

Anticipating Climate Change Across the United States

Based on BFI Working Paper 2023-79, "[Anticipating Climate Change Across the United States](#)," by Adrien Bilal, Harvard University, and Esteban Rossi-Hansberg, University of Chicago

A new dynamic spatial model of the US economy and its 3,143 counties, featuring costly forward-looking migration and capital investment decisions, reveals that damages from a 3°C increase in average world surface temperatures are about twice as large as what alternative models yield.

The ability to anticipate future climate change has profound implications for our ability to adapt and reduce its harmful consequences. How do we determine the causes and consequences of such responses to a warming climate?

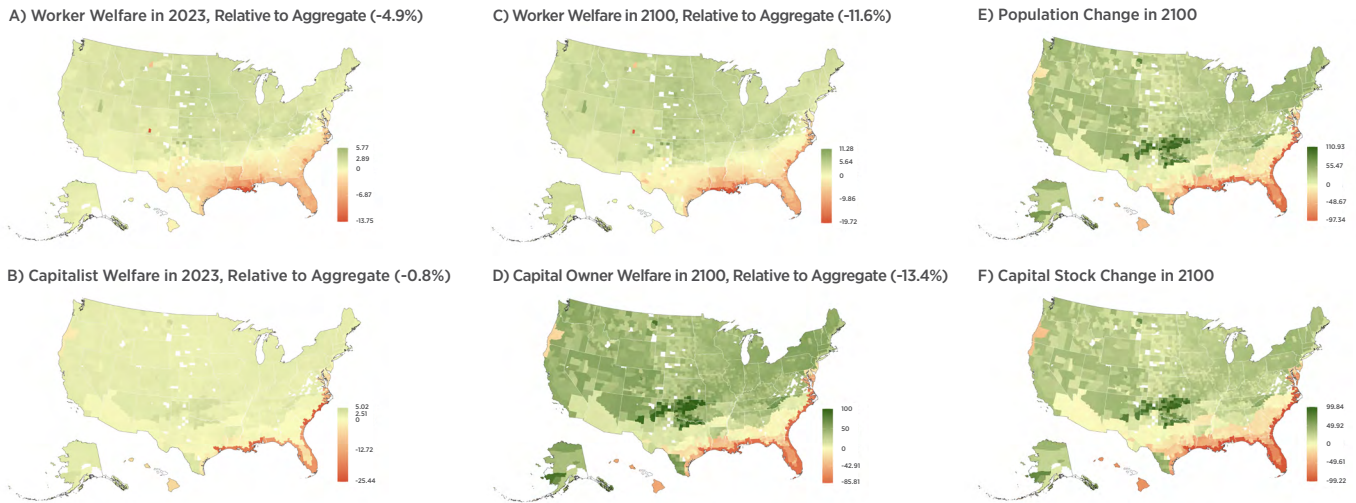
The authors address this key question by developing a model of the US economy including its 3,143 counties. Climate change increases the frequency of severe storms, which depreciate capital, and heat waves, which reduce productivity and amenities. Agents anticipate the effects of climate change and make forward-looking migration and local capital investment decisions. To quantify their model, the authors construct novel empirical estimates of the local impact of storms and heat waves on economic activity. Further, and importantly, numerical solutions are available in seconds because of the methodological advances that the authors employ to solve for the dynamic equilibrium of the model (or an equilibrium that changes over time).

Specifically, to quantify the damage functions that relate global temperature increases with increases in local capital depreciation rates, and declines in amenities and productivity, the authors use an extensive dataset of daily precipitation, windspeed,

and temperatures since 1900 at the county level. These data, together with economic information at the county level, allow the authors to estimate the observed impact on local population, output, and investment from storms and heat waves. The model is then quantified to match these empirical estimates and, therefore, provides reliable estimates of the future effects of global warming. In particular, the authors study the implied damages from a 3°C increase in average world surface temperatures for the United States and find the following:

- Accounting for the effect of temperature on capital depreciation through the impact of more frequent storms is essential to obtain more accurate estimates of the welfare losses of climate change. To the point: The impact of climate on capital depreciation magnifies the US aggregate welfare costs of climate change twofold to nearly 5% in 2023 under a business-as-usual warming scenario.
- As workers and capitalists foresee the slow build-up of climate change, they tend to migrate and to move investment, though the effects are mixed. Anticipation of future climate change has small average effects on welfare but leads to large

Figure 1 • Impact of 3°C Additional Warming by 2100



increases in migration flows and large changes in the geography of investment, as workers and capitalists correctly anticipate the persistence of climate damages in particular regions.

- Migration has a small average impact on welfare, but it leads to substantial increases in the dispersion of worker and capitalist welfare across locations; worker movements increase the losses in the value of capital at locations harmed by climate change. In sum, while both anticipation and migration are important for local impacts, their effect on aggregate US losses from climate change is small.

To give just one example of the predictive power of the authors' model, including its ability to focus on particular counties, let us take note of its estimated effects of storms and heat waves on capital depreciation, productivity, and amenities: Storms

generate a 17% capital depreciation shock, while heat waves generate a 5.1% productivity shock together with a 6.8% amenity shock. The South-Eastern Atlantic coast should expect a 2 to 4 percentage point increase in the annual capital depreciation rate for every 1°C increase in global mean temperatures because of rising storm activity. Southern Florida should expect a 5% reduction in productivity, and a 6.6% reduction in amenities, for every 1°C increase in global mean temperature. (See accompanying Figure, which illustrates spatial effects of climate change.)

Bottom Line: The authors' dynamic model (over space and time), which is the first to include migration and capital investments to quantify the effect of climate-change-induced storms and heat waves in the United States, offers an innovative tool for anticipating the future effects of climate change. Importantly, this model reveals those effects at an aggregate and local level.

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NO. 2023-79 · JUNE 2023

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