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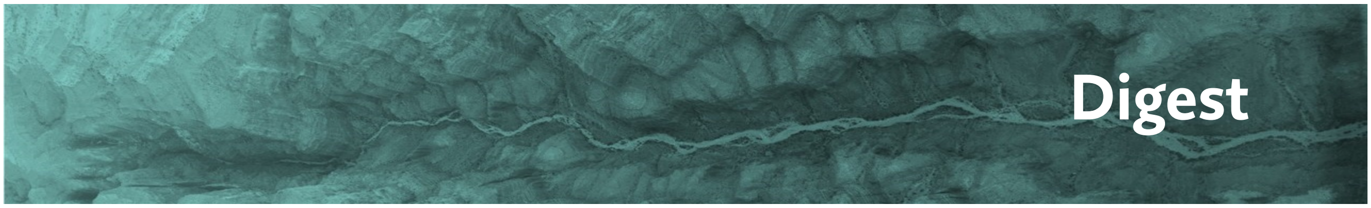

Quantifying trade-related transboundary climate risks

May 2023

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Climate change impacts are unevenly distributed. International trade can spill-over physical damages from one region to trading partner countries that are domestically less affected. While the body of literature acknowledging this propagation channel has been growing steadily, quantifications, particularly for future risks, are still rare and incomplete. There is broad consensus that ignoring spill-over effects substantially underestimates national-scale risk assessments.

Nina Knittel et al. (2020), in "A global analysis of heat-related labour productivity losses under climate change—implications for Germany's foreign trade," assess the macroeconomic consequences of spill-over effects for global heat-related labor productivity loss using a computable general equilibrium (CGE) model. By 2050 and under the highest emission scenario (RCP8.5), global labor productivity losses decrease Germany's imports from regions outside Europe by around 2.5%, partly compensated by imports from within Europe. Exports to regions outside Europe are lower too, but total exports can slightly increase due to higher exports to the EU. Germany's GDP shrinks by up to – 0.4%, highlighting that positive trade effects constitute a comparative improvement rather than an absolute gain under climate change. In a recent application for Austria, some of the same authors also consider damages from sea level rise and changes in agricultural yields.

Johanna Hedlund et al. (2022), in "Impacts of Climate Change on Global Food Trade Networks," examine how climate-induced changes to yields of wheat, rice, and maize affect global food trade networks by the end of the century in a simple network model. Results suggest that maize trade is the least stable under climate change impacts. Whether this is a threat to global food security depends on the production changes of major international producers and the ability of trade communities to balance production and import loss in vulnerable countries.

Sven Norman Willner et al. (2018), in "Global Economic Response to River Floods," show that indirect losses through trade can exceed direct losses from fluvial floods by a multiple. Regionally differentiated risk profiles lead to heterogeneity across direct and indirect losses and gains. Numerical results suggest that China faces the highest direct losses, while the United States is mostly indirectly affected. Without large-scale structural adaptation, the total economic losses from fluvial floods will globally increase by 17% over the next 20 years.

Elco Koks et al. (2019), in "The Macroeconomic Impacts of Future River Flooding in Europe," They consider the mitigating role of trade relations for three scenarios (1,5°, 2°, and 3°C) and take a closer look at sectoral differences. They find that up to 60% of indirect losses can be offset by finding alternative suppliers and markets. Yet, economic flood losses are expected to increase across scenarios. Indirect losses will rise by 65% compared to direct asset damages. Across sectors, commercial services and public utilities are expected to be most affected.

While these studies particularly consider the transmission of climate risks along trade pathways, there are several other channels that allow risks to cross borders.

"A Conceptual Framework for Cross-Border Impacts of Climate Change," is provided by **Timothy R. Carter et al.** (2021). They distinguish climate triggers, categories of impacts, scales, and dynamics of impact transmission, targets and dynamics of responses, and the socio-economic and environmental context. The framework is applied to the floods in Thailand in 2011 and the projected Arctic Sea ice decline, demonstrating its usefulness for capturing complex system dynamics and identifying adaptation strategies in the wider context of resilience planning.

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