GRANULAR PRODUCTION NETWORKS

MAPPING AND TESTING PRODUCT-LEVEL VULNERABILITIES

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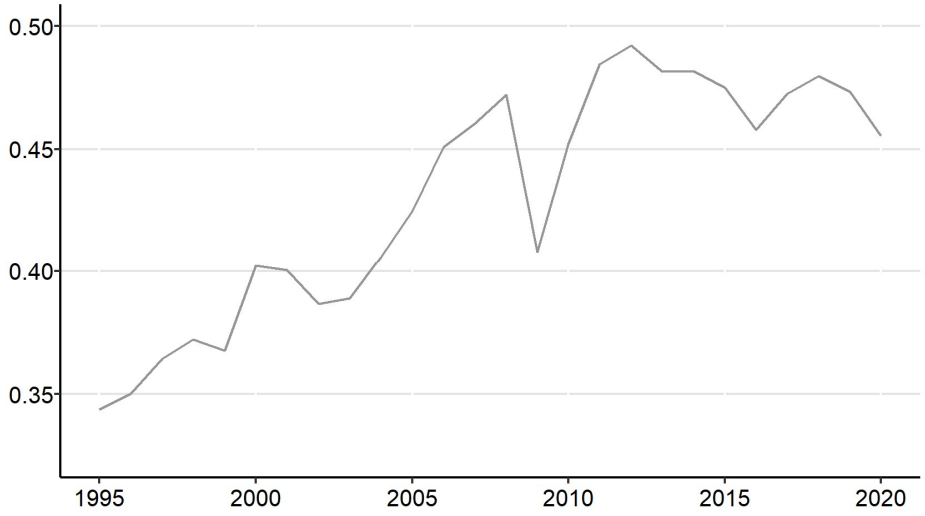
OCDE
DES POLITIQUES MEILLEURES POUR UNE VIE MEILLEURE

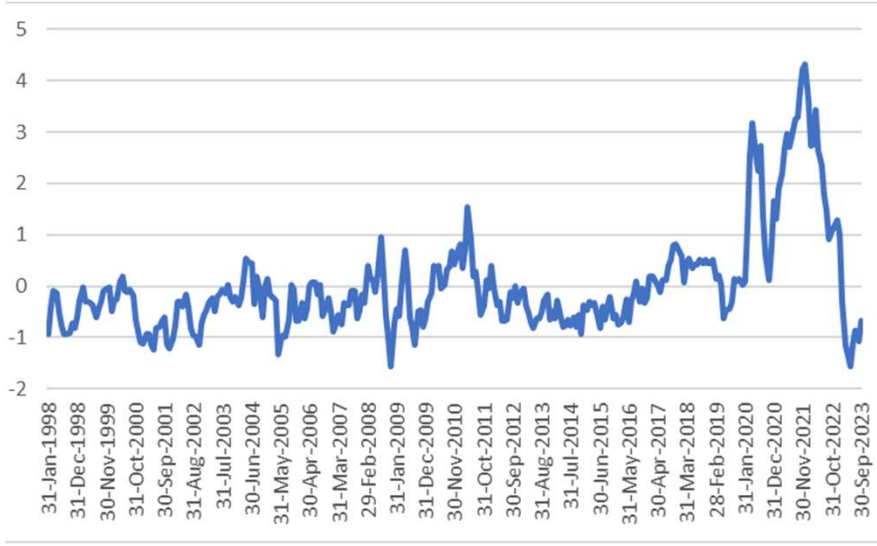
GVCs are stagnating, risk of disruption has increased

Foreign Input Reliance



Source: ICIO, OECD computations

Global Supply Chains Pressure Index



Source: New York Federal Reserve

Objectives of the paper

1. **Map Global Value Chain vulnerabilities at the product level**
   - Use UN Comtrade data to identify vulnerable products from trade in goods data
   - Focus on intermediate products (based on OECD's BTDxE classification)
   - Combine this data with OECD's Inter-Country Input-Output tables to identify vulnerabilities for downstream industries

2. **Develop a quantification framework to stress-test granular supply chains**
   - Account for substitutability between suppliers and products in the short and medium-term, and for supplier shares
   - Stress-test scenarios: **i) Natural disasters** affecting the supply of many products; ii) productivity shocks in some products (e.g. advanced tech products)
   - Only accounts for direct trade linkages at this stage

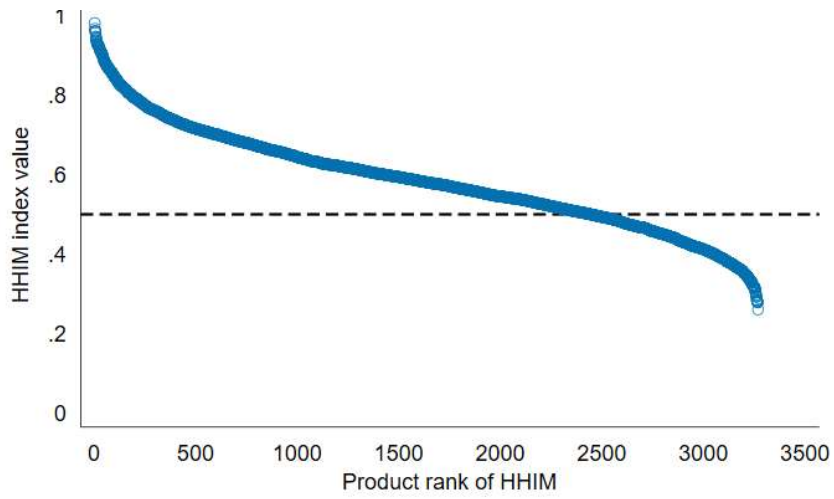
1. GRANULAR GVC MAPPING:

Tracking GVC dependencies at the product-level

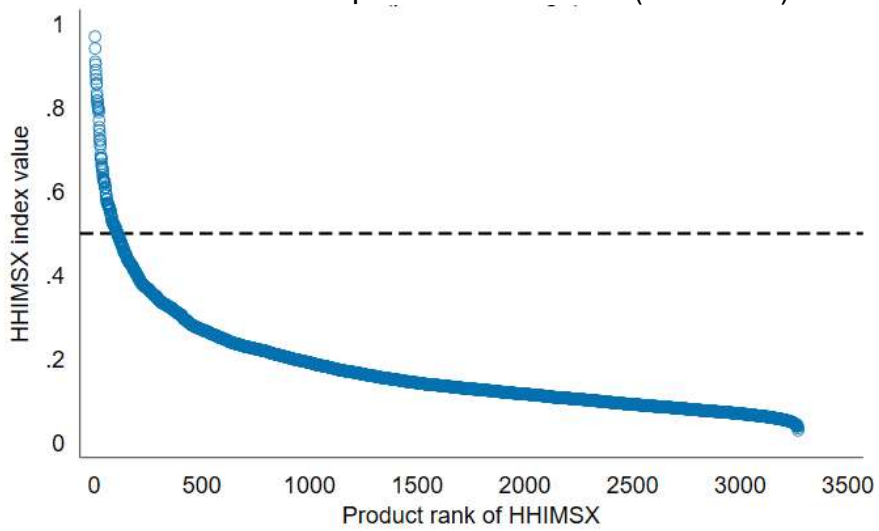
Downstream industries rely on few product suppliers even when exports are not too concentrated

Geographical concentration of product-level trade (average 2017-2021)

Supplier concentration (HHI-M)



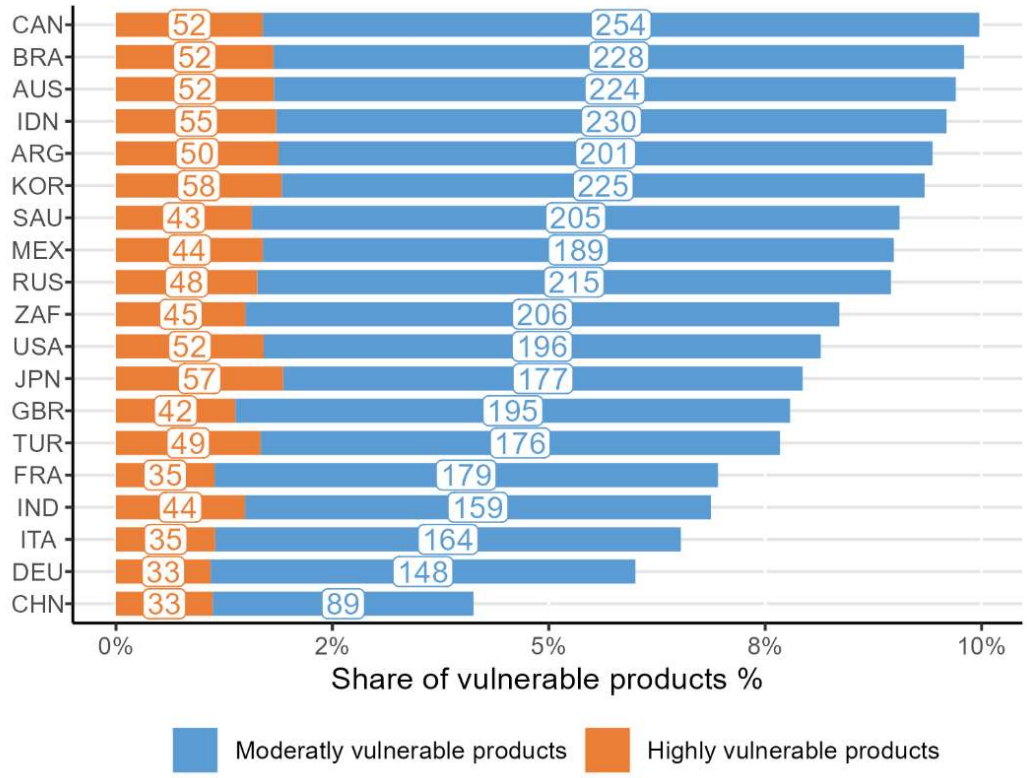
Global export market shares (HHI-MSX)



Source: Comtrade, BTDIxE, OECD calculation

About 8% of products are vulnerable across G20 economies

Share of vulnerable products among all intermediary products, 2019



Source: Comtrade, OECD calculation

Highly vulnerable and **moderately vulnerable** products are defined using three criteria:

1) **Global export market share concentration (HHI-MSX):** above **0.5** and **0.3**, respectively

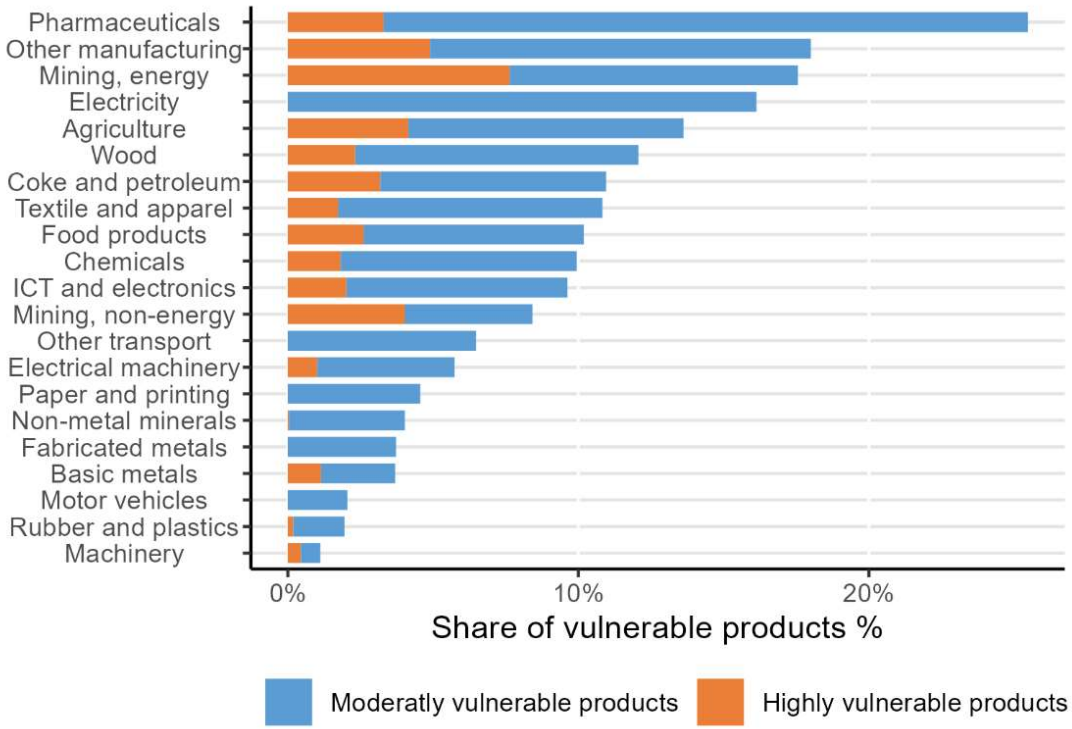
2) **Supplier's concentration (HHI-M):** above **0.5** and **0.3**, respectively

3) **Imports exceed exports**

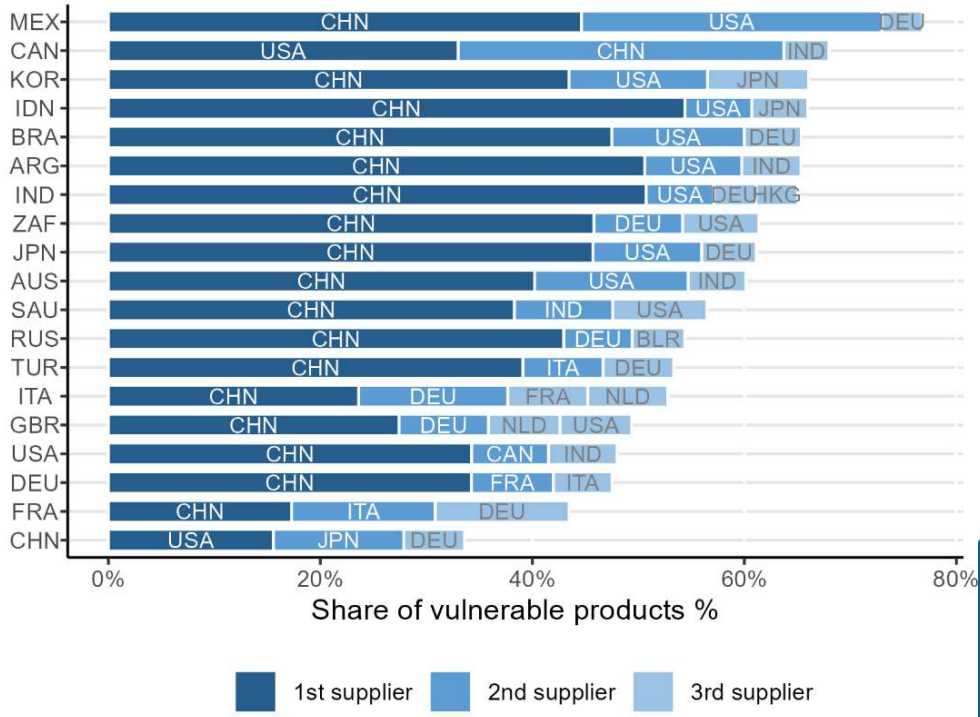
Product vulnerabilities by source industry and country in G20 economies

Share of vulnerable product, 2019

(A) by supplying industry



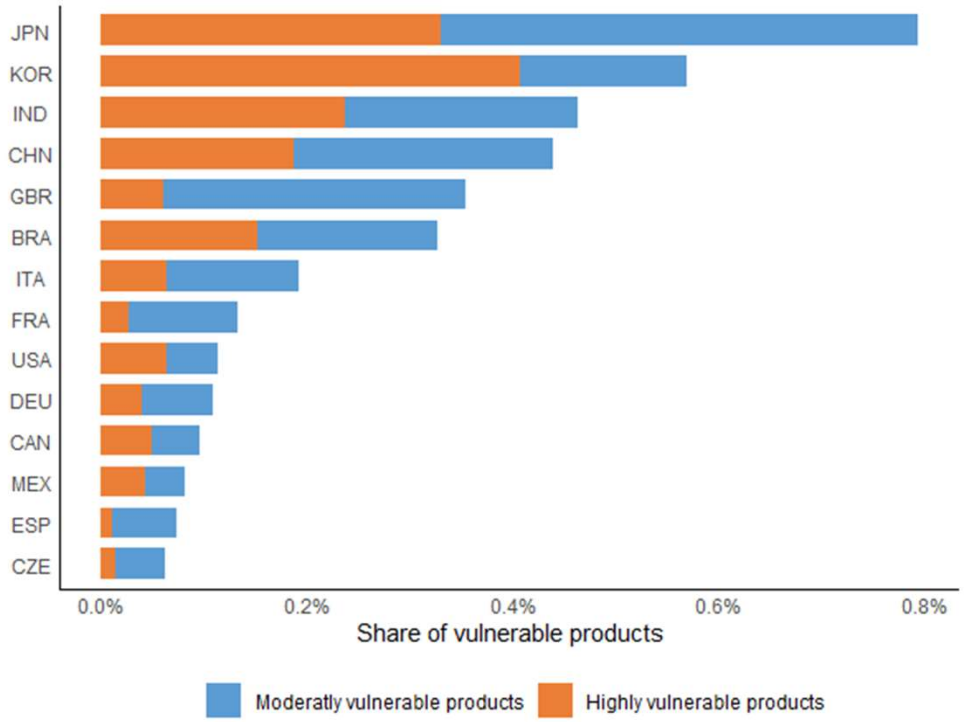
(B) by supplying country



Source: Comtrade, OECD calculation

Vulnerable products represent a tiny share of the value of imported intermediate inputs

Share of vulnerable products in total intermediary input cost by countries, motor vehicle, 2019



Source: Comtrade and ICIO, OECD calculation

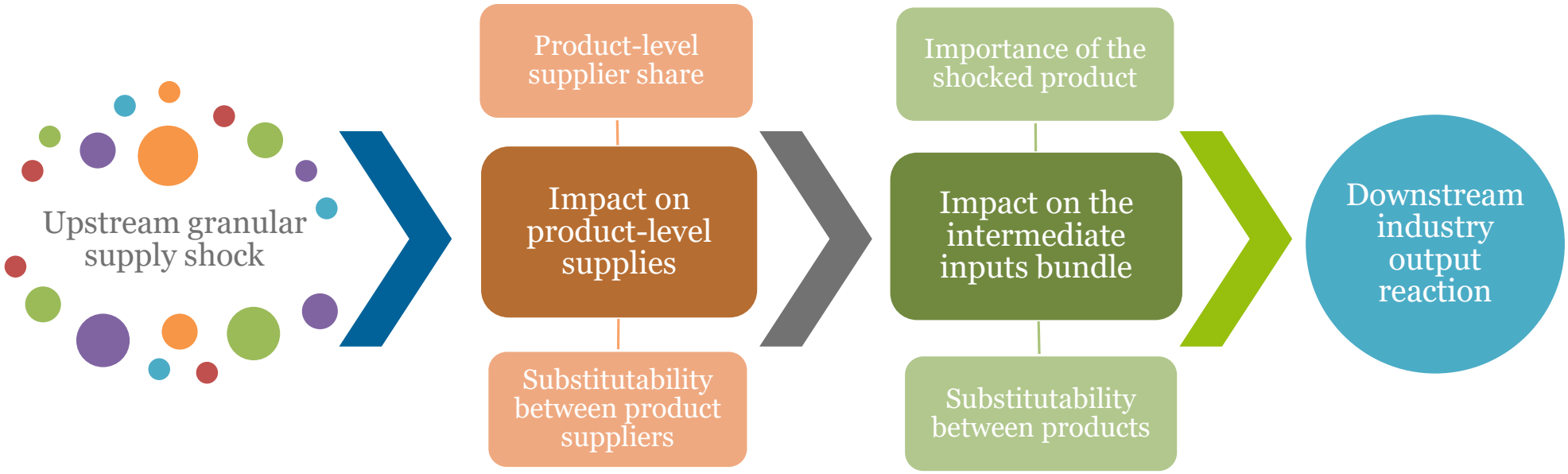
Combining vulnerable product imports with ICIO tables allows to evaluate product vulnerabilities in specific industries

- **Example**: products supplied to motor vehicles industry by top 3 supplying sectors in ICIO
- The value share of vulnerable product is generally small (less than 1%)
- However, supply disruptions can still have a large impact if the substitutability (between suppliers or products) is small

2. TESTING FOR GVC VULNERABILITY

A quantitative framework for granular GVC stress-testing

Ganular upstream shocks' impact on downstream production: conceptual framework

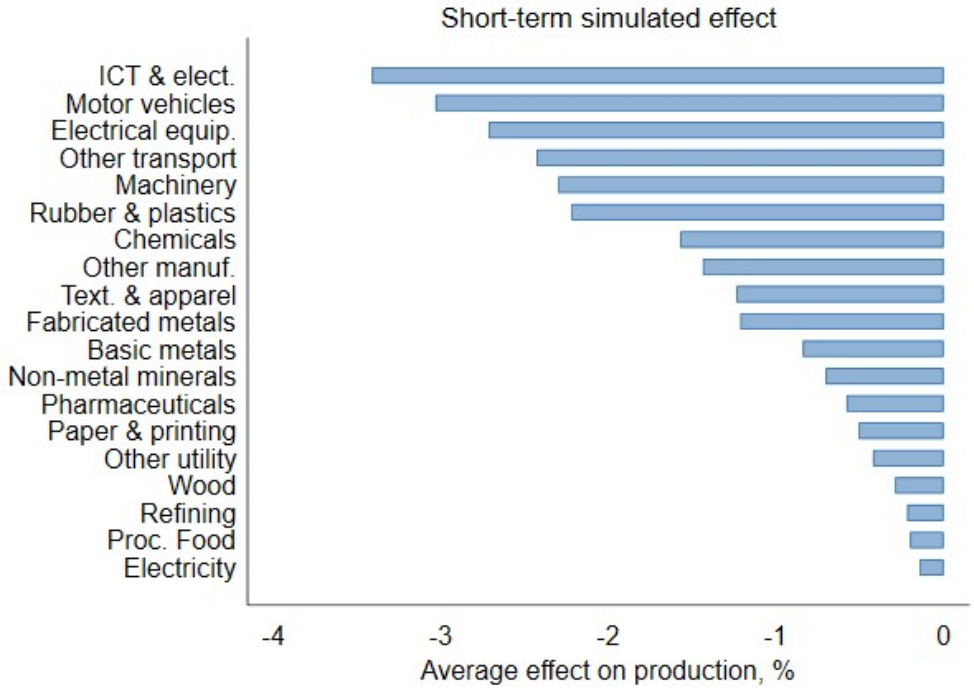


Source: Berthou et al. (2023) "Granular production networks: Mapping and testing product-level vulnerabilities", OECD STI, work in progress

Stress-test scenario: Natural disaster in Japan

Other scenarios presented in the paper consider natural disasters in other countries (e.g. Türkiye), or product-specific supply shocks (e.g., on advanced tech products supplied by China)

Impact of a temporary 30% drop in JP exports of all products to all partners



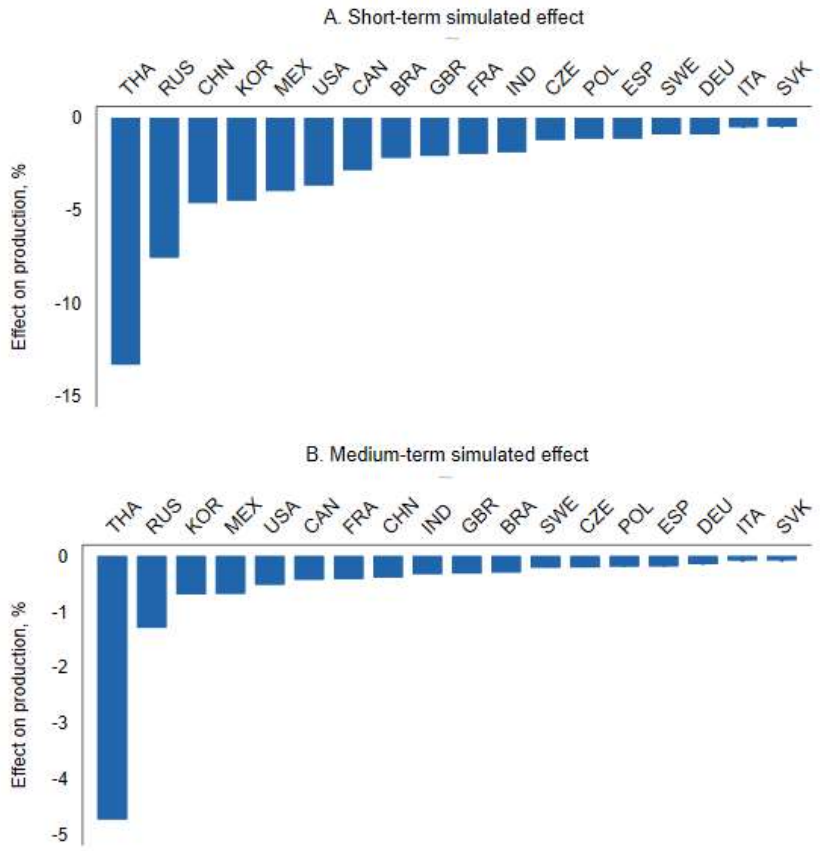
Average reaction by sector in affected countries

- Top 15 producing countries in each sector
- Short-term reaction (low elasticities)

Source: Berthou et al. (2023) "Granular production networks: Mapping and testing product-level vulnerabilities", OECD STI, work in progress

Main impact of the shock by country

Focus on the motor vehicles industry

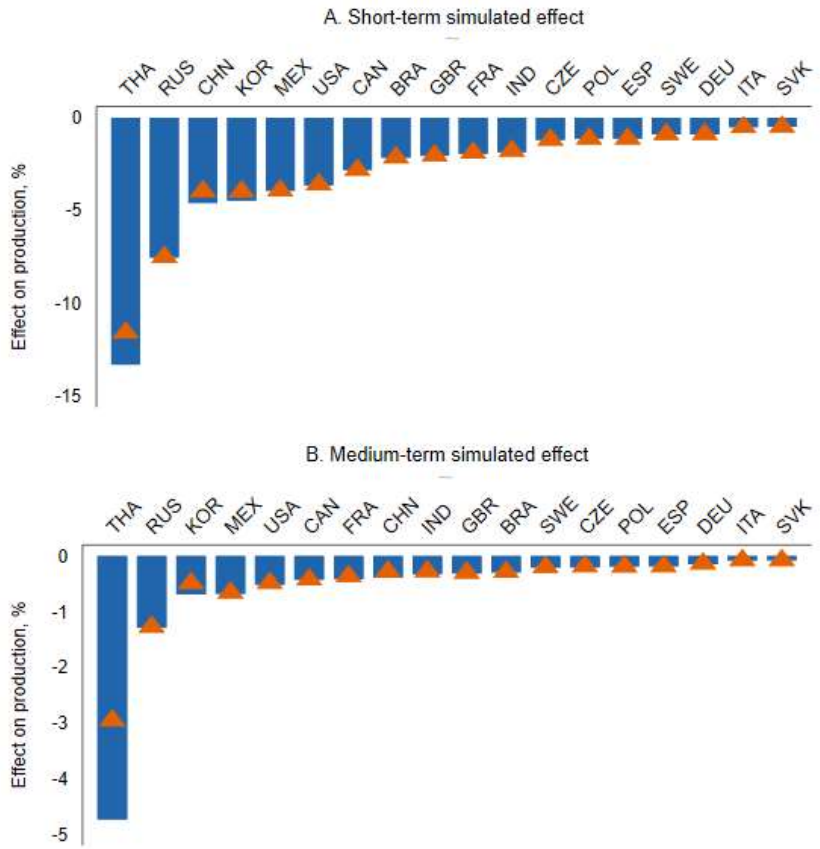


The baseline simulation reflects the geography of dependencies on inputs supplied by Japan

- **Example of Thailand:** very high dependency on intermediate products supplied by Japan for motor vehicles production explains the strong negative output response esp. in the short term.

- **Medium term**: Weaker quantitative effect of the shock for all countries is due to the higher substitutability between potential suppliers of the same product

Counterfactual simulation: Diversification policies

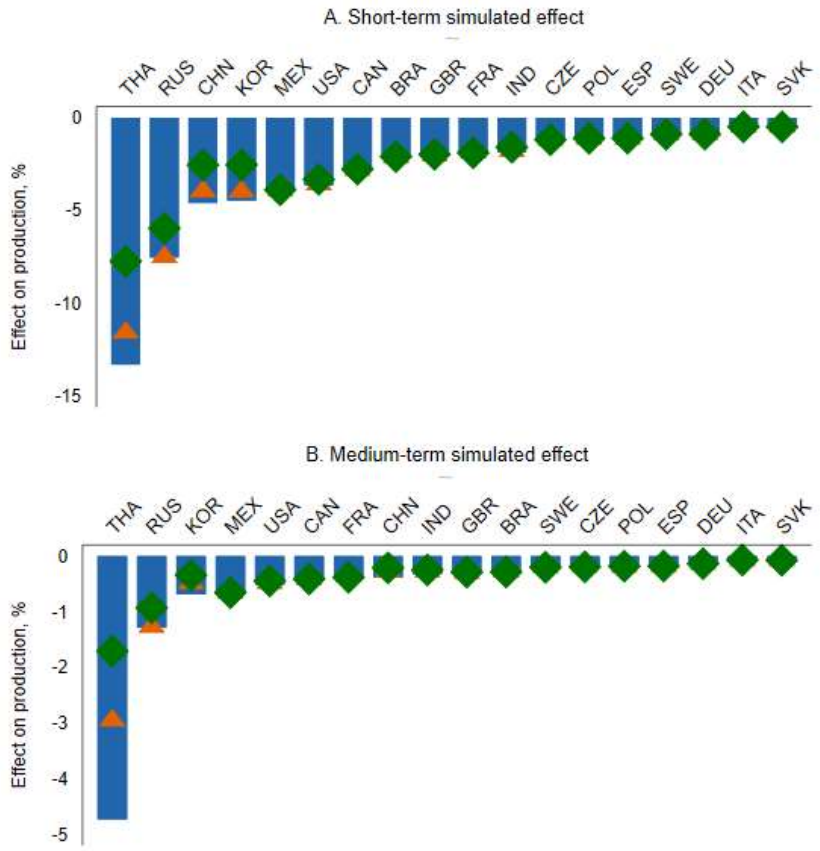


Reduce « top » product-level exposures

Set at a maximum for the supplier share in each product

1) Maximum level of exposure [Supplier share < 33%]

Counterfactual simulation: Diversification policies



Reduce « top » product-level exposures
Set at a maximum for the supplier share in each product

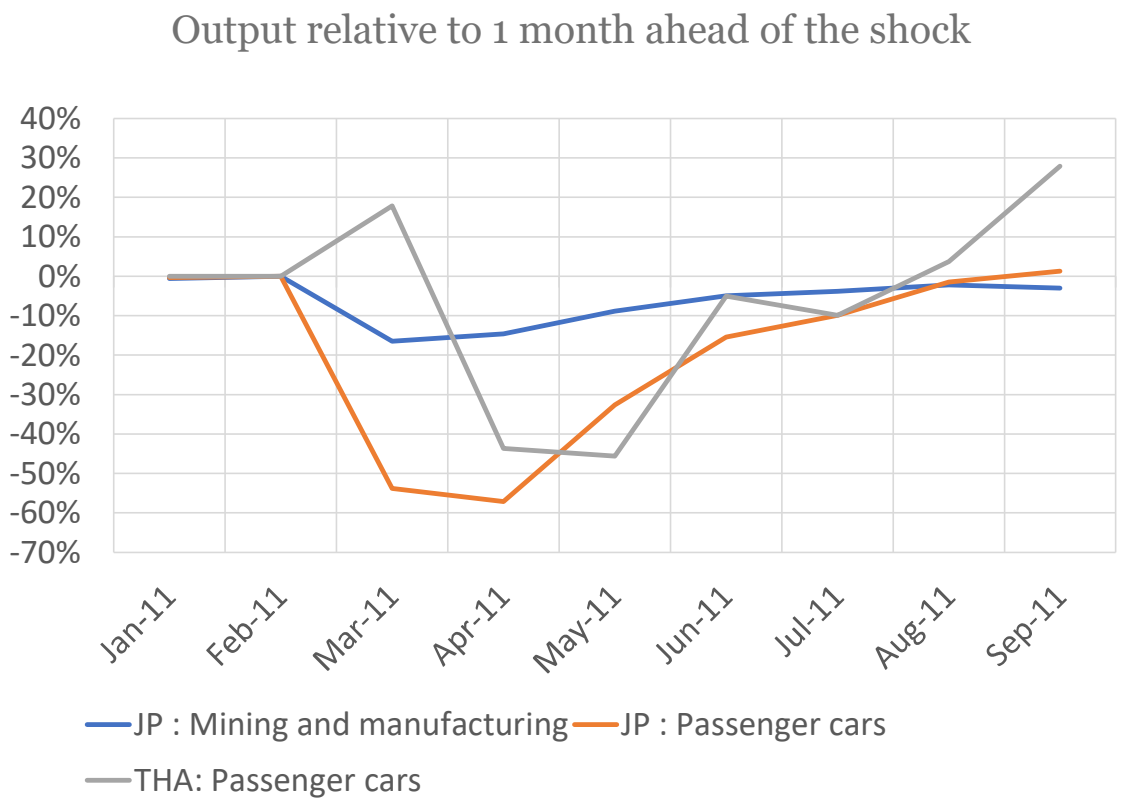
1) Maximum level of exposure [Supplier share < 33%]

2) Shift the « tail » of the supplier share distribution [Supplier share < top 75th percentile]

- **Complementarity between diversification and adaptation policies:** Diversification policies work more in the medium term when substitutability between potential suppliers is high

- **Non-linearity:** Diversification policies work more when the initial supplier share is not too high (e.g. scenario of shock on advanced tech products supplied by China)

Back to the data: Impact of the Tohoku earthquake in Japan (March 2011)



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3. POLICY IMPLICATIONS

What can policies do to make granular supply chains more resilient?

Policy trade-off:

- **Diversification** is costly and may hinder competitiveness
  - Higher costs due to the search and matching with additional suppliers
  - Difficulties inherent to the screening of quality, more complex logistics
  - Smaller suppliers are less efficient in sectors with increasing returns to scale
- **Re-shoring / friend-shoring policies** also involves competitiveness costs
  - e.g., it takes time to develop a new industry in a new supplying country
- Public policies need to concentrate their action on a **limited set of vulnerable supply chains**, which
  - Requires better mapping of granular supply chains **beyond direct suppliers**.
  - Building a **granular GVC stress-testing** tool to assess the impact of shocks in various ecosystems.
- **Adaptation policies** ex-ante increase the effectiveness of diversification policies and should be considered in combination

4. WAY FORWARD (work in progress)

- Using detailed IO tables

- accounting for specific events (e.g., Natural disasters)

Mapping and stress-testing GVC risks: The way forward

Ongoing work:

- Improving the **allocation of upstream products to downstream industries** (detailed IO tables, firm-level data)
- Accounting for the **indirect impact** of granular supply and downstream demand shocks
- Assessing the transmission of shocks based on **event studies** (e.g. natural disasters)

Thank you !

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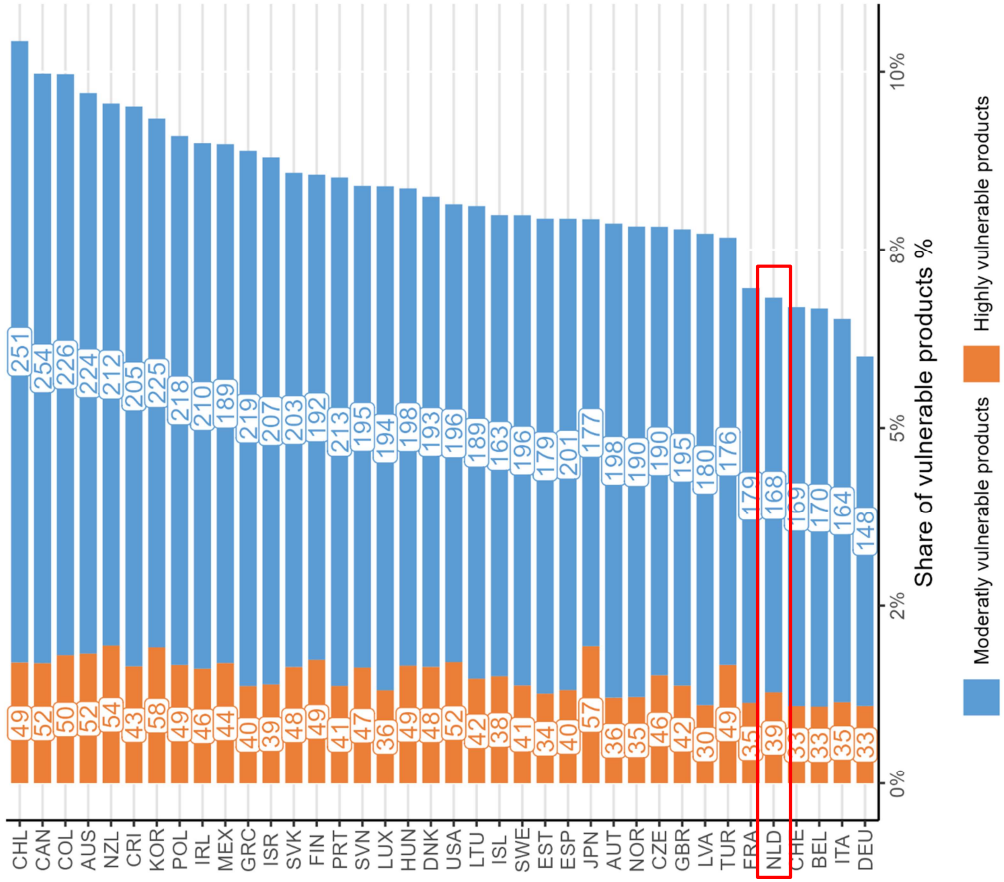
Share of vulnerable product among all intermediary products, 2019



Share of vulnerable products by supplier rank, 2019