

# Climate shocks and the divergence of global trade gains

Topic: Input-Output Modelling: Trade and Global Value Chains policies (5)

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**Short abstract:** The propagation of climate shocks through international trade has attracted attention. This study examines the impact of geographically limited climate shocks on transnational economic inequality through global trade. The findings indicate that heat exposure reduces the growth of economic value added in domestic production, traditional trade, simple global value chains (GVCs) and complex GVCs, leading to trade deficits, but only in poor countries. We provide suggestive evidence that the mechanism behind these effects are declining comparative advantage, reduced labor income, and more severe damage to electricity infrastructure in poor nations. As global warming intensifies, a deeper exploration of amplification effects in cross-border trade linkages could provide valuable insights into mitigating the unequal impacts of climate change.

(1) The research question. As global warming and trade integration deepens, climate shocks propagate physical risks through the channel of international trade. While these shocks are known to disproportionately affect low-income countries and individuals, their role in widening development disparities by eroding the gains from trade is not yet well understood. To explore how climate shocks reshape this geographic divergence, we examine the consequences of heat exposure for global economic inequality.

(2) The method. We begin with a theoretical model that describes how climate shocks affect a country's productivity, and how these effects are transmitted along the value chain through input-output linkages in trade, ultimately impacting a country's trade welfare. To further empirically test these issues, we focus on examining the unequal economic losses induced by climate shocks within the global production and trade networks. First, we decompose the disproportionate economic impacts of heat exposure into four distinct components: domestic production, traditional trade, simple global value chains (GVCs), and complex GVCs. This decomposition reveals how climate shocks erode trade-related growth in poor nations relative to rich ones, thereby deepening existing development disparities. Second, we focus on the cooperation and trade benefits between a country and its upstream and downstream trading partners. By tracing these cross-border economic activities, we quantify the impact of heat exposure on the disruption of cooperation among key trading partners and assess the extent to which these climate shocks exacerbate trade imbalances. Subsequently, we identify the underlying mechanisms by estimating the impact of temperatures on comparative advantage and labor income at the country-sector level, alongside its effects on the quality of critical electricity and communication infrastructure.

(3) Data. To further empirically test these issues, we use three datasets. First, we utilize dynamic production and trade network data for 175 countries and 26 sectors globally from 1990 to 2022, provided by the Eora Global Supply Chain database. Second, meteorological data comes from the European Centre for Medium-Range Weather Forecasts (ECMWF) Reanalysis v5 (ERA5), which offers global daily temperature and precipitation at a resolution of  $0.1^\circ$ — $0.1^\circ$ . Finally, we use geographical information, including latitude, elevation, distance to the coast, distance to navigable rivers, and standard deviation of elevation within a country, from the GEcon Yale dataset for each country. To conduct causal identification, we design a spatial-geographic fixed effect that makes the temperature changes exogenous to the country's poverty status (Hsiang, 2019).

(4) The novelty of the research. Utilizing a granular, global country-sector dataset, this study offers the first systematic evidence on how climate shocks redistribute comparative advantage across a diverse range of economic sectors. Our findings contribute to the literature on the economic impacts

of climate change and inequality. Studies in the field of climate economics have not examined whether the unequal economic impacts are caused by exogenous temperature fluctuations. Our study directly contributes to this literature by designing a spatial-geographic fixed effect to ensure the exogeneity of temperature changes and poverty status. We consider three key factors that influence cross-country temperature differences—latitude, elevation, and distance to the coast—to define spatial geographical zones. Specifically, we create 36 climate zones by interacting nine latitude groups (each 10° absolute latitude a bin) and four elevation groups (<200m, 200-400, 400-600, 600+ km above sea level). This grouping ensures that temperature changes for countries within the same geographical space (defined by the interaction of latitude, elevation, and distance to the coastline) are exogenous and unrelated to their poverty status.