

# The role of global supply chains in the transmission of weather induced production shocks

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## Motivation

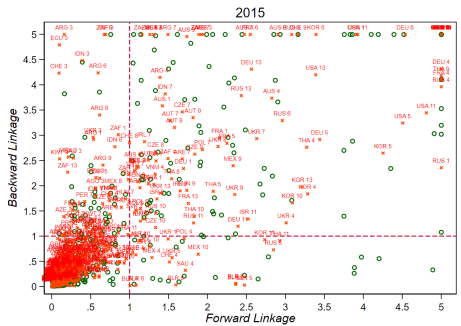
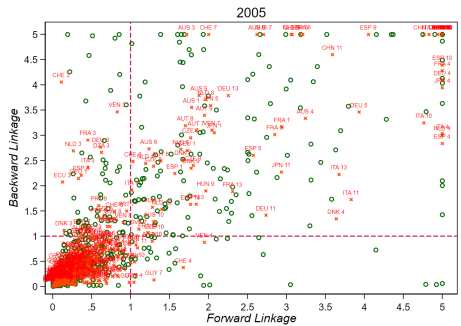
- Economies today are organized in fine interwoven networks of production units (Carvalho 2014).
- Idiosyncratic shocks, which are triggered for example by natural disasters, can be widely dispersed in the economy through inter-industry linkages.
  - 2011 flood in Thailand → doubling of global hard-disk prices (Livermann 2016).
  - 2011 Tōhoku Earthquake in Japan → large, significant impacts on the US manufacturing industry (Barrot & Sauvagnat 2016, Boehm et al. 2019).
  - More recent examples: 2019 Corona Pandemic; Feb 2021 North American Cold Wave (Texas).
- The extend of this effect depends on the in- and outdegree distribution in the production network, i.e. the degree of connectivity between the production units.

## Overview research strategy

- 1 Classify each country's sector according to its degree of spatial connectivity.
  - 1990-2015; 172 countries; 12 sectors.
- 2 Create a time series of extreme weather events for each country.
  - historic; future (2100) 5 global circulation models and two emission scenarios of climate futures.
- 3 Create 2 measures of supplier concentration based on the full network structure.
- 4 Combine this data in an econometric model which regresses supply chain shocks on sectoral export performance.
- 5 Project future exposure to supply chain shocks taking climate change induced changes in the occurrence of natural disasters into account.

# Descriptive evidence

## Sectoral forward and backward linkages and disaster shocks (2005 and 2015)



## Results I: historic impacts

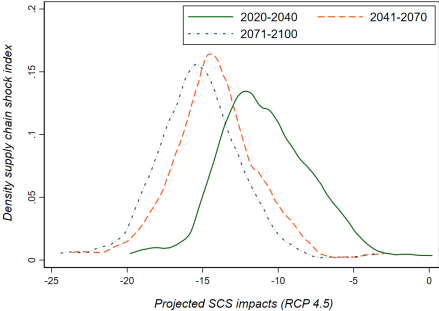
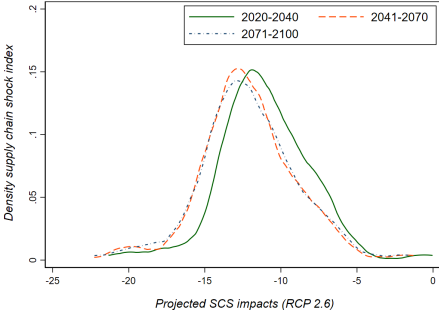
- Supply chain disruptions, caused by large natural disasters abroad, significantly reduces a sector's export value.
  - A one percent increase in our supply chain shock measure reduces a sector's export value by around 0.3 percent.
  - A one standard deviation increase in our supply chain shock measure reduces a sector's export value by around 11 percent.
- Negative effect is mainly driven by the manufacturing sector.

## Results II: historic impacts

- A large number of input suppliers can serve as a layer of protection as it enables firms to more easily find substitutes for suppliers affected by a disruption.
  - Extensive margin measure → number of suppliers.
  - Intensive margin measure → concentration in the supply market.
- Large concentration in the supply markets leads to an increased adverse effect of supply chain shocks.
- Our results suggest that it is the availability of large suppliers that matters.
- Low-income and lower-middle income countries are in particularly negative affected by supplier concentration and by supply chain shocks.
  - No difference in the mediating role of supplier concentration compared to higher income groups.

# Results III: Future projections (Frequencies)

Distribution of projected SCS impacts for three different time periods.



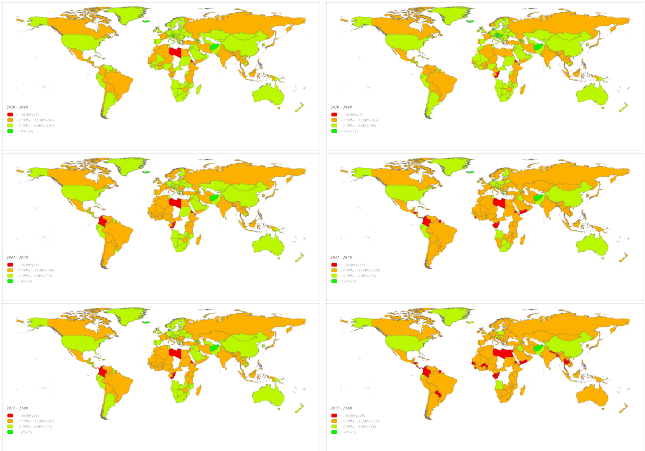
## Results V: Country specific impact (EU countries)

	2020-2040		2041-2070		2071-2100	
	RCP 2.6	RCP 4.5	RCP 2.6	RCP 4.5	RCP 2.6	RCP 4.5
Austria	-5.79	-5.85	-6.63	-10.27	-7.09	-11.81
Belgium	-7.43	-5.74	-7.58	-10.61	-6.85	-11.60
Bulgaria	-10.40	-10.29	-12.67	-14.5	-13.29	-16.76
Croatia	-13.27	-10.90	-12.02	-14.98	-12.55	-17.58
Cyprus	-11.52	-9.15	-12.69	-12.76	-12.38	-14.78
Czech Rep.	-8.92	-5.24	-7.30	-9.03	-7.05	-12.08
Denmark	-8.19	-4.65	-6.10	-8.03	-5.00	-9.61
Estonia	-7.94	-8.01	-9.48	-11.03	-8.75	-13.50
Finland	-10.24	-10.51	-11.23	-11.98	-10.36	-15.01
France	-13.11	-12.41	-13.43	-14.75	-12.11	-15.75
Germany	-7.23	-6.86	-7.96	-9.36	-6.59	-12.34
Greece	-7.97	-7.25	-9.98	-11.89	-9.48	-13.33
Hungary	-6.25	-5.60	-6.84	-9.08	-7.94	-11.40
Ireland	-9.29	-7.26	-9.08	-11.31	-9.84	-12.77
Italy	-11.86	-9.64	-12.50	-14.22	-12.04	-15.14
Latvia	-11.15	-8.91	-12.53	-13.57	-11.05	-13.87
Lithuania	-9.89	-7.80	-10.55	-12.14	-9.23	-13.24
Luxembourg	-9.57	-6.38	-9.68	-11.29	-7.78	-11.73
Malta	-11.53	-11.89	-13.25	-14.25	-13.31	-16.63
Netherlands	-11.38	-12.04	-14.08	-15.04	-12.85	-16.30
Poland	-10.61	-6.03	-8.24	-9.92	-7.75	-10.44
Portugal	-10.49	-12.10	-11.87	-14.78	-10.95	-16.23
Romania	-11.04	-9.88	-12.11	-13.74	-13.03	-16.05
Slovakia	-9.39	-7.31	-8.96	-10.34	-8.42	-13.08
Slovenia	-5.45	-4.53	-6.00	-10.18	-6.54	-12.10
Spain	-11.53	-11.81	-14.72	-14.53	-11.96	-16.31
Sweden	-10.92	-10.72	-12.04	-13.86	-10.79	-15.09
UK	-10.98	-11.05	-12.52	-13.65	-11.65	-14.93

Notes: Predictions of impacts are based on the mean of all five global circulation models considered.



# Projections: Country specific impact



Predicted export change (mean over 5 global circulation models) - left panel (RCP 2.6); right panel (RCP 4.5)

## Conclusion

- The production of a final good in a country is based on numerous input-output interlinkages domestically as well as increasingly internationally.
- Disturbances in one country can be propagated over the supply chain leading indirectly to a change in other countries' macroeconomic outcomes.
- This paper gives evidence that these shocks leads to large negative effects on a sectors export activity today as well as in future.
- We show that some countries, which are regularly hit by natural disasters, are also strongly interdependent in global production networks.

## Conclusion

- Firms and industries need to be made aware of the potential risk of supply chain disruptions.
- Geographical diversification as a (limited) adaptation choice.
- Storage facilities as adaptation options (trade off between storage costs and just in time production).

**Thank you!**

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### Discussion Question

*How do you see the increasing internalization of input sourcing regarding the supply chain risk of (European) industries?*