

Risk in the Electronics Supply Chain from Soup to Nuts¹

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¹Prepared for presentation at the the “Resilience in Supply Chains” NBER conference, December, 2024. The views expressed here are not represented to be the views of the Federal Reserve Board of Governors. Please do not circulate these slides without consulting the author.

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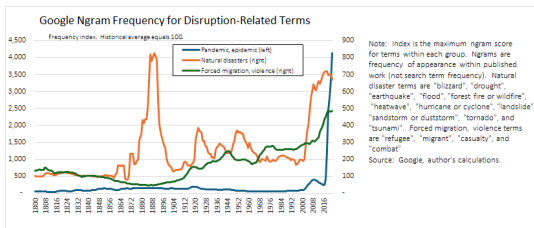
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Introduction: Motivation

Recent events have drawn attention to supply chain risk in the electronics sector

- COVID-19 pandemic
- Taiwan invasion threats
- Climate change

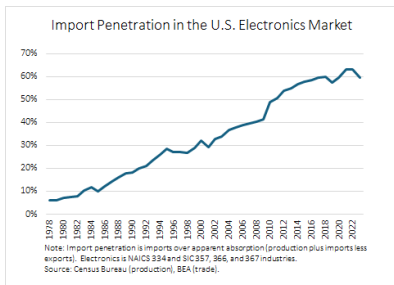


But are recent disruptions unusual?

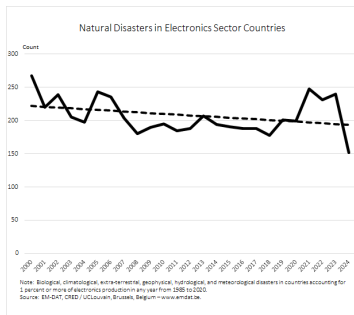
Year	Location	Type	Affected Activity
2024	N. Carolina	Flood	Quartz mining
2022	Ukraine	War	Neon production
2020	Global	Pandemic	Broad based
2011	Thailand	Flood	Hard drive production
2011	Japan	Tsunami	Chip production
2008	China	Earthquake	Chip testing
1999	Taiwan	Earthquake	Chip production
1989	California	Earthquake	Power generation

Introduction: Motivation (continued)

Global disasters increasingly relevant...



... but not more frequent?



To support quantitative work on

- Risk assessment
- Firm behavior
- Policy effects

We build disruption indexes from 2000 forward

- Based on event history
- Economy-level value-added weights
- By stage of production

For these types:

- Natural disaster
- Governance
- Industrial accident
- Transport

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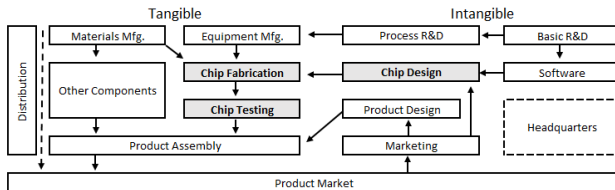
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Sector Description: Component Industries

Fig. 1: Industry Flow



Source: Byrne and Green (2023).

Note: Headquarters includes functions such as strategy, policy, marketing, back office, communications, and finance.

Sector Description: Drivers of Dispersion

Varying factor intensity
(and incomplete factor markets)

Labor intensive

- Chip testing
- Product assembly

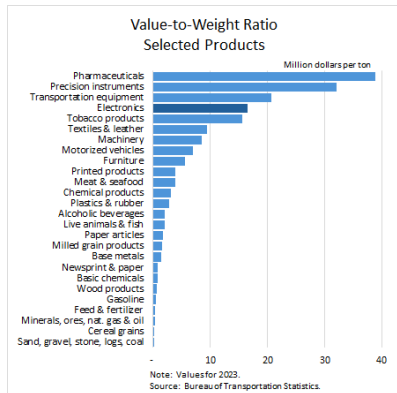
Tangibles intensive

- Equipment manufacturing
- Chip fabrication

Intangibles intensive

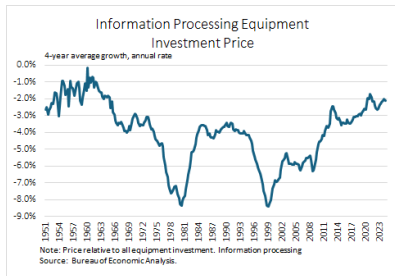
- Software
- Design

High value to weight ratio lowers the
(quality-adjusted) cost of dispersion



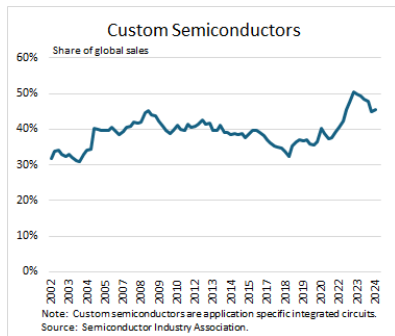
Sector Description: Drivers of (Low) Supply Elasticity

Electronics depreciate rapidly. Firms keep plant utilization high and inventory low ...



... and a new chip plant is \$10-30 billion.

Contractors commit to producing custom chips well in advance. Adjusting the mix of output is time-consuming and costly.



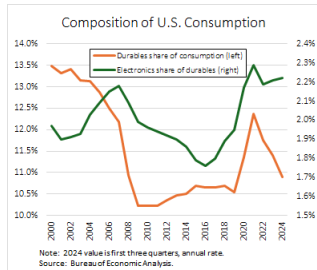
COVID-19 Pandemic: Simultaneous Shocks

Supply shock

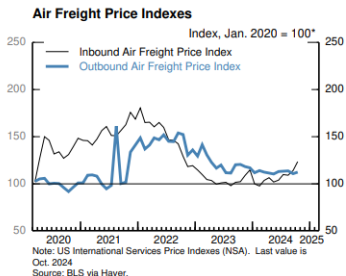
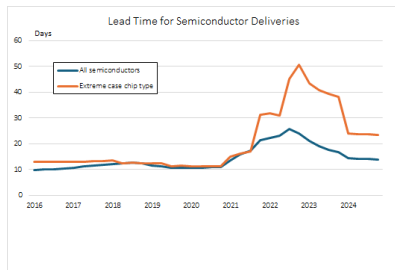
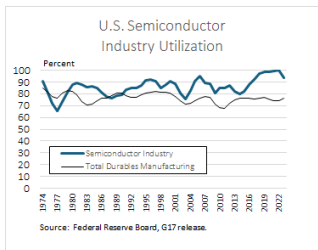
- Labor for product assembly and chip testing (lockdowns, illness)
- Reduced air cargo capacity (fewer passenger flights)
- Drought in Taiwan; winter storms in Texas; fires in Japan

Demand shock

Shift to durable goods and within goods to electronics.



COVID-19 Pandemic: Shock Effects



Global capacity increase of roughly 20 percent begins slowly coming on line in 2023.

Passenger travel returns.

Ongoing massive mix shift toward vehicle electronics is *anticipated*, so it doesn't have the same effect as the pandemic mix shift.

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Risks: Data Sources

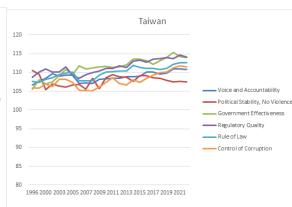
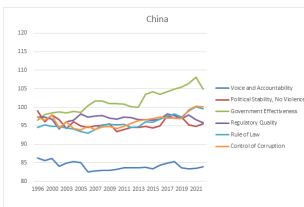
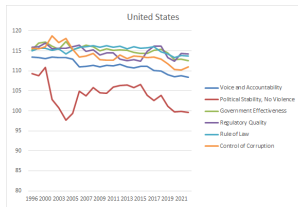
Disasters: EM-DAT

- Disasters: have unexpected and overwhelming harmful impact on human beings. (10 fatalities, 100 people affected, state of emergency, or international assistance)
- **Natural:** cyclone, flood, earthquake, disease, drought
- **Industrial:** fire, explosion
- **Transportation:** accidents
- Consistent from 2000 forward
- Centre for Research on the Epidemiology of Disasters, UC Louvain, Belgium.
- Sourced from UN agencies, NGOs, insurance companies, research institutes, and press agencies

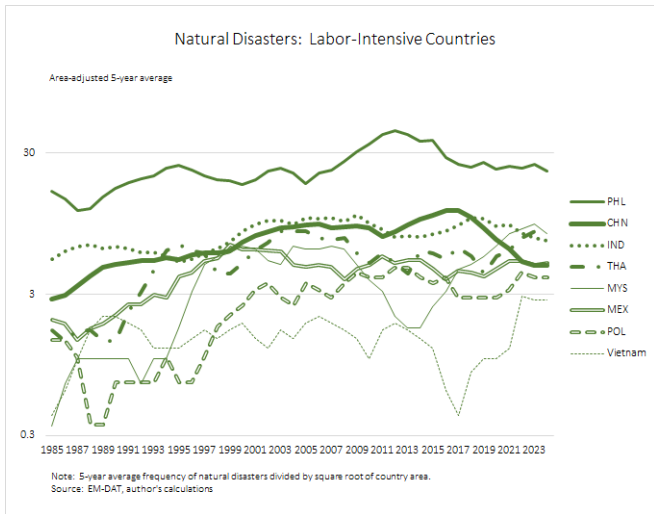
Political instability: Worldwide Governance Indicators

- Based on data from NGOs, think tanks, international organizations, private firms
- 6 component indicators: voice and accountability, political stability and absence of violence/terrorism, government effectiveness, regulatory quality, rule of law, control of corruption
- No aggregate. We use geometric mean
- 1996 forward
- World Bank Group

Fig. 2: WGI for Selected Economies



Risks: Natural Disaster



Risks: Value-Added Weights

Final Electronics Assembly

Economy	2000	2005	2010	2015	2020
China	6.4	22.1	34.2	44.6	44.7
United States	29.3	20.3	15.5	14.5	14.8
Japan	15.9	10.6	8.7	4.2	4.3
Germany	4.4	5.3	3.7	3.4	3.1
South Korea	4.0	5.4	4.0	3.4	2.6
France	3.1	2.6	1.8	1.5	1.5
United Kingdom	4.7	2.7	1.5	1.5	1.2
Memo:					
Other countries	32.2	31.0	30.6	26.9	27.8
HHI	1,276	1,130	1,571	2,286	2,305

Risks: Value-Added Weights (Continued)

- Completed: final electronics assembly, chip production, other component production
- Under construction: mining, mineral processing, raw wafer production, chip testing, chip fabrication & testing equipment manufacturing
- Future work: intangibles (R&D, software, design)

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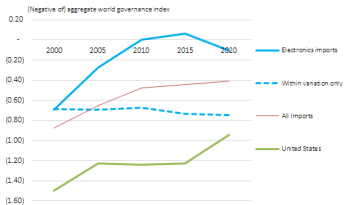
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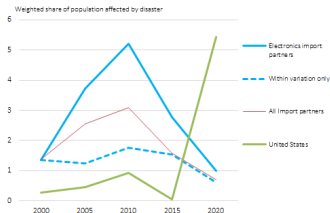
Results: Trading-partner-weighted

Political Instability



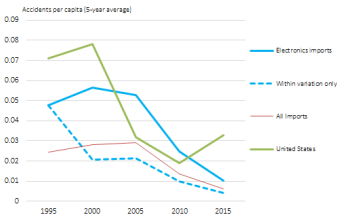
Note: Country indexes (geometric mean of country component indexes) aggregated by import shares.
 Within only index holds import shares constant at 1995 value.
 Source: World Bank (world governance index); Census Bureau; author's calculations.

Natural Disaster



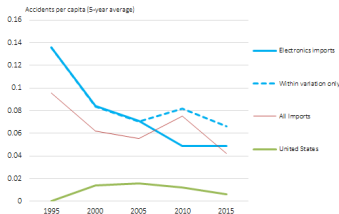
Note: Country indexes (5-year average share of population affected) aggregated by import shares.
 Within only index holds import shares constant at 1995 value.
 Source: Center for Research on the Epidemiology of Disasters; Census Bureau; author's calculations.

Industrial Accident



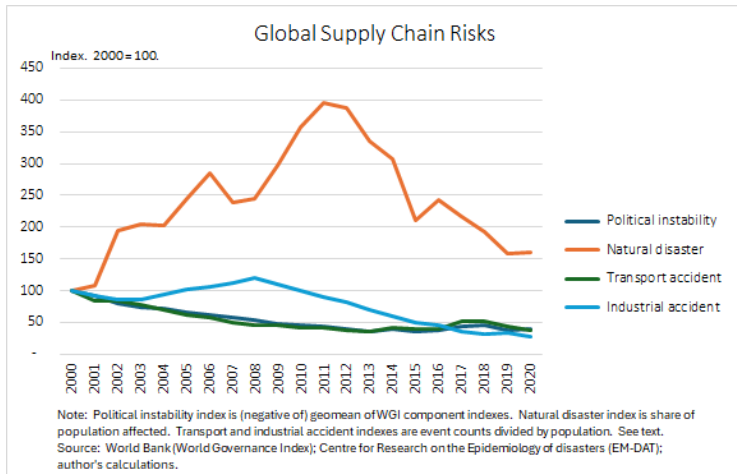
Note: Country indexes (accidents per capita) aggregated by import shares.
 Within only index holds import shares constant at 1995 value.
 Source: World Bank (world governance index); Census Bureau; author's calculations.

Transport Accident

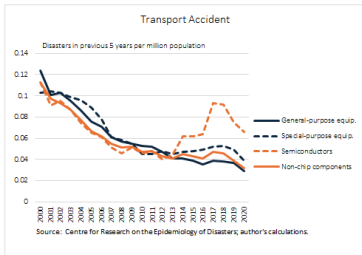
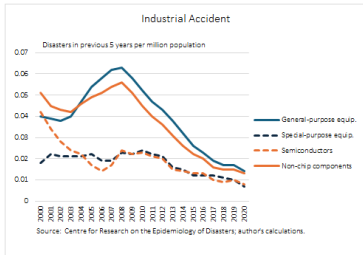
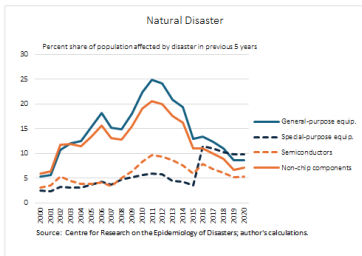
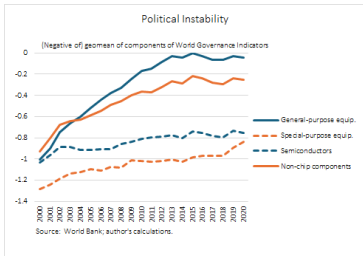


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Results: Country-weighted



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Very interested in comments!