8th World KLEMS Conference

Panel Discussion

# Global Supply Chains and Productivity

## Presentation


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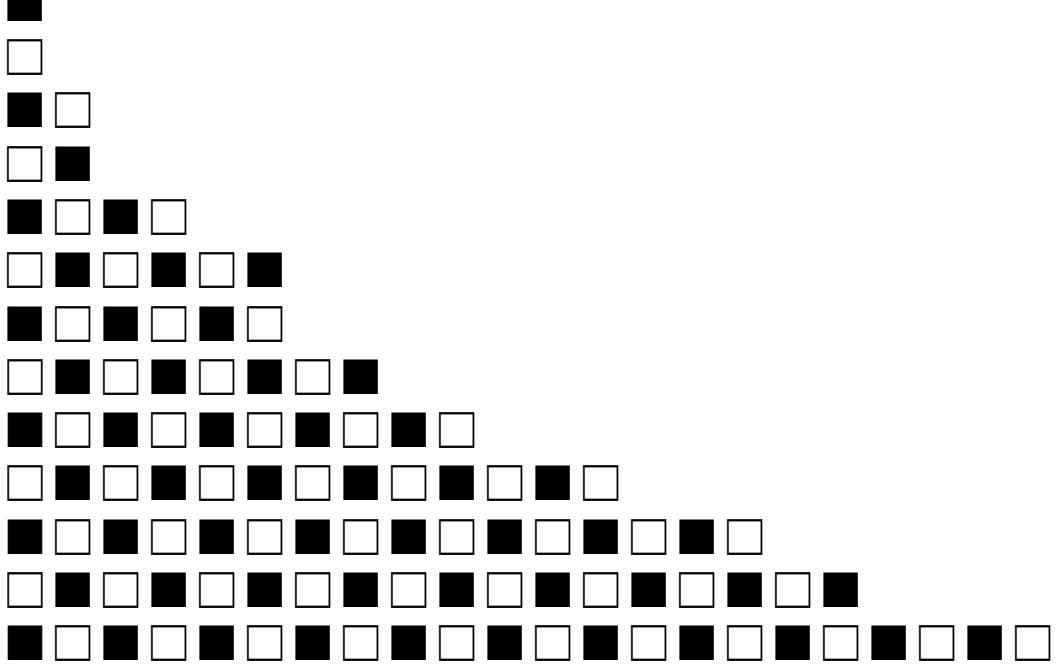
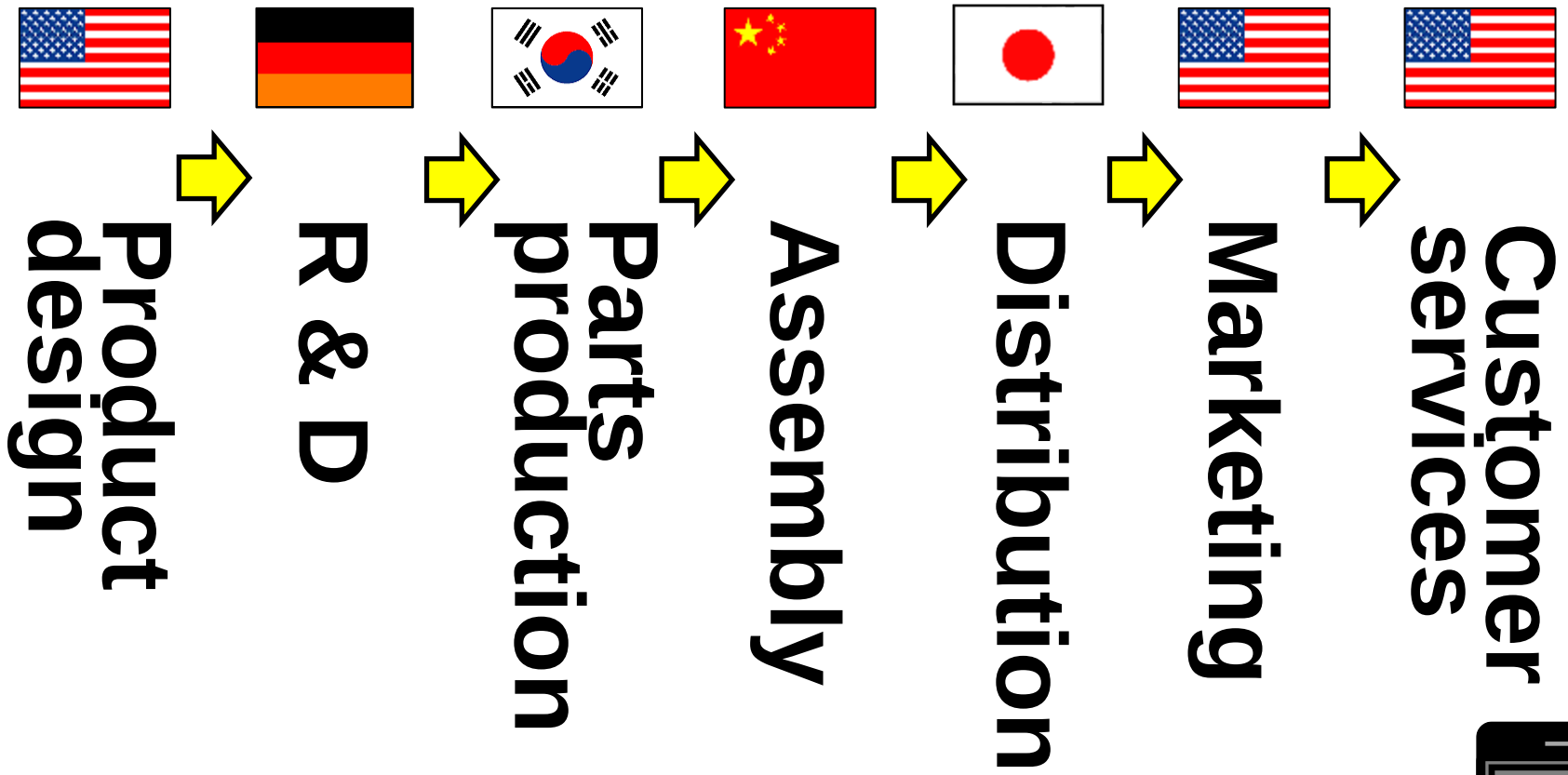
# Geographic concentration of global supply chains: volume versus frequency



Satoshi Inomata
IDE-JETRO

# Global value chain (GVC)




*"Designed by Apple in California, Assembled in China."*

**Supply chain efficiency "Just-in-time"**

**Supply chain risks "Just-in-case"**

# Concentration risk of supply chains

*"Don't put all eggs in one basket"*

# Geographical concentration of key production capacities

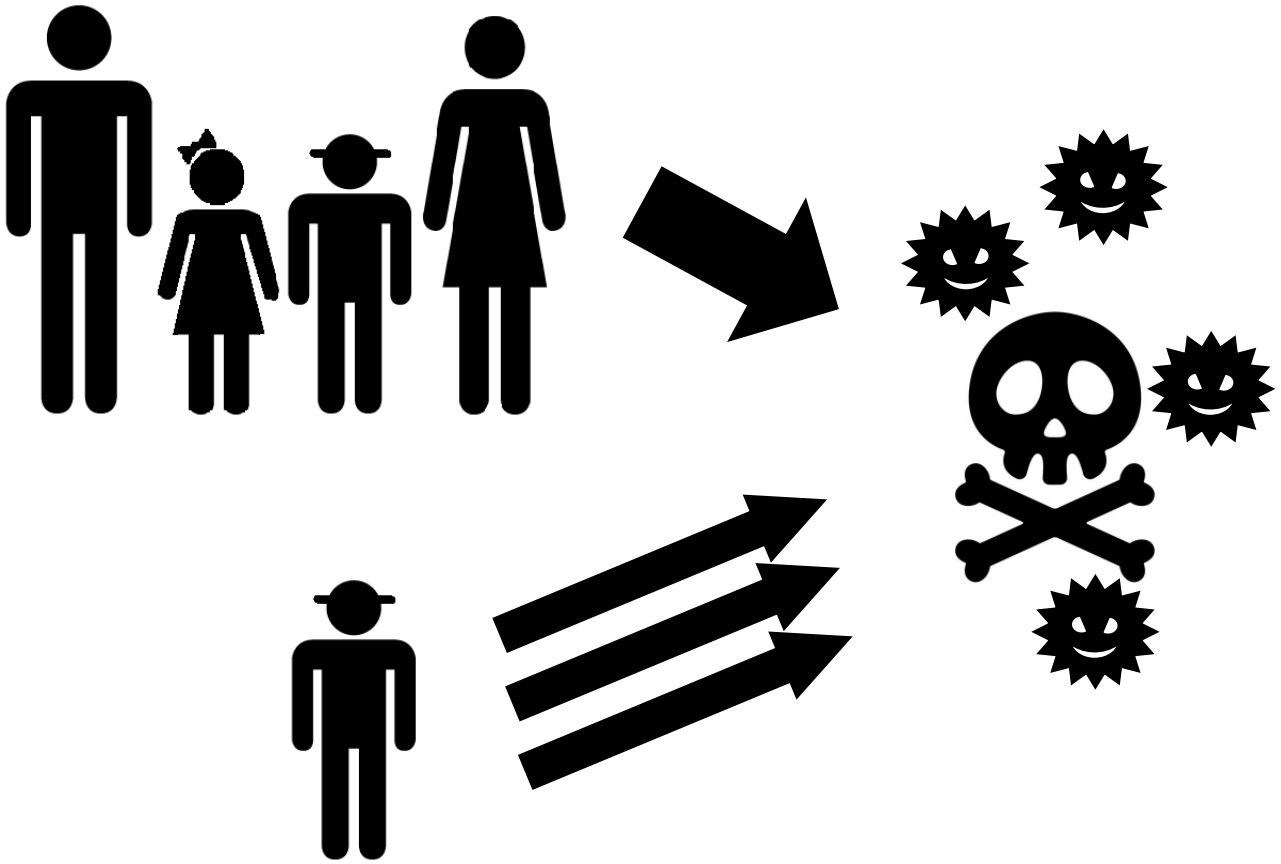
Production hubs ⇨ ⇨ ⇨ “**Choke points**”

*The Great East Japan Earthquake,*

*The Thai flood, The Lehman Shock,*

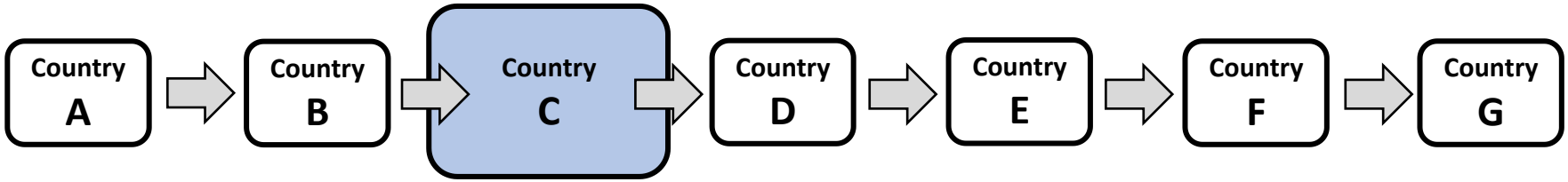
*Cyber-attacks, Covid-19, Geopolitical tensions …*

# Risk analyses
# Volume ⇔ Frequency



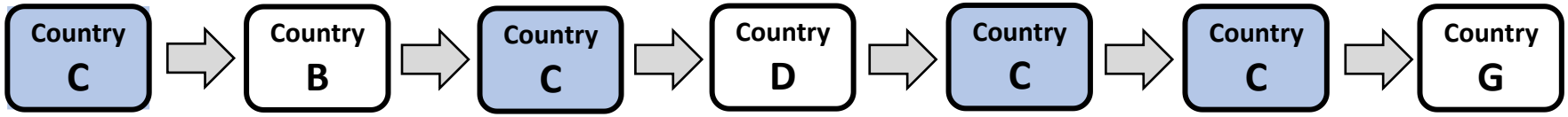
# A supply chain is considered highly exposed to a specific country risk,

- if its product contains a significant volume of value-added sourced from the country,

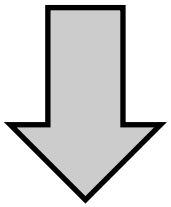



*or,*

- if the production activities along the supply chain involves frequent engagement with the country's industrial sectors.



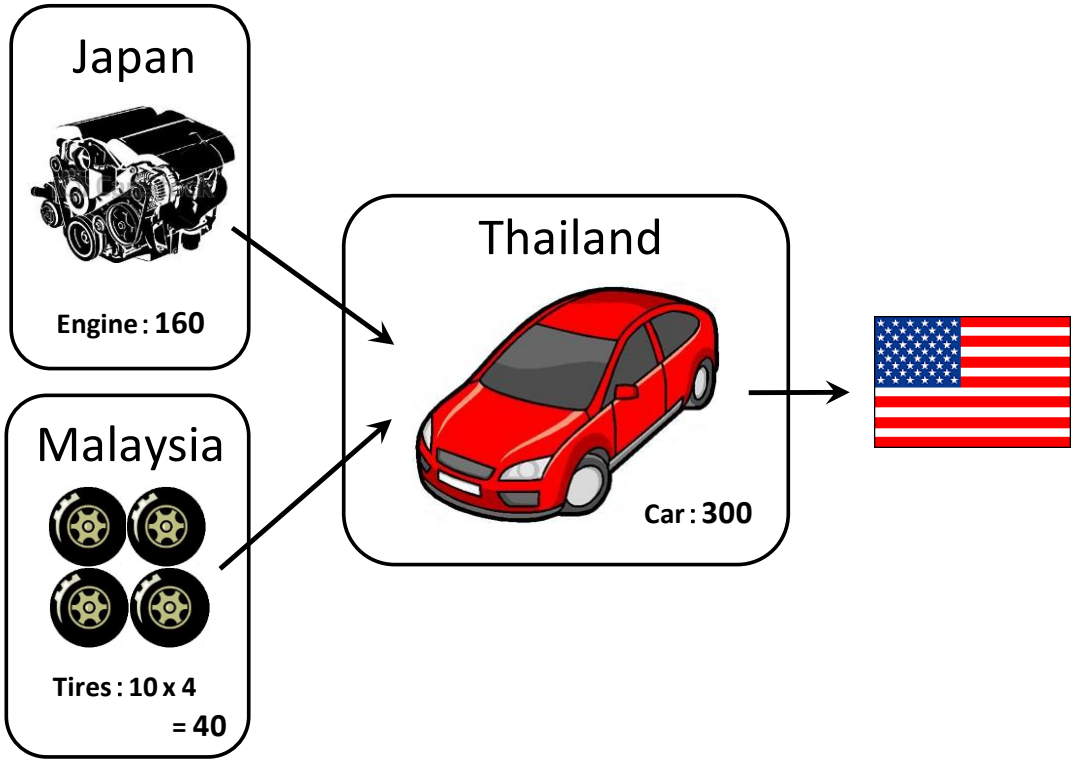
# Geographical concentration in volume



*Trade in value-added (TiVA)*

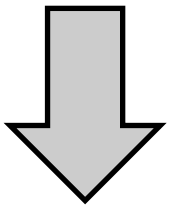
*How much value of the products is attributable to the value-added origin of which country*

→ supply chain dependence in volume

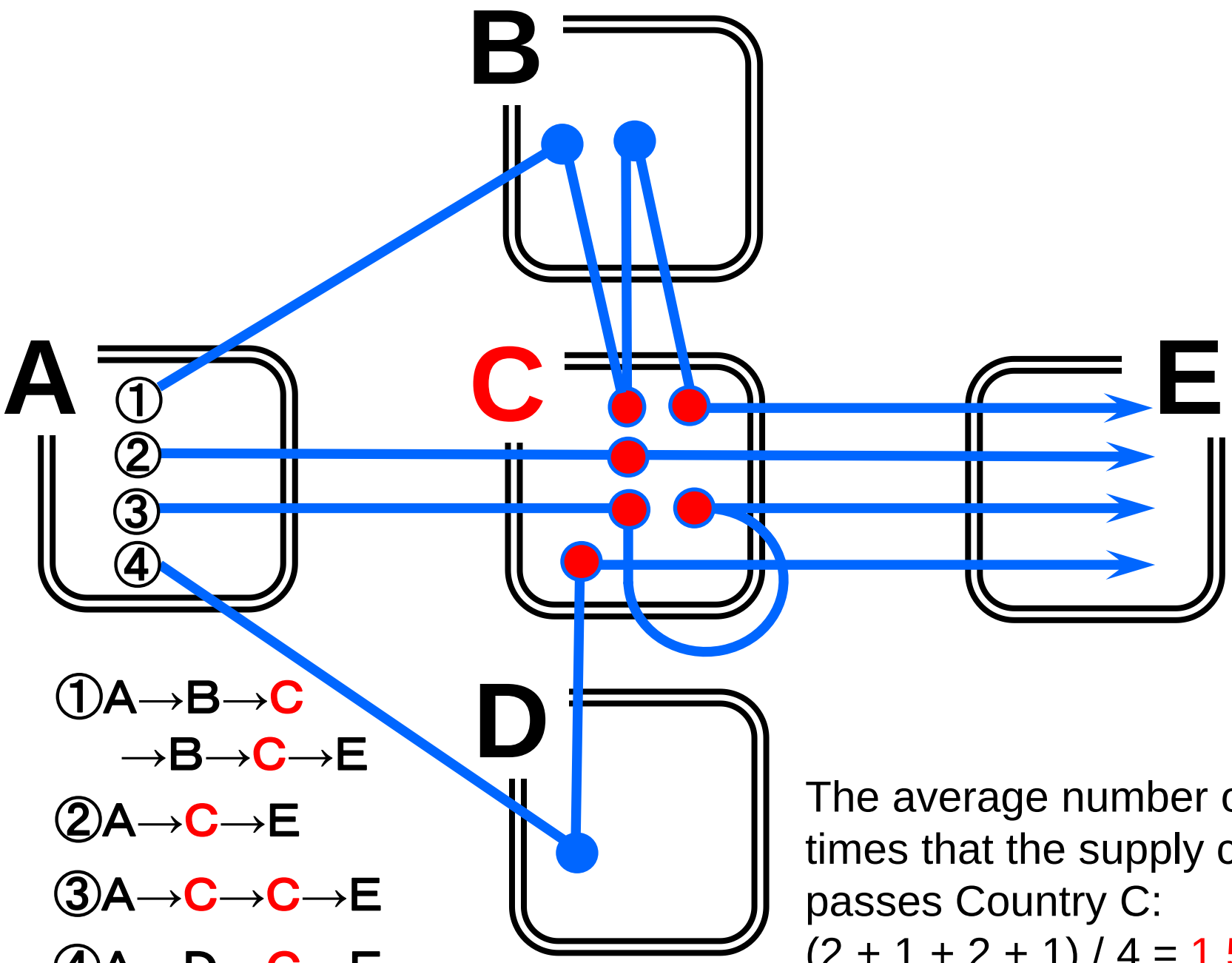



| | Traditional measurement | Value-added measurement |
|---|---|---|
| ① Japan→Thailand | 160 | 0 |
| ②Malaysia→Thailand | 40 | 0 |
| ③ Thailand→USA | 300 | 100 |
| ④Japan→USA | 0 | 160 |
| ⑤Malaysia→USA | 0 | 40 |
| ⑥ Total traded values | 160+40+300=500 | 100+160+40=300 |

# Geographical concentration in frequency



*How frequently a supply chain passes through the industrial sectors of a high-risk country*


B
A
①
②
③
④
C
E
D
①A→B→C
→B→C→E
②A→C→E
③A→C→C→E
④A→D→C→E
The average number of times that the supply chain passes Country C:
(2 + 1 + 2 + 1) / 4 = 1.5

Network concentration indicator

**Pass-through Frequency (PTF):**

The average number of times that a target supplier emerges along production paths;

In our context …

→ The *frequency* that a supply chain passes through the industrial sectors of a high-risk country.

# Pass-through Frequency (PTF)

$$f_{(t)_{s_1 s_k}} = c_{(t)} \cdot \frac{a_{s_1 s_k}}{[\boldsymbol{L} - \boldsymbol{I}]_{s_1 s_k}}$$

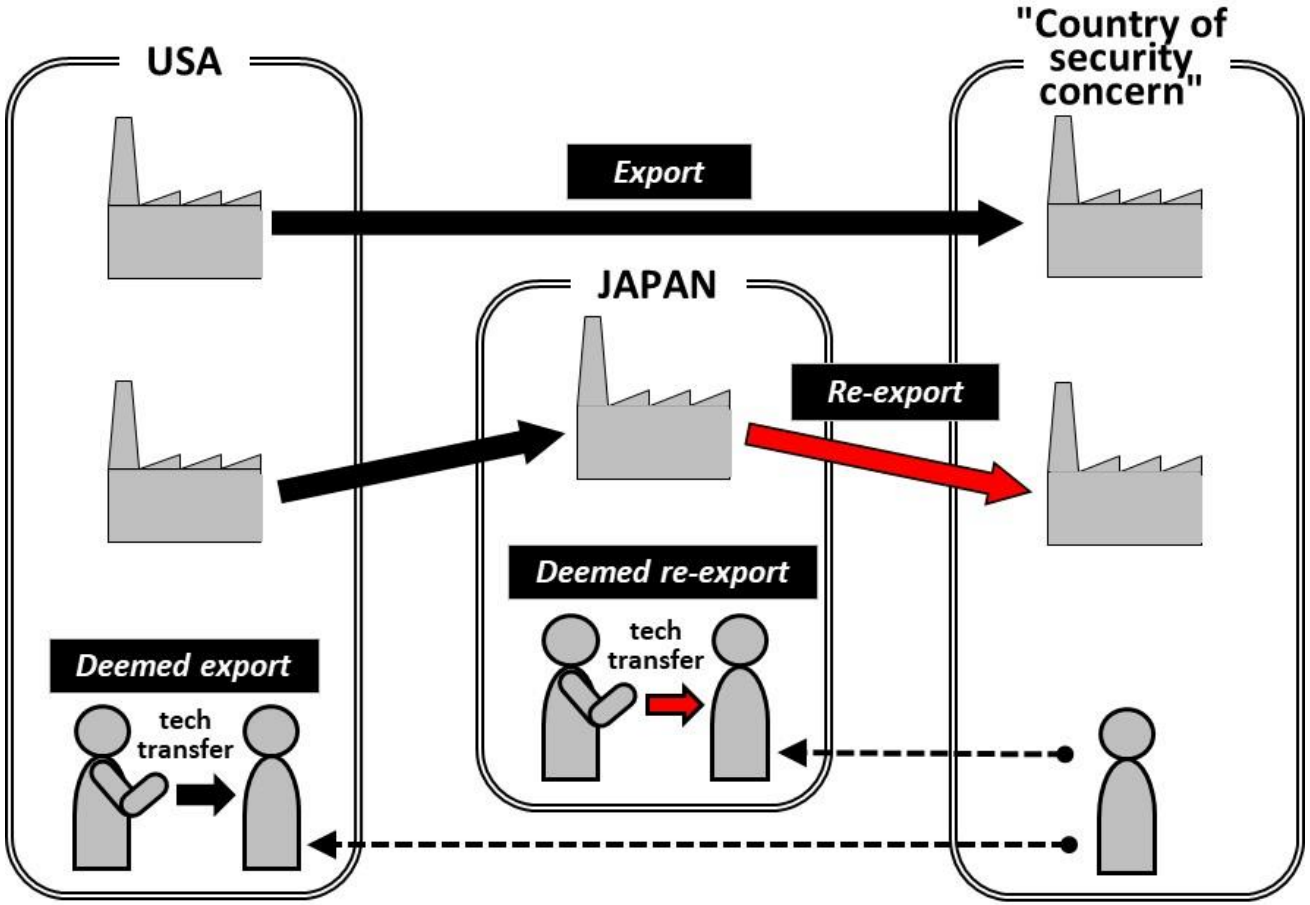
✓ Can be calculated solely from the information in an input-output table, hence
✓ Highly cost-effective, hence
✓ A handy reference of the first resort for relevant policy-making.

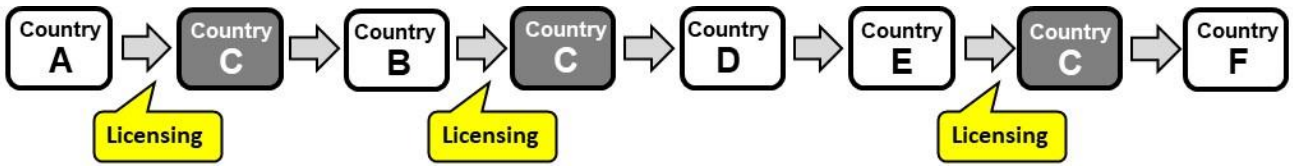
$$+ \sum_{k=3}^{\infty} \sum_{s_2,\ldots,s_{k-1}} \left( c_{(t)} \cdot \frac{a_{s_1 s_2}\, a_{s_2 s_3}\, a_{s_3 s_4} \cdots a_{s_{k-1} s_k}}{[\boldsymbol{L} - \boldsymbol{I}]_{s_1 s_k}} \right)$$

$$\Leftrightarrow \quad f_{(t)_{ij}} = \frac{\left[\boldsymbol{L}\, \boldsymbol{J}_{(t)} \boldsymbol{L} - \boldsymbol{J}_{(t)}\right]_{ij}}{[\boldsymbol{L} - \boldsymbol{I}]_{ij}}$$

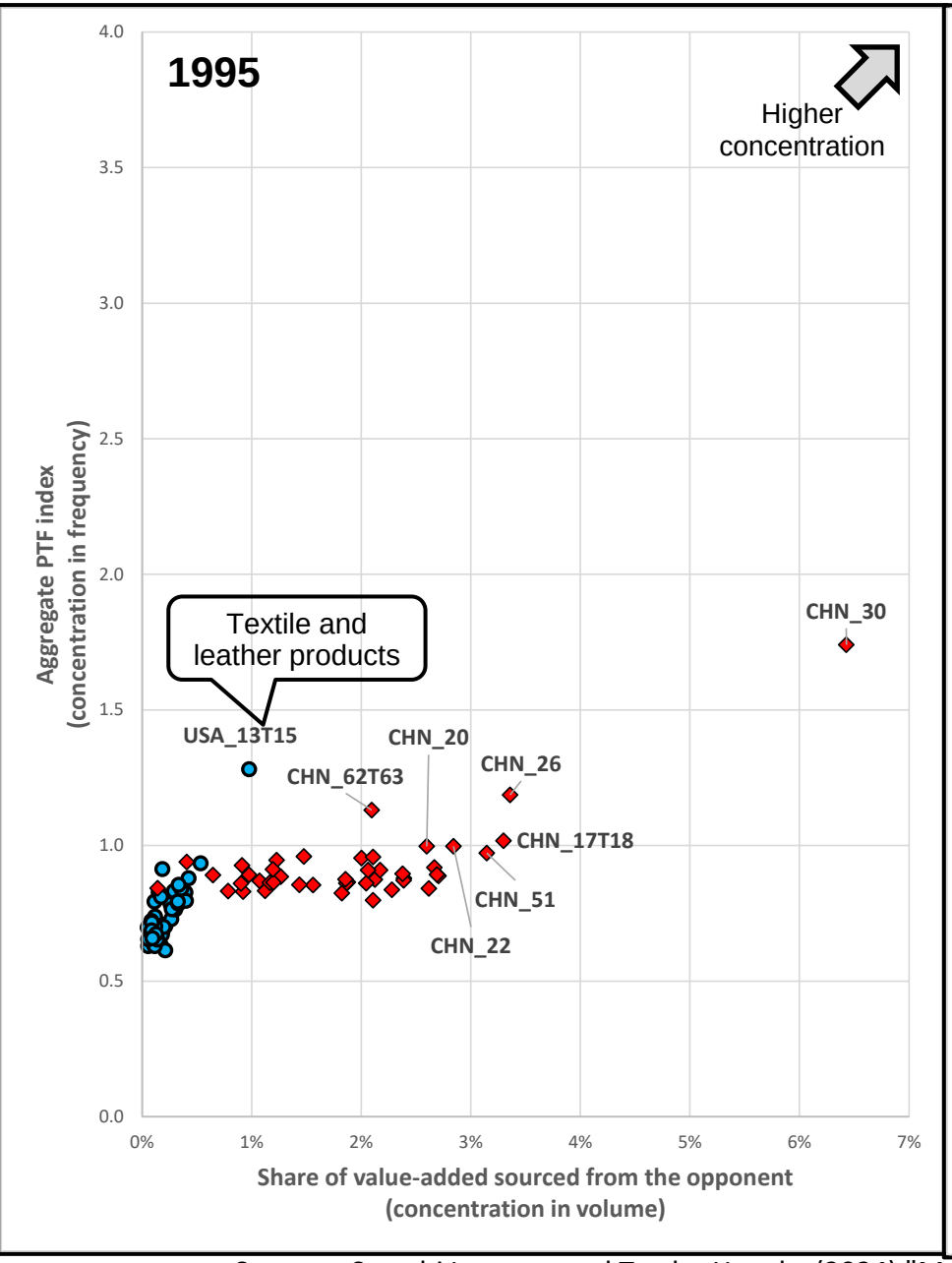
$\boldsymbol{J}_{(t)}$ : a matrix with 1 for $(t, t)^{\text{th}}$ element and zeros elsewhere.

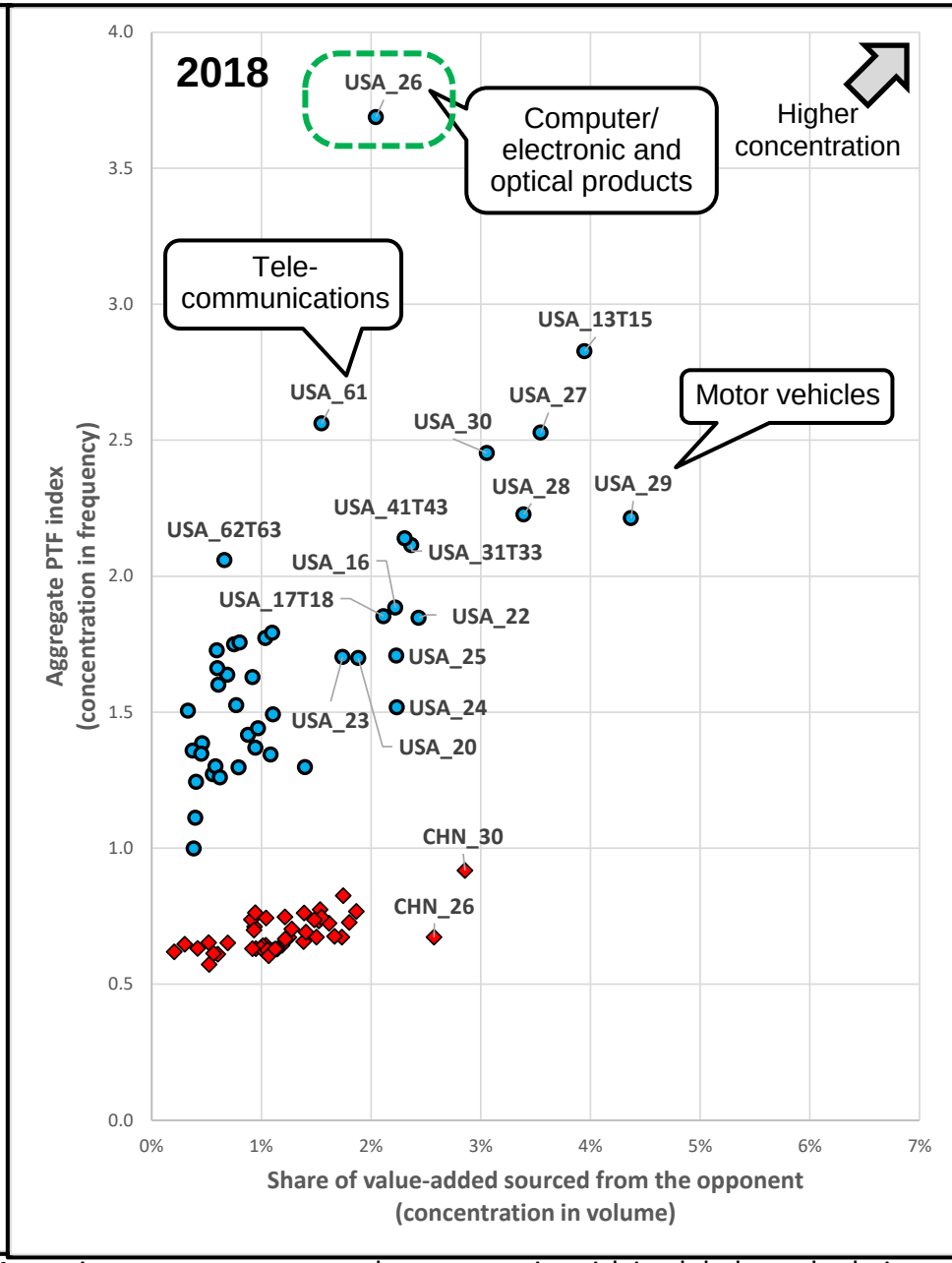
# Why does frequency matter?
# A case of the US export control measures



# Relative risk positions: the United States vs China (1995, 2018)

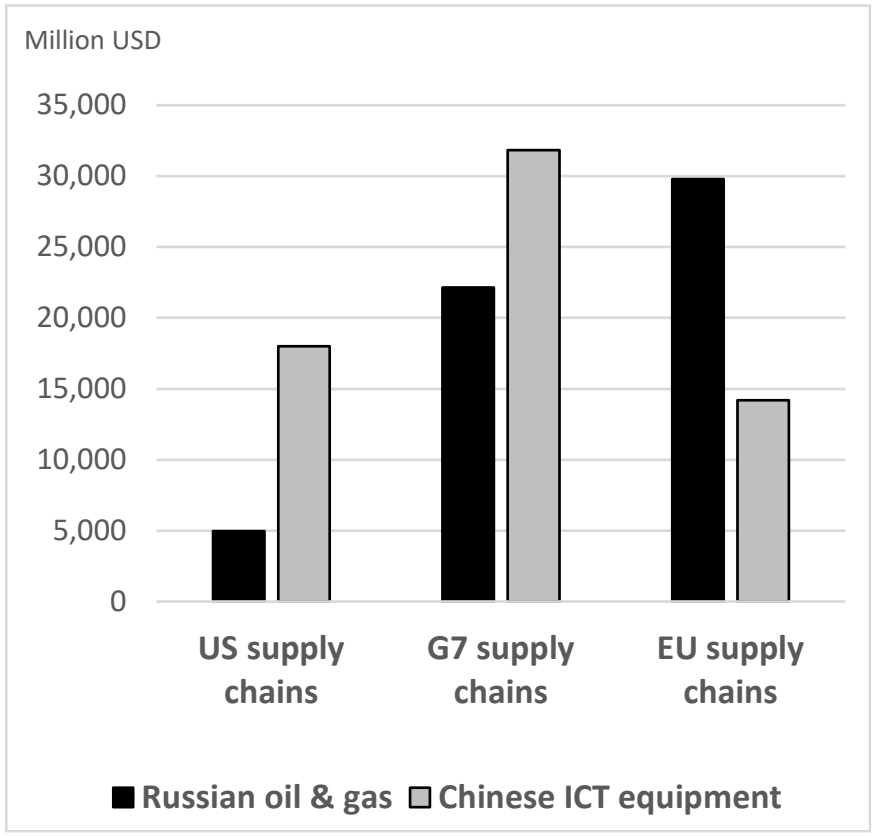


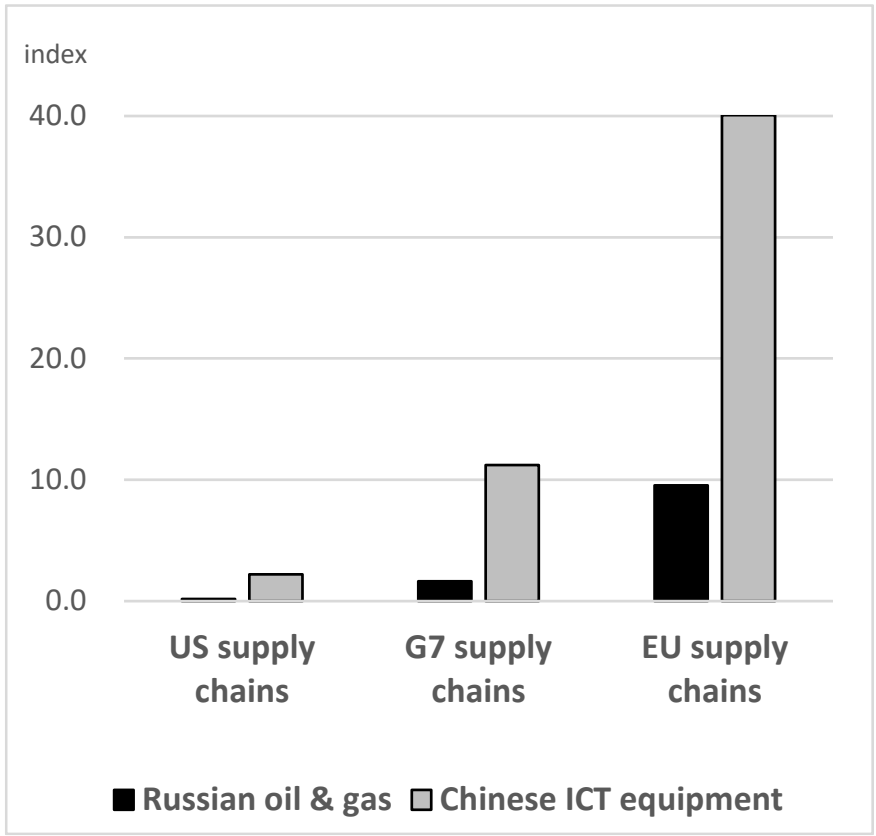

Source: Satoshi Inomata and Tesshu Hanaka (2024) "Measuring exposure to network concentration risk in global supply chains: Volume versus frequency," *Structural Change and Economic Dynamics*, 68, pp.177-193.

# Concentration risk analysis at the sectoral level (2020)

## Volume-based concentration (Trade in value-added)




## Frequency-based concentration (PTF)



# Pass-through Frequency

Pass-through frequency (PTF) indicator captures the degree of supply chain exposure to geographic concentration risk in the global production networks. It measures the frequency that a supply chain involves transactions with suppliers of a particular country throughout the production processes.

Dataset



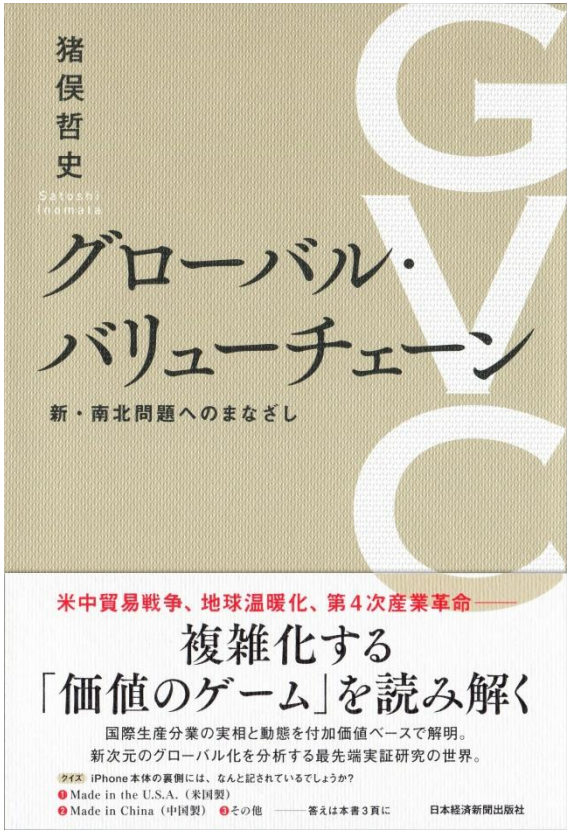
## About

The pursuit of optimal resource allocation across borders often resulted in the agglomeration and concentration of key production capacities in a specific country. With increasing uncertainty of the global economy, however, these production hubs can quickly become “choke points” for the entire economic system.

Trade in value-added (TiVA) indicators present origins of value added in gross exports/final demand, but what happens in-between? How many countries-industries do intermediate goods and services pass through, and how often, before being used in final production?

*Where are the potential exposures to concentration risk along supply chains?*


https://www.oecd.org/en/data/datasets/pass-through-frequency.html

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