

On the economic geography of climate change

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Abstract

Climate change is a defining challenge of our times. The five papers collected in this special issue provide foundations to well-informed policymaking by addressing two main themes of the economic geography of climate change. First, it brings effects that are heterogeneous across space. Some regions of the globe will lose more than others and some may even be better off as a result. Second, humans will have to adapt in order to survive. We emphasize how the lack of mobility could contribute to worsening the socioeconomic costs of climate change. This issue also considers alternative margins of adjustment, such as fertility, specialization and trade.

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1. Introduction

The planet is likely to be at least 3°C warmer in 2100 than at the time of writing even if immediate and radical action is undertaken (Tollefson, 2020). Climate change is thus a defining challenge of our times (the loss of biodiversity is just as pressing). The scenarios issued by the Intergovernmental Panel on Climate Change (IPCC) provide sophisticated modeling of the complex interactions between human activity and climate. Yet, their modeling of heterogeneous spatial effects and of the multiple margins affected by this phenomenon remain rather simplistic (Cruz and Rossi-Hansberg, 2021). The five papers collected in this Special Issue of the Journal of Economic Geography (JoEG) contribute to filling this gap and they address important aspects of two main themes of the economic geography of climate change.¹ First, climate change brings effects that are heterogeneous across space. Some regions of the globe will lose more than others and some may even be better off as a result. Such analysis allows us to identify winners and losers and it is crucial in thinking of policies that may redistribute, correct or compensate those populations who are predicted to undergo large losses. Several papers in this special issue document this heterogeneity at a fine spatial scale. Second, humans (and other species) will have to adapt in order to survive. Margins of actions to slow down climate change include making consumption habits and production processes less carbon- and methane-intensive. However, there are also adjustments to the potential consequences of climate change. Several papers in this special issue emphasize adaptation via migration and geographic mobility. In

1 Yohe and Schlesinger's (2002) earlier paper in this Journal also addresses both themes.

particular, as mobility may attenuate negative economic effects, or act to reduce the risks of increased social pressure or local conflict, the papers emphasize how lack of mobility could contribute to worsening the socioeconomic costs of climate change. The insights provided by the papers should be used as the foundation of well-informed and solid policymaking, which will be needed in the economic and social transitions needed to cope with climate change.

The paper by [Conte et al. \(2021\)](#), henceforth CDNRH, speaks to both themes outlined above and we organize the current introductory remarks around their work. These authors introduce a quantitative dynamic spatial growth model featuring, as in the pioneering work of [Nordhaus \(1993\)](#), the two-way relationships among economic activity, carbon emissions and temperatures. Importantly, the analysis allows for two sectors, agriculture and nonagriculture, which are heterogeneously sensitive to temperature, and for a very fine spatial disaggregation: the authors feed their model with data on population, temperature and sectoral output at the $1^\circ \times 1^\circ$ resolution for the whole world, and with increases in the carbon stock and global temperatures that follow the IPCC scenario known as Representative Concentration Pathway 8.5. With the model thus calibrated, they let it run forward for 200 years to quantify the spatially heterogeneous effects of climate change on population, Gross Domestic Product (GDP) per capita and in the production mix of agriculture and nonagriculture outputs. They also stress the roles of trade and migration in mitigating or amplifying the losses induced by climate changes for each $1^\circ \times 1^\circ$ spatial unit. Let us start by outlining some important heterogeneous spatial effects of climate change suggested by that paper and by others in the volume.

2. Heterogeneous spatial effects of climate change

The initial scenario in CDNRH assumes that frictions to mobility of populations and of goods are constant over time. Their model then predicts very heterogeneous spatial effects. In particular, Scandinavia, Finland, Siberia and northern Canada gain populations and see increases in income per capita, while North Africa, the Arabian Peninsula, northern India, Brazil and Central America lose on both counts. Agriculture becomes spatially more contracted and shifts toward Central Asia, China and Canada. These scenarios imply substantial mobility of populations within and across countries, especially if trade is costly. How much of the cross-country migration will take place will crucially depend on policies regulating its costs and therefore impediments to mobility may produce substantially less efficient transitions.

The paper by [Castells-Quitana et al. \(2021\)](#) complements this work in two ways. First, it offers a retrospective regression analysis, to quantify effects of past climate change on rural–urban migrations, whereas the CDNRH paper is mainly an exercise in forecasting. Second, it studies the relationship between the evolution of rainfalls and temperatures on the urbanization rates of countries and on the structure of large cities over a long period of time, 1950–2015. Importantly, they allow for heterogeneous effects among low-, middle- and high-income countries and they study the effects on the whole urban structure of countries, including urban hierarchy (between cities) as well as urban size, density and form. They find that worsening climate conditions (higher temperatures of lower rainfalls) are associated with higher urbanization rates in countries with unfavorable climate initial conditions, and that these effects are especially strong in developing countries and affect density and growth of cities of all dimensions including the largest metropolitan areas.

Another important aspect, complementary to the economic effect of climate change, is its effect on local social tensions and conflicts. The paper by [Bosetti et al. \(2021\)](#) analyses whether cross-border migration influenced the link between temperature increases and conflicts for 126 countries over the period 1960–2000. On the one hand, a significant body of literature has shown that increased temperatures and more frequent droughts affect the probability of local conflict, by increasing local scarcity of resources (e.g. [Hsiang et al. 2011](#)). On the other hand, economic models of migration, such as CDNRH, show that, where possible, mobility attenuates economic losses due to the drop in productivity caused by climate change. In their contribution, [Bosetti et al. \(2021\)](#) combine these two insights and document that the probability of civil conflict is positively correlated with temperature in poor countries, and that this correlation is especially strong in countries with low propensity to emigrate. Emigration, that is, serves as an ‘escape valve’ in times of economic duress driven by climate change. Reducing population pressure in areas of developing countries experiencing losses in agricultural productivity is an effective way to reduce the risk that those turn into local conflict. Heterogeneity in opportunities and cost of mobility will therefore be another important dimension affecting the differences in local impact of climate change.

Not much explored yet are the effects of climate changes on fertility. Addressing this issue is [Grimm’s \(2021\)](#) paper that studies the relationship between climate shocks and the demographic transition in the USA for the period 1870–1930. Grimm documents a positive relationship between the variance in rainfall of an area and its fertility differentials between farm and nonfarm households. As another example of differential response to climate changes, depending on the heterogeneous incentives of local economies and societies, the findings of this paper are consistent with the idea that child labor constitutes an insurance mechanism against income shocks. In rural societies, child labor provides additional resources when climate change and uncertainty increase variation in agricultural productivity; rural families may thus increase fertility, while this mechanism does not operate in urban families.

Climate change leads to rising sea levels and to more frequent hurricanes and typhoons. Coastal areas are at particular risk.² Using an approach conceptually close to the one in CDNRH, [Desmet et al. \(2021\)](#) estimate the economic costs of coastal flooding. The paper by [Indaco et al. \(2021\)](#) in this special issue complements this paper by documenting the effect of Hurricane Sandy on NYC *business*. The 2011 flooding led to a heterogeneous reduction in employment (about 4% on average) and wages (about 2% on average), with larger effects in Brooklyn and the Queens than in Manhattan. These heterogeneous effects reflect heterogeneity in the severity of flooding and of industry composition.

3. Margins of adaptation to climate change

We have already emphasized that migration is a crucially important adaptation channel to climate change. [Desmet et al. \(2021\)](#) develop a model in the same family as CDNRH and estimate that the economic loss due to coastal flooding in 2200 increases from 0.11% of real income when the migration response is allowed to 4.5% when it is not. Three other

2 [Lin et al. \(2021\)](#) document a surprising rise (from 12% to 14%) in the share of housing units built on coastal areas at risk of flooding on the US Atlantic and Gulf coasts for the period 1990–2010. [Balboni’s \(2019\)](#) paper suggests that past investments in infrastructure may explain the persistence of coastal cities.

papers in this special issue also focus on the role of migration as an adaptation mechanism to climate change, as well as its consequences.

Castells-Quitana et al. (2021) document emigration from rural areas to cities within country boundaries and focus on mobility as a force affecting the urbanization consequences of climate change. Bosetti et al. (2021) analyze how cross-border migration influences the link between warming and conflicts for 126 countries over the period 1960–2000.³ Their finding that emigration attenuates the effect of increases in temperature on the probability of armed conflict while it does not increase probability of conflict in neighboring (immigration) countries is a very significant finding emphasizing the importance of reducing mobility costs in developing countries.

The margin of mobility is crucial also for businesses and employers. Indaco et al. (2021) show that business adapts to flood risk by relocating establishments and that some businesses may even benefit from it, by being involved in reconstruction and improvements after the floods. Specifically, their paper shows that firms in NYC reacted to Hurricane Sandy by closing and relocating establishments to neighborhoods less exposed to flood risk. The ability of relocating depends on the sector of business, but in general mobility of firms is also a crucial margin to adjust to climate changes.

CDNRH also finds that migration and trade are substitutes. High trade frictions are an impediment in the local adaptation of the production mix to climate change, as a move toward autarky prevents exploiting a region's evolving comparative advantage (the authors find that higher trade costs act as a break to the spatial concentration of agriculture). This encourages migration out of regions that are most adversely affected toward regions that are least affected by rising temperatures. Interestingly, the authors stress that such regions are concentrated in Europe, Japan and in the USA, where productivity is high. It follows that high trade costs do not lead to uniformly higher climate costs.

A recent paper by Cruz and Rossi-Hansberg (2021), also complementary to CDNRH, considers two other margins of climate-induced changes: amenities and fertility. While still little explored the fertility channel takes center stage in the paper by Grimm (2021) in this special issue. The analyzed context is the USA in the period 1870–1930. Grimm analyzes fertility differences between farm and nonfarm households within counties over time to identify causal effects of rainfall and drought risks on the demographic transition. He finds that the fertility differential in areas with a high variance in rainfall was significantly higher than in areas with a low variance in rainfall. Interestingly, this effect disappeared when irrigation and agriculture machinery weakened the link between rainfall variance and yields.

4. Concluding remarks

Ultimately the complex set of consequences of climate change on the economy and society needs to be analyzed both considering comprehensive models, which guide our understanding of channels, mechanism and heterogeneity of the effects, and case-studies and more targeted empirical analysis that zooms on one or few of those and provide details and causal connections. In this volume, we have gathered some pioneering papers that do this and combine these two types of approach. We hope these papers will encourage

3 Yohe and Schelsinger (2002) or Cattaneo et al. (2019) also document the urbanization response to increasing temperatures; Cattaneo and Peri (2016) document the international migration response.

research and more interactions between micro- and macroeconomists doing research on the consequences of climate change.

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