Equity and Efficiency in US Climate Adaptation Funding

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Climate adaptation funding is growing rapidly around the world, often targeting the least developed areas and most vulnerable people (UNEP, 2022). The United States has recently followed the same trend. The Biden Administration has authorized more than 50 billion dollars for climate adaptation, with an emphasis on targeting low income and historically disadvantaged locations (The White House, 2023a). Specifically, 40% of the funds are to be invested in disadvantaged census tracts under the new Justice40 initiative (The White House, 2023b). Given the substantial amount of current funding allocated to climate adaptation, and projections of rapid growth in adaptation needs (UNEP, 2022), it is critical we understand the economics of how to allocate adaptation funds to assist those who are disadvantaged and most vulnerable, while also maintaining that the funds are spent efficiently.

In this paper we examine the equity and efficiency of US climate adaptation funding under the Bipartisan Infrastructure Law and the Inflation Reduction Act. First, we provide new descriptive evidence documenting how funding is allocated across different income and racial groups (reflecting equity motives), as well as how funding is allocated across regions projected to suffer differing levels of climate damages (reflecting efficiency motives). Second, following the methodology of our companion paper focused on multilateral adaptation funds (Lemoine, Marcheva, and Rudik, 2023), we use the government's funding decisions to estimate its preferences for equity versus efficiency, priority for the vulnerable within a given metric for equity, and the perceived effectiveness of adaptation spending. Third, we use the estimated effectiveness of spending parameters to trace out the equity-efficiency frontier of achievable outcomes given the actual adaptation budget, and we identify how sharp tradeoffs may be around the observed funding allocation across counties. Finally, we quantify how the government could shift the equity-efficiency frontier and achieve improved efficiency and equity outcomes by accounting for how adaptation spending has positive spillover benefits through the US production network in its funding decisions.

1 Conceptual Framework

Here we provide a high-level description of the model, with details and analysis of a related internationally-oriented model in Lemoine, Marcheva, and Rudik (2023). A social planner is endowed with some budget of funds to use for climate adaptation investments that can be allocated across different counties in the US to blunt the negative impacts of a county's warming on that county's total factor productivity. The planner's objective is, for a given distribution of warming across US counties, to minimize a convex combination of the aggregate nationwide income losses and the increase in inequality across people. The former is her efficiency criterion and the latter is her equity criterion.

In our model, we account for how the spatial structure of the US economy links warming and adaptation funding in particular places to changes in other places' income. For example, maize

production in Iowa is an input into beef production in Texas, and beef production in Texas is an input into restaurant services in New York. Negative climate shocks to Iowa then raises maize prices, which increases the cost of beef production. Higher beef costs are then passed through as higher food prices at restaurants, decreasing demand for restaurant workers and increasing prices that restaurant consumers face. This decreases restaurant worker nominal (and real) wages and also decreases restaurant consumer real wages. Our companion paper illustrates that accounting for these linkages is critical for understanding the efficiency and equity consequences of global climate adaptation portfolios.

2 Data

To see where funding has been distributed to date, we have collected award data for both the Bipartisan Infrastructure Law and the Inflation Reduction Act (Bureau of the Fiscal Service, 2023). These laws include 110,196 and 681 projects, respectively. We designate 1,293 and 90 of these as climate adaptation-focused by using their Catalog of Federal Domestic Assistance number and project description. Awards are designated at different geographic levels, ranging from city to multi-state. Only a small percentage of climate adaptation projects in our data are distributed through formula and block grants, so our preliminary results could be driven by who applies for grants rather than the planner's preferences. In order to further examine the applicant pool, we have submitted FOIA requests to NOAA and the EPA to get data on the universe of applications.

We combine adaptation funding award data with socioeconomic data that can reveal different distributional goals. The first dataset is the Climate and Economic Justice Screening tool, the standardized metric by which a census tract is determined to qualify for funding under the Justice40 initiative (Council on Environmental Quality, 2023). Under this metric, a census tract must be at least in the 65th percentile of number of people at or below 200% of the federal poverty rate, as well as be "overburdened" in at least one of the areas of climate change, energy, health, housing, legacy pollution, transportation, water, and workforce development.

We also collect data about projected climate risks and damages. The FEMA risk index scales expected annual loss data from 18 natural disasters with social vulnerability (factors like poverty levels, percent of population that is elderly, number of mobile homes) and resilience (for example environmental quality, and institutional and social capital) FEMA (2023). We also include projected losses from climate change, particularly regional mortality costs (Carleton et al., 2022) and total economic damages by county and county-income decile (Hsiang et al., 2017). And we include county demographic data and future climate projections.

To measure economic linkages between counties, we use the Commodity Flow Survey, which gives the movement of goods between states and metropolitan areas in the US (US Census Bureau, 2021). We measure linkages between different counties' economies by disaggregating the 329 regions in the Commodity Flow Survey's subarea estimates using county-specific GDP by industry, population, and national IO tables for factor inputs.

3 Estimation

We estimate the government's preferences for efficiency and equity of adaptation funding using data on the observed adaptation funding distribution, projections of future climate change damages, and county-level demographics and income. We assume that the government does not originally take into account spillovers through cross-county economic linkages because equity funding is legally location-based. However, in our simulations we compute potential efficiency and equity gains if

adaptation benefit spillovers were taken into account. We estimate the model parameters using GMM, with the moments deriving from the first-order conditions of the planner's problem.

4 Preliminary Descriptive Results

Simple plots of how adaptation dollars have been distributed reveal two patterns. The first is that lower income census tracts do appear to be getting the majority of the funds. Figure 1 shows a nearly linear negative relationship between county average household income and adaptation funding per capita, after being residualized by future climate damages (since expected damages are highly negatively correlated with income). In Figure 2 we perform the opposite exercise, where we plot adaptation funding against expected climate damages, residualizing on income. Funding follows a U-shape in damages, suggesting that the government is not especially targeting the areas that will experience the highest damages. Figure 3 maps counties by the tercile of projected future damages and adaptation funding. The map shows that the largest mismatch of funding and future damages occurs in the US South which is projected to have high climate damage yet, outside of a handful of areas, has received little adaptation funding. We find the same pattern for the 4% of the projects that are formula or block funded instead of competitively funded.

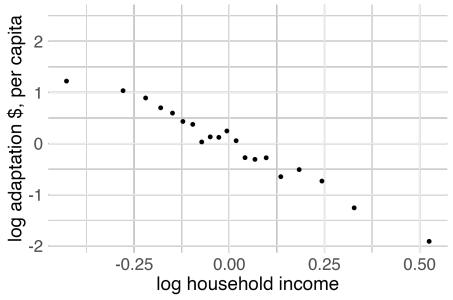


Figure 1: How funding is distributed by income, residualized by expected climate change damage

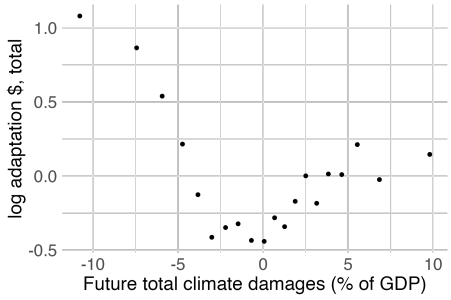


Figure 2: How funding is distributed by expected climate damages, residualized by household income

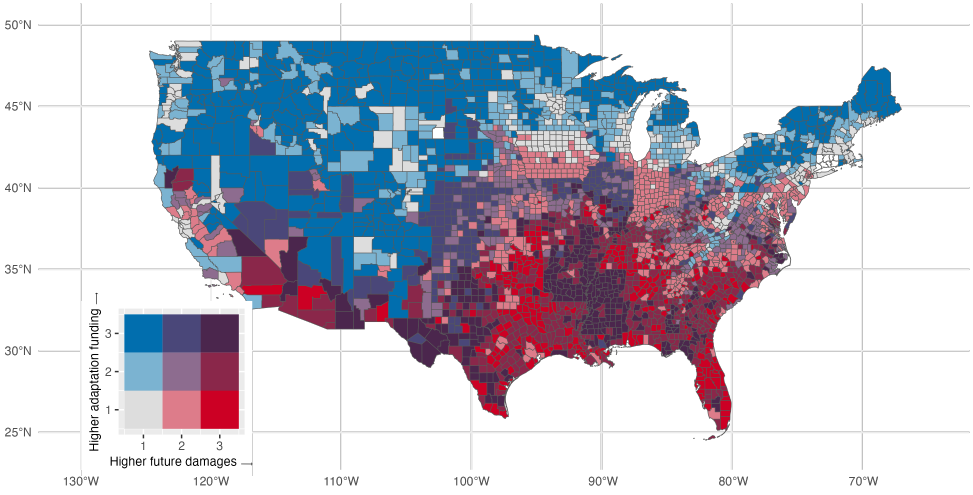


Figure 3: Future damage risk and adaptation funding over space