

NBER Conference on Resilience in Supply Chains: Measuring Supply Chain Disruptions and Resilience

Alireza Tahbaz-Salehi
Northwestern University

Fall 2024

Two Fundamental Challenges

1. Obtain measures to capture the riskiness and resilience of supply chains
 - ▶ both papers
2. Detailed measurement of supply chains and supply chain disruptions at the firm- and product-levels
 - ▶ [Lemmers et al.](#): product level; case study of Dutch pharmaceutical industry
 - ▶ [Liu et al.](#): firm level; based on seaborne shipment-level import for the U.S.

Two Fundamental Challenges

1. Obtain measures to capture the riskiness and resilience of supply chains
 - ▶ both papers
 2. Detailed measurement of supply chains and supply chain disruptions at the firm- and product-levels
 - ▶ [Lemmers et al.](#): product level; case study of Dutch pharmaceutical industry
 - ▶ [Liu et al.](#): firm level; based on seaborne shipment-level import for the U.S.
-
- Important for policymakers
 - Any such exercise relies on (explicit or implicit) assumptions
 - **My comments:** why answering these questions is far from trivial (and why some assumptions are better than others)

“Supply Chain Disruptions and Supplier Capital in U.S. Firms”

Liu, Liu, Smirnyagin, and Tsyvinski (2024)

One-Slide Summary

(1) Firm-level index of supply chain disruptions

- ▶ definition: fraction of “established” trading partners that temporarily cease trading activities at the product category level
- ▶ study impact of supply chain disruptions on firm performance

(2) Supplier capital

- ▶ definition: total import \$ value accounted for by established trade partners
- ▶ study investment in supplier capital in response to supply chain disruptions

(3) Supply chain criticality

- ▶ definition: concentration of suppliers within a specific product category
- ▶ study relationship between criticality of suppliers and supply chain pressure

1. Firm-Level Index of Supply Chain Disruptions

- Index of supply chain disruption of firm i at time t

$$\text{index}_{it} = \sum_{\text{prod. cat. } j} \text{import share}_{ijt} \times \text{temp. stop in trade by established pairs trading product category } j$$

1. Firm-Level Index of Supply Chain Disruptions

- Index of supply chain disruption of firm i at time t

$$\text{index}_{it} = \sum_{\text{prod. cat. } j} \text{import share}_{ijt} \times \text{temp. stop in trade by established pairs trading product category } j$$

- A measure of firm-level supply chain disruptions only if all temporary stops in trade between established partners are due to supply shocks: **i.e., if there are no demand shocks**

1. Firm-Level Index of Supply Chain Disruptions

- But there are demand shocks: customer may draw down inventories, face reduced demand themselves, production line issues, etc.



World ▾ Business ▾ Markets ▾ Sustainability ▾ Legal ▾ Breakingviews ▾ More ▾

Reuters NEXT kicks off with international policymakers, business leaders and innovators

Technology

Exclusive: Samsung delays taking deliveries of ASML chip gear for its new US factory, sources say

By Heekyong Yang, Hyunjoo Jin and Toby Sterling

October 18, 2024 3:39 AM EDT · Updated 2 months ago



SEOUL, Oct 18 (Reuters) - Samsung Electronics ([005930.KS](#)) has postponed taking deliveries of ASML ([ASML.AS](#)) chipmaking equipment for its upcoming factory in Texas as it has yet to win any major customers for the project, three people familiar with the matter said.

1. Firm-Level Index of Supply Chain Disruptions

- Not addressed by the “leave-one-out” IV strategy in the paper either.

values at the product level as weights. Intuitively, this instrument is designed to capture the notion that when a given established trade pair is inactive, and this is concurrent with a drop in activity among that U.S. firm’s established shippers, it is likely that the inactivity is driven by supply considerations rather than a decline in the given firm’s demand.

- Simultaneous halts in shipments can be due to **industry-wide demand shocks**
- Example: reduction in demand for jet fuel during Covid

The U.S. Energy Information Administration’s (EIA) data show that demand (measured by EIA as product supplied) for motor gasoline increased in May as many states began to relax stay-at-home orders, but demand for jet fuel continued to decline because of reduced commercial air travel. EIA’s July *Petroleum Supply Monthly* (PSM), which includes data through May 2020, shows how crude oil and petroleum product markets continue to be affected by the measures taken to mitigate the spread of coronavirus.

1. Firm-Level Index of Supply Chain Disruptions

$$\text{index}_{it} = \sum_{\text{prod. cat. } j} \text{import share}_{ijt} \times \begin{matrix} \text{temp. stop in trade by established} \\ \text{pairs trading product category } j \end{matrix}$$

- **Not really a firm-level index:** two firms are assigned the same index as long as they have identical import shares, irrespective of
 - ▶ where their actual suppliers are located
 - ▶ trade routes (Pacific vs. Atlantic)

1. Firm-Level Index of Supply Chain Disruptions

$$\text{index}_{it} = \sum_{\text{prod. cat. } j} \text{import share}_{ijt} \times \begin{matrix} \text{temp. stop in trade by established} \\ \text{pairs trading product category } j \end{matrix}$$

- **Not really a firm-level index:** two firms are assigned the same index as long as they have identical import shares, irrespective of
 - ▶ where their actual suppliers are located
 - ▶ trade routes (Pacific vs. Atlantic)

- Example: Natural rubber (HS 4001)
 - ▶ **Vietnam:** mostly used by the medical industry (medical gloves)
 - ▶ **Thailand:** tire manufacturing industry

- According to the paper's index: breakup of relationships due to floods in Thailand is a disruption to the supply chain of medical industry.

2. Measure of Supplier Capital

- Total import value in USD accounted for by established trade partners—**summed up across all suppliers**—with whom the firm recently traded.
- The term **supplier capital** invokes a notion of **relationship specificity**.

2. Measure of Supplier Capital

- Total import value in USD accounted for by established trade partners—**summed up across all suppliers**—with whom the firm recently traded.
- The term **supplier capital** invokes a notion of **relationship specificity**.
- But does it capture a notion of relationship specificity?
 - ▶ if a firm consistently spends a lot on 100 suppliers in total but very little on each, is supplier capital high or low?
 - ▶ even given a single supplier, high import value is perfectly compatible with high substitutability.

3. Measure of Supply Chain Criticality

- A product more **critical** to the US economy if its suppliers are more concentrated
 - ▶ **underlying assumption**: if US firms are importing from fewer suppliers, then any disruption will be harder to address.

3. Measure of Supply Chain Criticality

- A product more **critical** to the US economy if its suppliers are more concentrated
 - ▶ **underlying assumption**: if US firms are importing from fewer suppliers, then any disruption will be harder to address.

High HHI			Low HHI		
HS Code	Description	Mean HHI	HS Code	Description	Mean HHI
7611	Aluminum tanks	0.987	8443	Printing machinery	0.050
7203	Iron ores	0.986	6203	Men's clothing	0.049
8905	Light vessels	0.986	4001	Natural rubber	0.048
5805	Woven tapestries	0.984	6307	Used textiles	0.046
5212	Cotton fabrics	0.983	4202	Travel goods	0.034
2515	Marble	0.979	9506	Sporting goods	0.041
5303	Flax, raw	0.975	8504	Electrical transformers	0.041
0504	Whale fins	0.975	9403	Wooden furniture	0.043
0603	Cut flowers	0.975	8708	Vehicle parts	0.023
8602	Railway locomotives	0.975	6403	Leather footwear	0.028

3. Measure of Supply Chain Criticality

- A product more **critical** to the US economy if its suppliers are more concentrated
 - ▶ **underlying assumption**: if US firms are importing from fewer suppliers, then any disruption will be harder to address.

High HHI			Low HHI		
HS Code	Description	Mean HHI	HS Code	Description	Mean HHI
7611	Aluminum tanks	0.987	8443	Printing machinery	0.050
7203	Iron ores	0.986	6203	Men's clothing	0.049
8905	Light vessels	0.986	4001	Natural rubber	0.048
5805	Woven tapestries	0.984	6307	Used textiles	0.046
5212	Cotton fabrics	0.983	4202	Travel goods	0.034
2515	Marble	0.979	9506	Sporting goods	0.041
5303	Flax, raw	0.975	8504	Electrical transformers	0.041
0504	Whale fins	0.975	9403	Wooden furniture	0.043
0603	Cut flowers	0.975	8708	Vehicle parts	0.023
8602	Railway locomotives	0.975	6403	Leather footwear	0.028

- Hard to imagine these inputs are critical to the U.S. economy:
 - ▶ **HS 5805**: hand-woven tapestries of the type Gobelins, Flanders, Aubusson, Beauvais and the like, and needle-worked tapestries.
 - ▶ **HS 0603**: cut flowers and flower buds of a kind suitable for bouquets or for ornamental purposes.

3. Measure of Supply Chain Criticality

- Maybe the underlying assumption is not as intuitive as it first appears.
- Supply chain relationships are endogenous.
 - ▶ firms establish more long-term relationships when inputs are not easily replaceable, but buy from the cheapest supplier when there are plenty of alternative options available.
- In general, notion of criticality should be somehow linked to the production technologies and consumer preferences.

“Which Products Are Traded in Your Supply Chain
And How Do They Score on Risk Indicators?”

Lemmers et al. (2024)

One-Slide Summary

- (1) Map inter-industry linkages across countries in the value chain at the (6-digit) product level
 - ▶ **main idea:** use [international trade data](#) and national [detailed use tables](#) to obtain granular data at the product level

- (2) Constructing risk indicators:
 - ▶ composite indicator based of five different risk measures

Comment on the Risk Indicator

1. World market concentration
 2. Import diversification of the Netherlands:
 3. Non-EU share in EU-imports
 4. Substitution ratio EU
 5. Centrality
- The paper lists a few limitations of the methodology. But maybe there is at least one more
 - The various measures are meaningful under different economic assumptions. Not clear the right way to aggregate them is to sum them up (or even they can be aggregated at all).
 - ▶ world market concentration: **limited substitutability with other products**
 - ▶ import diversification of the Netherlands: **relationship-specificity**
 - ▶ centrality: **Cobb-Douglas technologies and competitive markets**

One-Slide Summary

- Extremely important question.
 - Laudable attempt by both papers.
-
- Very hard to get to satisfactory answers.
 - In my view, progress requires relying more on theory