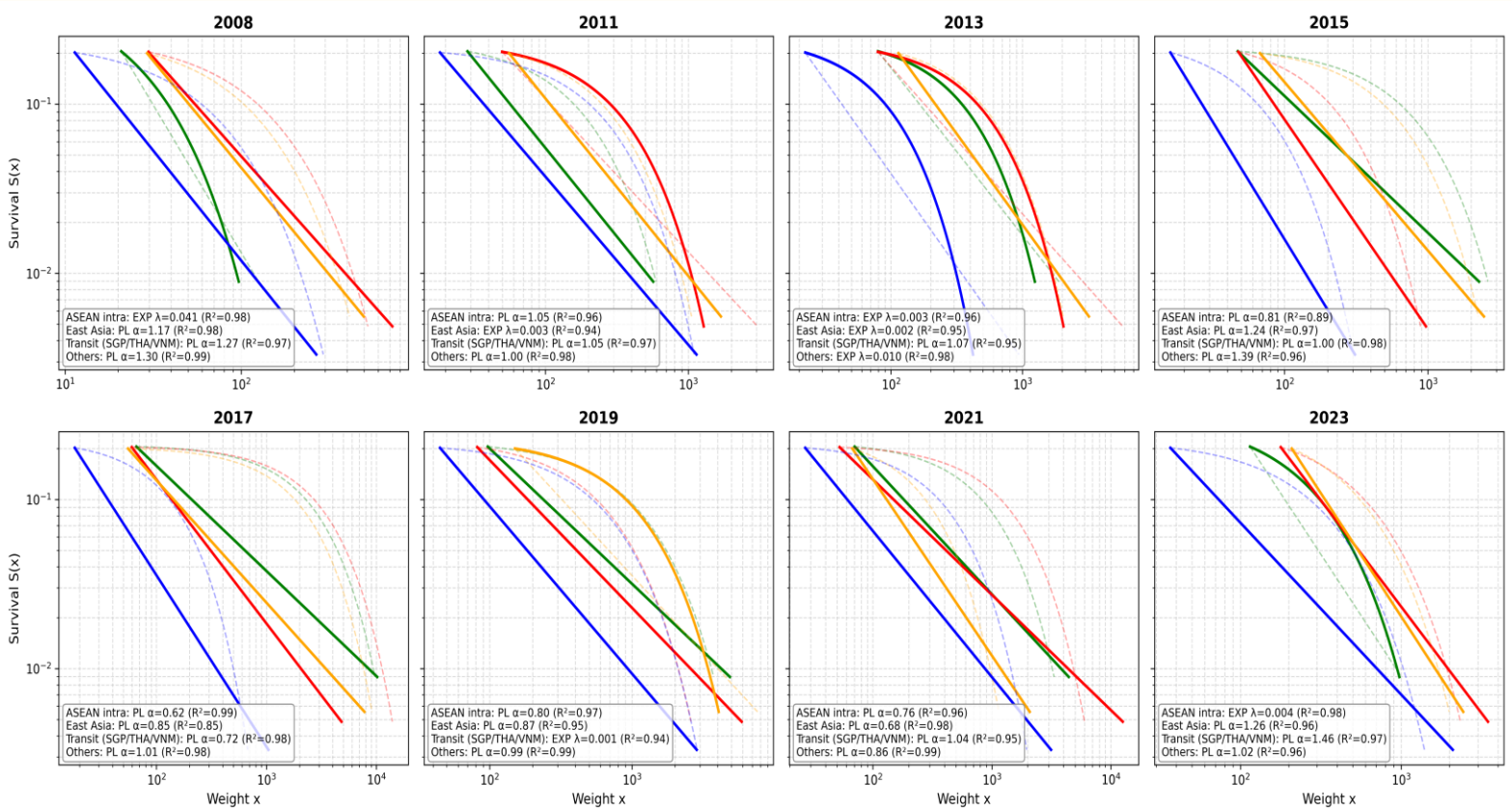
3. Fit alternative functional forms

Compare exponential vs. power-law fits to determine network structure.

This tells us whether strong price impacts are widely shared or concentrated in just a few dominant pathways.

Dynamic Shifts in Price Linkage Distributions

From Diversified to Concentrated Price Linkages



ASEAN intra (KHM, IDN, LAO, MYS, PHL, SGP, THA, VNM)
East Asia (CHN, JPN, KOR, TWN)
Transit hubs (SGP, THA, VNM)
Others (AUS, DEU, IND, RUS, USA)

A straight line: Power-law pattern — concentration in a few dominant links.
A curved line: Exponential pattern — dispersion across multiple pathways.

Advanced economies (blue)

- **Pattern:** Straight → Power-law (concentration)
- **Implication:** Price transmission relies on a few dominant links.
- **Structure:** Relatively rigid over time.

ASEAN economies (green)

Period	Pattern	Structural meaning
2008 & 2013	Curve, exponential	Dispersed, flexible
2015 - 2022	Straight, power-law	Concentrated; slope steepened (“thin concentration”)
2023	Curve, exponential	Re-dispersion, regained flexible

Overall: Dynamic transition,
Dispersed → Concentrated → Re-dispersed

Increasing Concentration of Link Strengths

1

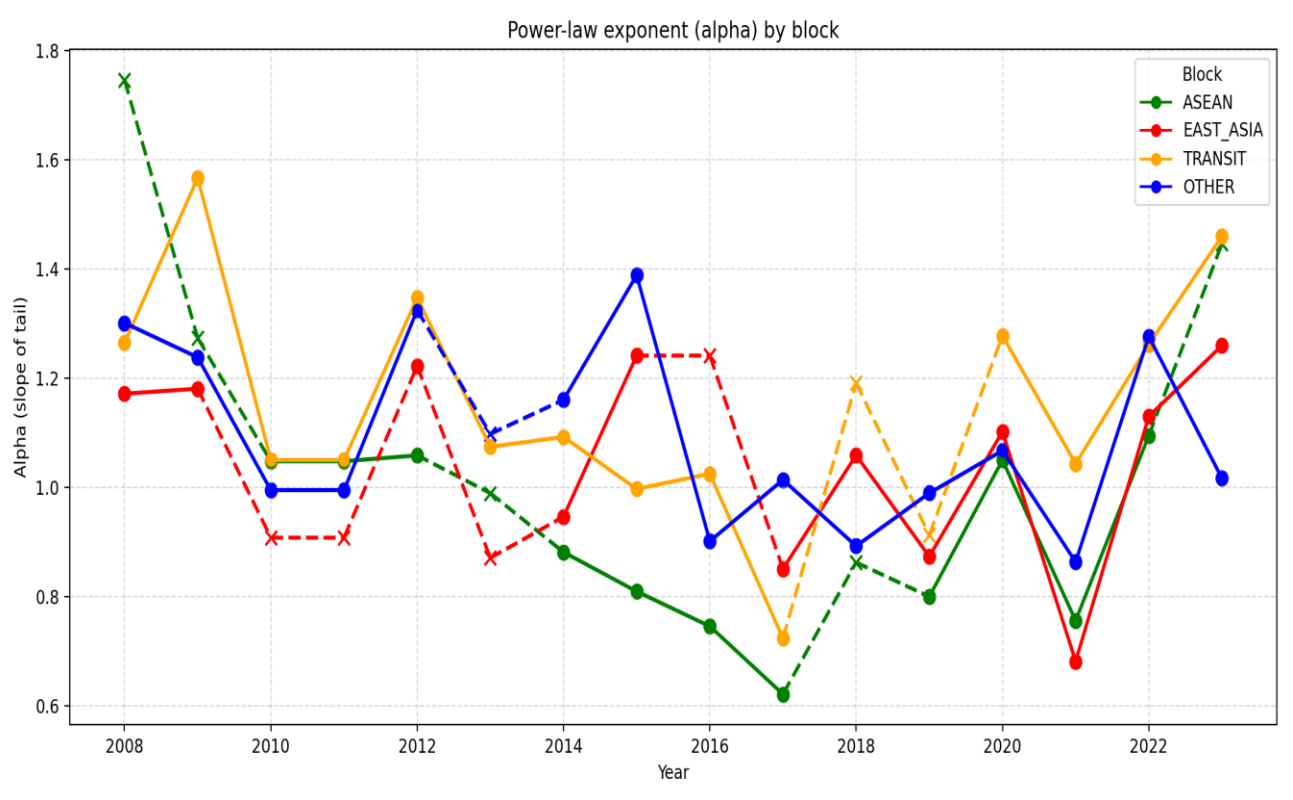
Understanding Alpha (α)

A lower α indicates stronger concentration around a few major hubs, while **a higher α** indicates a more dispersed, multi-path network.

2

Regional Trajectories

- ASEAN : α declined until 2017, rising internal concentration → rebounded afterward, indicating gradual diversification.
- East Asia : α stayed stable before 2019 → dropped sharply during trade conflict/COVID-19 → rebounded after 2021, indicating partial re-diversification.
- Transit Asia (SGP, THA, VNM) : shifting inter-regional links, with a strong rebound after 2020.
- Others (AUS, DEU, IND, RUS, USA) : moderate fluctuation → mild recovery after 2020, indicating gradual redistribution of link strengths.



3

Post-2020 Signals

- α begins to rise again, suggesting a gradual recovery of dispersion.
- Structural progression: dispersion — concentration — back re-dispersion.

Conclusion

From Multi-Polar Expansion to Selective Reconfiguration

Structural Reconfiguration

Where did the change occur?

- After the global shocks, the network gradually contracted.
- ASEAN's mediating role is weakened.
- The center of gravity remains in East Asia — CHN, JPN, KOR, and TWN continue to anchor the network.

Fragmentation & Fragility

What was lost?

- The dominance of strong linkages has declined.
- Connections remain, but the pressure among them has softened.

Selective Connectivity

What do the remaining connections suggest?

- The network no longer appears to be connected simply based on scale.
- Instead, the remaining connections seem to be more selective.

🧭 Key Insight

The regional price network is no longer expanding through scale.
The network appears to be shifting from scale-driven connectivity to connectivity that may reflect more deliberate or meaningful linkage.

🔭 Future Research

Future research will examine what sustains these selective ties, and how this new structure affects domestic price adjustment and resilience.

Q & A