10 Policy brief
May 2024

CHAIR
EDMOND DE ROTHSCHILD
PARIS SCHOOL OF ECONOMICS
ÉCOLE D'ÉCONOMIE DE PARIS
International Migration Economics

By
Klaus Desmet

Adapting to Climate Change: Moving Goods or Moving People?*

Rising temperatures are hurting some regions of the world more than others, and not all economic sectors are equally vulnerable to global warming. As climate change shifts patterns of absolute and comparative advantage across the globe, people can adapt by switching to less hard-hit sectors or by moving to less hard-hit regions. Liberalizing trade stems the flow of climate migrants, but also keeps more people trapped in vulnerable places.

The impact of rising temperatures depends on where you are: sub-Saharan Africa is poised to suffer large losses, while southern Canada might experience modest gains. It also depends on what you do: a farmer's crop yields are highly sensitive to temperature, whereas a service worker's productivity is less closely tied to climatic conditions. As such, climate change can be thought of as a shock to the geography of comparative advantage (Costinot, Donaldson and Smith, 2016). By facilitating local adaptation through shifts in specialization, trade may be a powerful tool for mitigating the impact of global warming. Regions facing falling agricultural yields can transition to less vulnerable sectors and import their food instead (Desmet and Rossi-Hansberg, 2015).

Of course, shifting away from farming may not be as beneficial if the rest of the economy suffers from low productivity. And if trade is too costly, goods have to be sourced locally, limiting the scope of specialization. If the capacity of trade to mitigate the impact of climate change is limited, we might witness a rise in migration. This hints at trade and migration acting as substitutes: make trade cheaper and less people will show up on the developed world's shores. As the rest of this policy brief will argue, this substitutability comes with a caveat: by reducing the flow of climate migrants, freer trade also keeps more people trapped in less productive areas, potentially affecting global welfare negatively.

To assess the roles of trade, specialization and migration in adapting to climate change, in Conte, Desmet, Nagy and Rossi-Hansberg (2021) we develop a dynamic spatial integrated assessment model (S-IAM) with costly trade and migration. The model considers both the impact of temperature on productivity and the influence of production on carbon emissions and global warming. We partition the world into 64,000 one-degree-by-one-

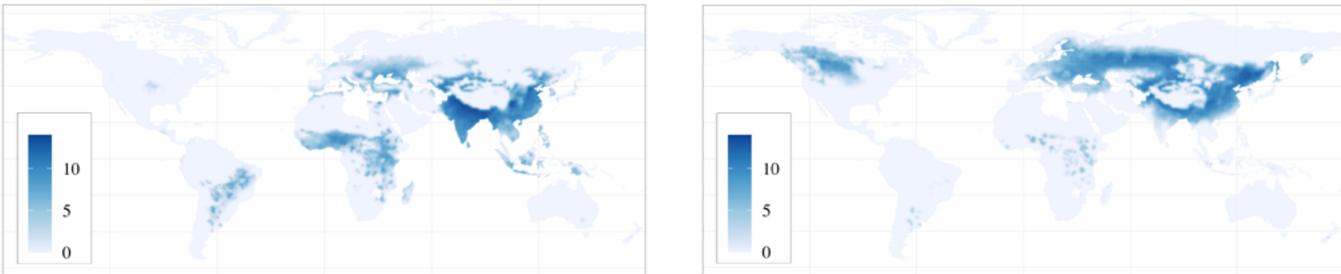
*This policy brief draws largely on VoxEU column "Trade to adapt: Changing specialisation to cope with climate change" by the same authors, published on May, 4th 2021. It is a joint publication of the PSE International Migration Chair and the Crossing Borders Program at LISER.

degree cells (approximately equal to 100 km by 100 km at the Equator), and simulate the model forward for 200 years. Our simulation is based on a rather pessimistic scenario of fossil-fuel-intensive growth, consistent with a projected 3.7 °C increase in global temperature by the end of the 21st century. This aligns with Representative Concentration Pathway 8.5, a scenario used by the Intergovernmental Panel on Climate Change (IPCC).

Changing patterns of specialization

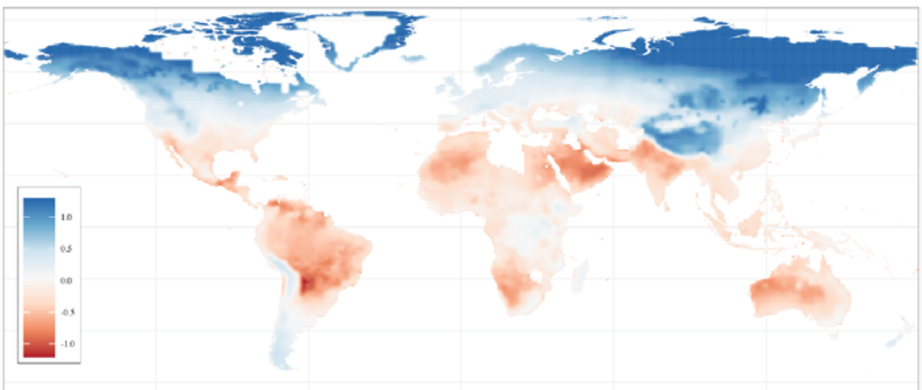
The model predicts that global warming dramatically alters the geographic distribution of agricultural production across the globe. Without climate change, by the year 2200, South America, sub-Saharan Africa, India, eastern China and eastern Europe would become the world's primary breadbaskets. In contrast, with global warming, Canada, Russia and Central Asia become prominent agricultural producers. Today they still face a large productivity penalty due to their cold temperatures. As the globe warms up, they emerge as major players in agriculture *(Figure 1)*.

Figure 1.
Agricultural output in the year 2200 without climate change (left) and with climate change (right). The numerical scale is in logs.



As equatorial regions become inhospitable to agriculture, they transition into other activities and increasingly rely on food imports. While trade helps alleviate some of the adverse effects of temperature increases, these regions still fall behind. Limited productivity in other sectors constrains their adaptive capacity. As a result, equatorial regions experience a rise in outmigration towards the world's more temperate zones *(Figure 2)*. Given the higher productivity in northern latitudes, a greater proportion of the global population ends up residing in the world's most advanced economies.

Figure 2.
The map depicts the climate-induced log difference in population in the year 2200. More specifically, it shows log (population in 2200, with climate change) minus log (population in 2200, without climate change).

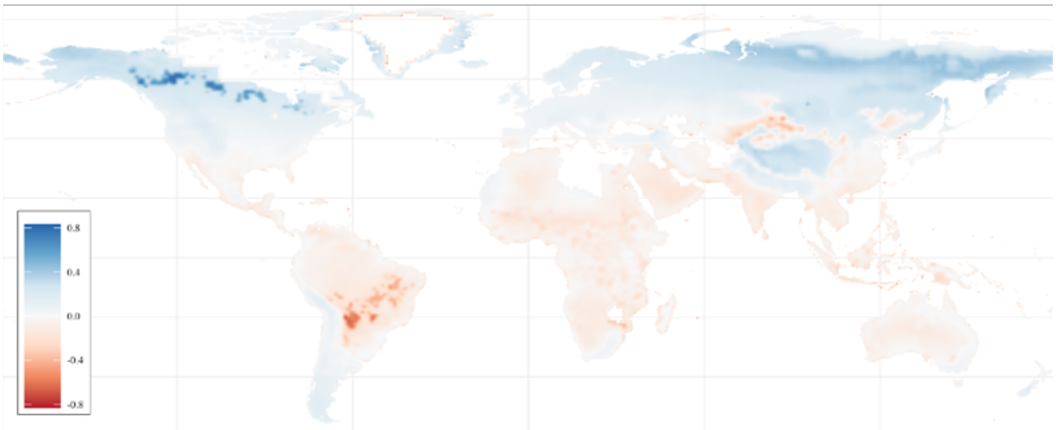


Are trade and migration substitutes in responding to climate shocks?

What would happen if we increase trade costs? In that case, climate change would prompt increased relocation from regions close to the Equator to more northern latitudes *(Figure 3)*. This is consistent with the notion that trade and migration act as substitutes in their response to climate change. The rationale is straightforward: if the scope of trade to act as an adjustment mechanism is hampered because of higher costs, migration becomes a more appealing alternative. That is, if people in sub-Saharan Africa and Latin America cannot easily transition to other sectors because food needs be produced locally due to costly trade, then climate change will incentivize them to migrate.

Figure 3.

Climate-induced log difference in population with trade costs 50% higher minus climate-induced log difference in population with trade costs 50% lower than baseline (year 2200). Blue regions receive more climate migrants (and red regions send out more climate migrants) when trade costs are higher.



Although trade and migration act as substitutes, they are not perfect substitutes. This becomes evident when considering their impact on climate-induced losses in global real GDP per capita. In this context, an increase in trade costs generates two opposing effects. On the one hand, it constrains the ability to locally adapt to higher temperatures by changing sectoral specialization. This exacerbates the losses from global warming. On the other hand, higher trade costs incentivize people to relocate to temperate zones less affected by climate change. Given that these regions are typically highly developed, this helps alleviate the losses from global warming. Our model predicts that over the next two centuries the latter effect outweighs the former. In other words, the increased push factor associated with costly trade leads to more people residing in the world's most productive regions, mitigating the global income losses from climate change.[1]

To enhance our understanding of this result, consider a reduction in trade costs instead of an increase. Our findings imply that trade liberalization facilitates local adaptation, yet it also traps more people in the low-productivity regions of the world. Overall, this leads to worse outcomes in terms of global income per capita. This suggests that any policy leading to lower migration flows may be harmful. This is perhaps unsurprising: given the large productivity differences across the globe, migration is bound to be a powerful mechanism to alleviate the negative impact of global warming (Burzyński *et al.*, 2022; Cruz and Rossi-Hansberg, 2023).

[1] After 300 years, the model projects a reversal, so that higher trade costs lead to larger climate-induced losses in GDP per capita.

References

Burzyński M., Deuster C., Docquier F. & de Melo J., 2022, "Climate Change, Inequality, and Human Migration", *Journal of the European Economic Association*, 20(3): 1145–1197.

Conte B., Desmet K., Nagy D.K. & Rossi-Hansberg E., 2021, "Local Sectoral Specialization in a Warming World", *Journal of Economic Geography*, 21(4): 493-530.

Costinot A., Donaldson D. & Smith C., 2016, "Evolving Comparative Advantage and the Impact of Climate Change in Agricultural Markets: Evidence from 1.7 Million Fields around the World", *Journal of Political Economy*, 124(1): 205-248.

Cruz J-L. & Rossi-Hansberg E., 2023, "The Economic Geography of Global Warming", *Review of Economic Studies*.

Desmet K. & Rossi-Hansberg E., 2015, "On the Spatial Economic Impact of Global Warming", *Journal of Urban Economics*, 88(C): 16-37.

✦ **Klaus Desmet** is professor of Economics at the Southern Methodist University in Dallas, Texas.