INSTITUTE OF GOVERNMENTAL STUDIES
UNIVERSITY OF CALIFORNIA, BERKELEY

Research Brief

Examining the Unintended Effects of Climate Change Mitigation

A New Tool to Predict Investment-Related Displacement

Karen Chapple, Alex Ramiller, Renee Roy Elias, Julia Greenberg, and Jae Sik Jeon

Image credit: Peter Ehrlich

Executive Summary

Responding to the changing climate requires reducing greenhouse gas emissions (mitigation) as well as preparing for its impacts (adaptation), such as extreme weather events. Cities around California (and beyond) are investing in more sustainable land uses and transportation infrastructure to help reduce emissions. However, the recent proliferation of climate-related public investments such as rail system expansions, bike lanes, and parks have raised fears about the potential for negative social impacts such as gentrification and displacement. This study explores whether climate investments inadvertently contribute to the indirect displacement of vulnerable residents, using a bespoke database of climate-related investments and household mobility data to examine how transit and active transportation/greening investments impact out- and in-migration in the San Francisco Bay Area, Los Angeles County, Sacramento County, and Fresno County.

The effects of living within a climate investment neighborhood around the time of its opening vary substantially by income group. For transit investment neighborhoods, we observe higher rates of outmigration only among very low-income (VLI) renter households in the years preceding and following the opening of transit investments, which may indicate both anticipatory effects of transit projects opening as well as increased displacement pressures once the projects have opened. For active transportation/greening neighborhoods, we observe higher rates of outmigration among VLI, low-income (LI), moderate-income (MI), and high-income (HI) households. Extremely low-income (ELI) renter households do not exhibit higher rates of outmigration in either type of climate investment neighborhood (Figure ES1). Overall, average migration rates increase with income; in other words, HI households tend to move more often in general compared to lower-income households.

Results also vary by region. In Fresno and Sacramento, there were only a few significant results for any investment type or income group. In LA, mean outmigration rates are approximately 0.8 percentage points higher for VLI renters and 0.6 percentage points higher on average for LI renters in transit investment tracts within three years of the investment opening (Figure ES2). It should be noted that these neighborhoods also experienced heightened levels of in-migration among the lower-income categories during the study period. For active transportation/greening investment neighborhoods in LA, meanwhile, we observe slightly higher outmigration rates and substantially lower in-migration rates for lower-income households, suggesting that there may be a net outmigration effect in those neighborhoods.

Figure ES1: Predicted probabilities of out- and in-migration for each income category within three years of project opening in control, transit, and active transportation/greening neighborhoods

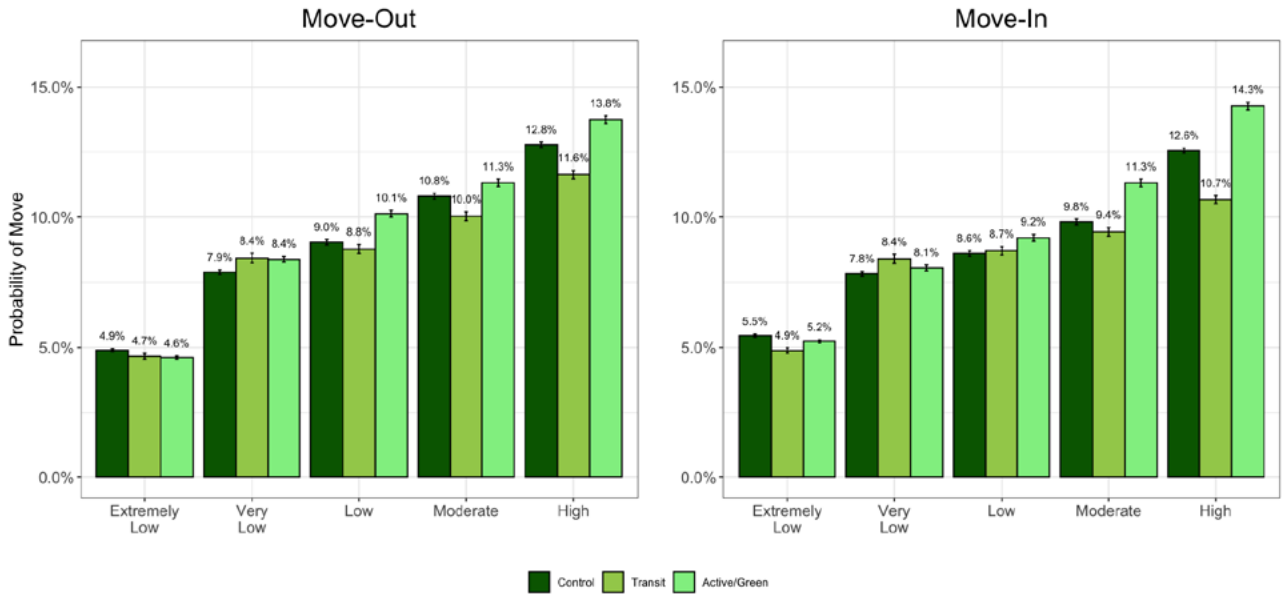
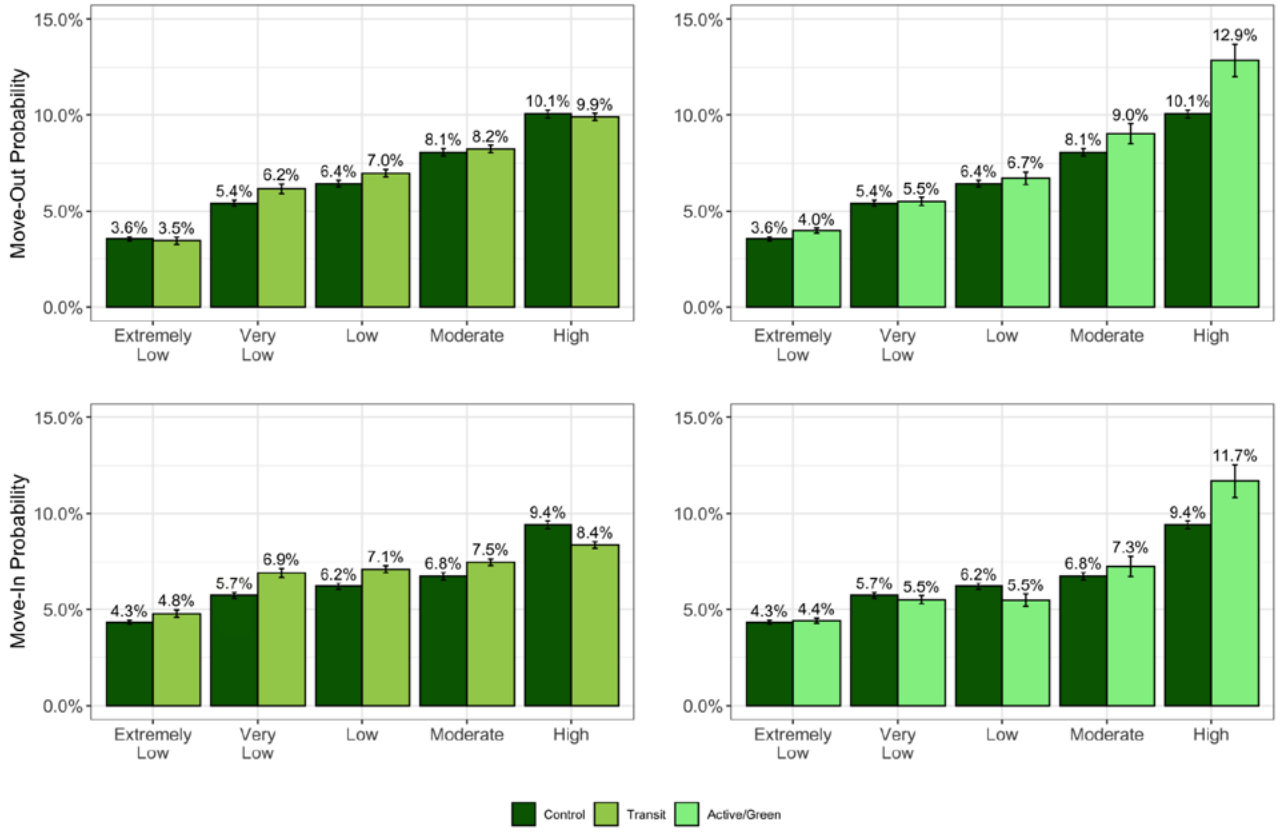
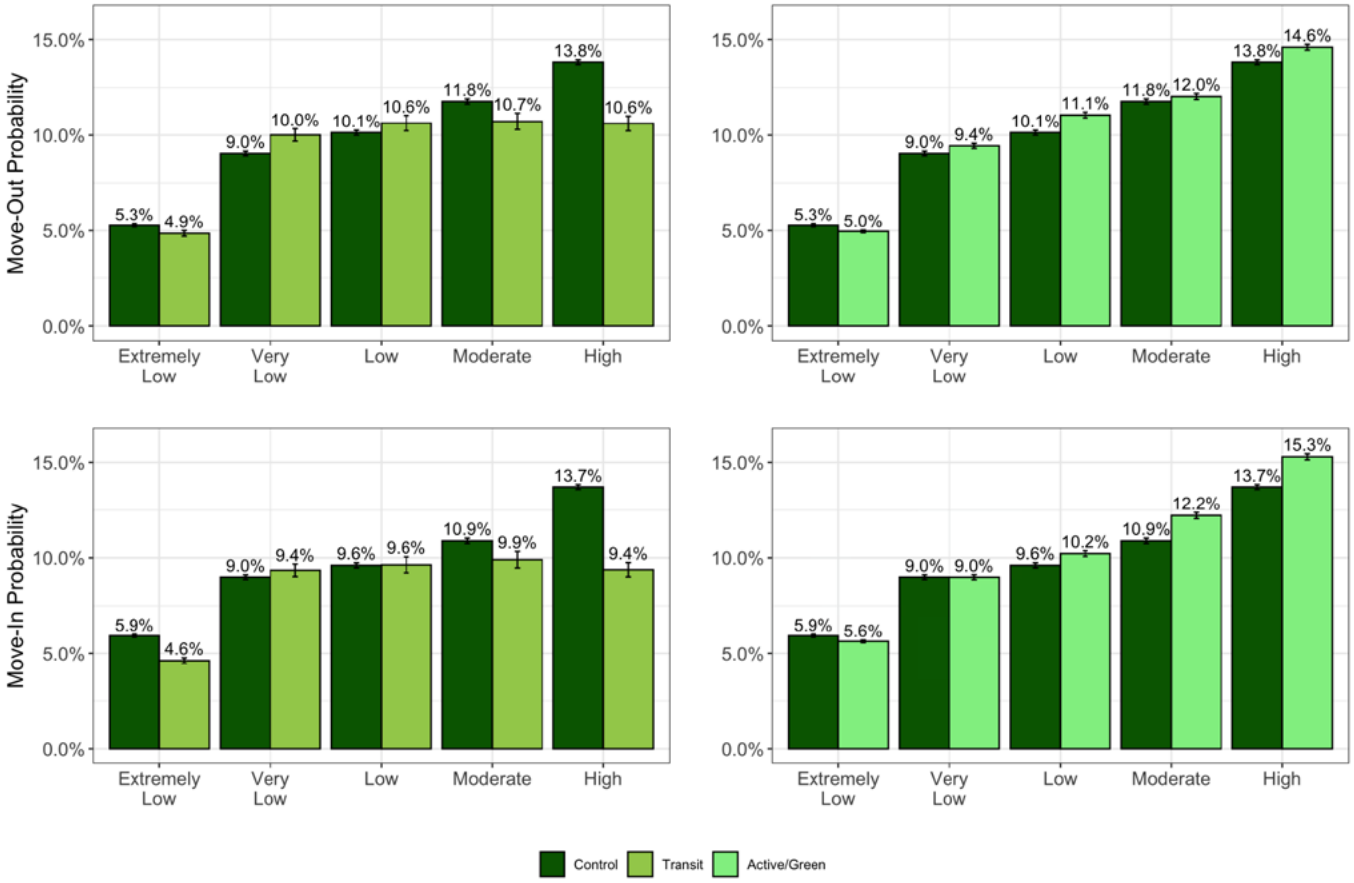


Figure ES2: Predicted probabilities of out- and in-migration for each income category within three years of project opening in Los Angeles County



In the Bay Area, we find higher rates of outmigration for VLI and LI renters in transit investment neighborhoods, and higher rates of outmigration for all income groups except ELI households in active transportation/greening investment neighborhoods (Figure ES3). In San Francisco specifically, we see that outmigration in transit investment tracts is generally fairly similar to control tracts; however, migration rates do increase in transit investment tracts two years after the completion of transit projects, suggesting a possibly delayed effect from the completion of the transit projects. For active transportation/greening projects, meanwhile, we see fairly consistent trends over time, with migration rates for ELI households staying somewhat lower than the control neighborhoods, while VLI and LI renters appear to experience higher migration rates in active transportation/greening investment tracts on average.

Figure ES3: Predicted probabilities of out- and in-migration for each income category within three years of project opening in the Bay Area



In sum, climate investments sometimes lead to higher outmigration rates, but the impact is always minor and varies significantly by region, investment type, income group, and even project (Tables 3 and 4). When migration impacts increase, it is typically by less than one percentage point and rarely more than two percentage points; this means, for example, that in a neighborhood where 10 of 100 LI households move out each year, now 11 or 12 will move out. For transit investments in Los Angeles and active transportation/greening investments in the Bay Area, some of the same income groups are migrating into the neighborhood at a higher rate than outmigration is occurring. VLI and LI renters are particularly prone to displacement impacts, with effects differing by region. However, ELI renter households generally remain in place when climate investment occurs, perhaps due to

residence in subsidized housing. Particularly with transit investments, increases in outmigration may occur well before or after the opening, indicating anticipatory or delayed effects.

The broad conclusion from this quantitative analysis is that the specific outmigration effects associated with climate investments are small and contextually specific. While higher outmigration rates in investment tracts are observed among certain income groups and at certain points in time, there is no consistent relationship detected between different climate investments and outmigration rates. Impacts are generally lower in our Northern California cases than in Los Angeles and Fresno, and in a few cases, there is net positive in-migration for low-income groups instead of displacement. This could reflect the effectiveness of anti-displacement policy in the San Francisco Bay Area; or the types of investments or neighborhoods could differ between regions. We observe some anticipatory and delayed effects of the investments; once more time has elapsed since construction, it will be possible for future research to explore these impacts in more detail.

The outmigration effects of climate investments are small and variable. This leads to two key findings: first, it is likely possible to mitigate the short-term effects via anti-displacement policies (e.g., the construction or preservation of affordable housing), and second, local communities can (and should) play a role in the selection of which anti-displacement policy is appropriate. This suggests an important role for community organizing. In the following section, our six case studies shed light on how communities might organize for specific anti-displacement policies.

Our six case studies offer three important lessons for communities experiencing climate-related public investments, whether transit, active transportation/ greening, or infill development generally.

First, **bottom-up and top-down policy-making need to occur simultaneously** in order to put anti-displacement policy in place expeditiously. As the cases of Crenshaw Boulevard, LA River, and The Alameda show, local organizing or coalition-building around anti-displacement policy or community benefits builds leadership capacity and puts pressure on the public sector. However, change occurs fastest when governments are already putting resources or programs in place. Thus Downtown Crenshaw Rising's push for community ownership may become formalized via LA County's CLT pilot program; organizing around the LA River is met by the parks district's formal incorporation of anti-displacement strategies, and the Diridon Area Neighborhood Group's actions found support via San Jose's Citywide Residential Anti-Displacement Strategy. In some cases, community organizing is spurring implementation of city or county strategies, but in others, these processes are occurring simultaneously and create mutual reinforcement.

Second, **either organized efforts to resist private development or incorporation into formal government policy-making processes play a critical role in increasing critical community capacity.** Formal roles in the Anti-Displacement Task Force and Transform Fresno bolstered community capacity in Fresno; Metro formed the Community Leadership Council for the Crenshaw/LAX line; and a community steering committee helped shape the Alameda Plan for the Beautiful Way. New capabilities have also formed in reaction to developments in San Jose (Google), Sacramento (UC Davis Medical Center), and Los Angeles (SoFi Stadium). In all of these cases, new leadership emerged—whether in response to a development project proposal or through official involvement in government processes —which then helped the community engage in a more sophisticated discussion about climate investment and anti-displacement policy.

And third, **education about climate investments, anti-displacement policies, and tenants' rights will help to find consensus-based approaches.** Los Angeles provides two examples of educational efforts that helped to set the stage for discussions about displacement: TOD University, which educated residents about light rail in West Los Angeles, and numerous organizations publishing recommendations for addressing green gentrification and affordable housing needs around the LA River.

Likewise, the publication of the Displacement Avoidance Plan in Fresno has helped provide a framework for future organizing around climate investments. Each effort like this empowers the community to develop thoughtful positions as new investments arise.

Investments meant to mitigate climate change have unintended consequences, sometimes increasing outmigration rates. Yet, these effects are small and contextually specific. This then creates both an imperative and a space for action. If impacts are small, they are likely mitigable. And if they vary by region, investment type, income group, and even project, it will be important to engage local communities in determining the exact shape that this mitigation should take. Given the small scale of these unintended consequences, community land trusts may be a promising approach to such mitigation.

Introduction

Responding to the changing climate requires reducing greenhouse gas emissions (mitigation) as well as preparing for its impacts (adaptation), such as extreme weather events. Cities around California (and beyond) are investing in more sustainable land uses and transportation infrastructure to help reduce emissions. However, the recent proliferation of climate-related public investments such as rail system expansions, bike lanes, and parks have raised fears about the potential for negative social impacts such as gentrification and displacement. Might these investments have unintended consequences for the communities in which they are applied? By raising property and housing values, might climate investments inadvertently contribute to the indirect displacement of vulnerable residents?

"While investments in certain regions are associated with slightly higher rates of outmigration, these effects differ substantially by region, income category, investment type, and even project"

An emergent literature provides recommendations on how best to green cities without causing gentrification and displacement (see, for instance, Rigolon & Christensen 2019, Wolch et al. 2014), and our own literature review for this study identifies some 300 sources (Cash et al. 2020). However, these studies provide little direct evidence of the impact of investments on housing stability in disadvantaged communities. Looking at housing investment in particular, a number of studies (e.g., Boarnet et al. 2017, Chapple & Loukaitou-Sideris 2019) have attempted to examine transit investment-related displacement, but with data limitations, and thus mixed results. Our own recent work on the impacts of market-rate development on displacement overcomes these issues of data and methods, but does not analyze the impacts of climate-related investments (Chapple et al. 2022).

This study thus provides the most comprehensive examination to date of a range of climate-related investments located in four regions of California. Using a bespoke database of climate-related investments, coupled with data on household mobility, we look at how transit and active transportation/greening investments impact out- and in-migration in the San Francisco Bay Area, Los Angeles County, Sacramento County, and Fresno County. We find that the relationship between climate investments and the outmigration of low-income renters is extremely contextually specific. While investments in certain regions are associated with slightly higher rates of outmigration, these effects differ substantially by region, income category, investment type, and even project.

In short, there are no easy answers to the question of whether climate investments contribute to low-income displacement. Our findings indicate that while local jurisdictions should promote a range of measures to protect housing affordability—particularly for larger investments—communities should not assume that a consistent displacement effect will result from investment.

In the following pages we present our data and methods, followed by our quantitative and case study findings. For both the quantitative analysis and case studies, we partnered with organizations

who work in the regions under study: California Housing Partnership Corporation (statewide), Public Advocates (San Francisco Bay Area and Sacramento), Public Counsel (Los Angeles), and Leadership Counsel for Justice and Accountability (Fresno). Each organization provided feedback on the quantitative methodology and results, helped to select the case studies, and connected the team with interviewees. Staff from two of the five organizations co-authored selected case studies with the team and provided detailed feedback on drafted text. We are grateful for their insights and collaboration, but any remaining errors are our own.

Data and Methods

For this study, we built and analyzed datasets on climate investments and household mobility, and then conducted interviews for case studies in partnership with our community partners. We begin by describing the data and methods for the quantitative analysis, followed by a description of our qualitative research design and approach to developing the interactive tool.

Database of Climate Investments

Our sample includes climate investments that were funded by programs or policies that aim to reduce emissions, but may also impact housing costs and displacement patterns. We focused on investments located within eight counties across four study areas: the five-county Bay Area (Alameda County, Contra Costa County, San Francisco County, San Mateo County, and Santa Clara County), Sacramento County, Fresno County, and Los Angeles County.

We compiled this list of investments using relevant data from the California Air Resources Board's (CARB) Climate Investments Project Map, as well as data from contacts at various administering agencies, including the Metropolitan Transportation Commission (MTC), California Department of Housing and Community Development (HCD), Los Angeles Metropolitan Transit Authority Records Management Center, USDA Forest Service, and California Department of Parks. The original database included more than 1,4000 investments. However, we then narrowed down our list based on the following criteria: (1) the project cost is at least $100,000; (2) the project is in our study area; and (3) the project was completed between 2006 and 2018. Some additional limitations, such as data availability or lack of geographic specificity of investments, further restricted what we were able to include. See Figure A1 in the appendix for a full list of policies and programs that provided funding for the investments in our sample.

We assigned each investment to one of four project types: active transportation, greening, transit, or urban infill. To obtain a large enough sample size for analysis, we grouped active transportation and greening investments into a single category. A comparison of the list of urban infill projects associated with climate investments with other databases of new construction revealed that the developments in the database were only a small subset of total new development. This meant that it would be impossible to isolate the impact of climate-related new development from other new projects. As a result, we decided to remove infill projects from the analysis and were left with 285 total investments.

Table 1: Largest Transit Projects by Region (Opening Year)

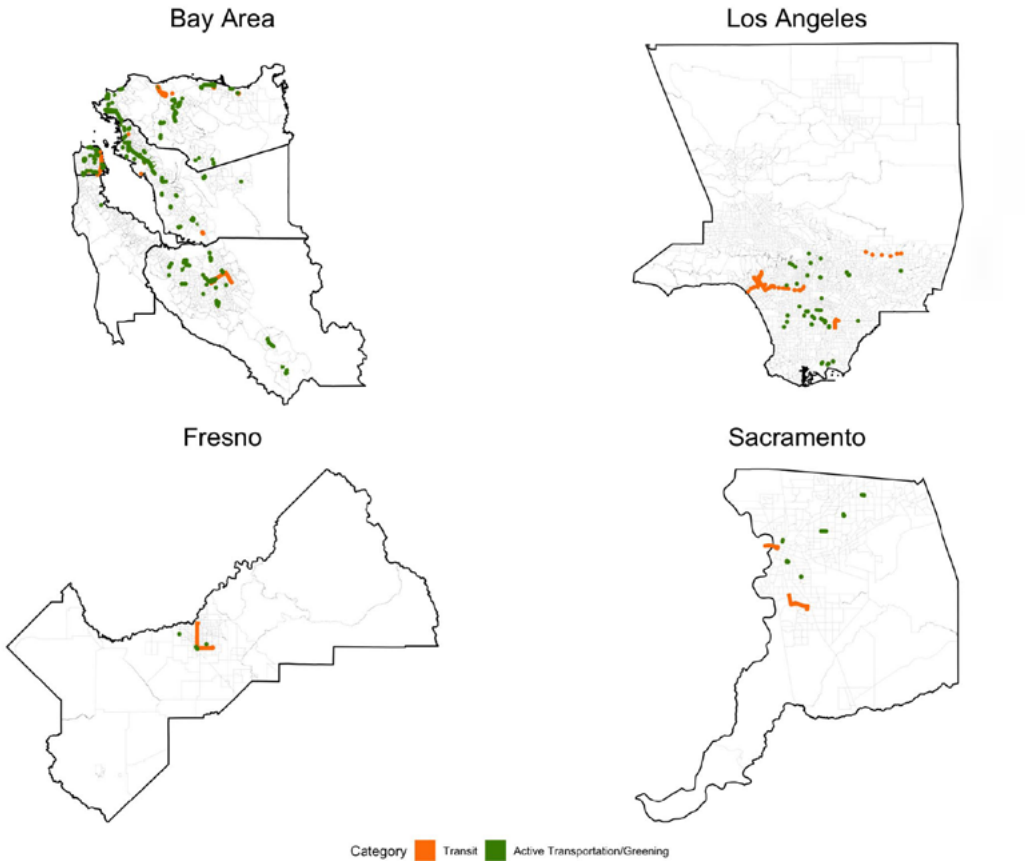
Los Angeles	Bay Area	Fresno	Sacramento
Expo Line Extension to Santa Monica (2016)	Transbay Terminal (2018)	BRT Improvements (2018)	South Line Light Rail Extension (2015)
Expo Line to Culver City (2012)	BART Warm Springs Extension (2017)		Yolobus West Sacramento Pilot (2018)
Gold Line Extension (2016)	San Francisco Third Street Light Rail (2007)		

Los Angeles	Bay Area	Fresno	Sacramento
Route 22 Extension (2018)	eBART Antioch Extension (2018)		
Fixed Route Bus Transit Operations – Routes 15 & 17 (2017)	BART Oakland Airport Connector (2014)		

Table 2: Largest Active Transportation/Greening Projects by Region (Opening Year)

Los Angeles	Bay Area	Fresno	Sacramento
Yvonne Burke-John D. Ham Park & Community Center (2017)	Santa Clara Caltrain Bike/ Ped Tunnel (2017)	Fulton Mall Reconstruction Project (2017)	Arcade Creek Park Preserve Development (2014)
Jacaranda Park (2017)	SF Bay Trail – Pinole Shores to Bay Front Park (2018)	Universally Accessible/ Inspiration Park (2015)	Artivio Guerrero Park (2015)
Lynwood Linear Park (2016)	Downtown Berkeley BART Plaza Improvements (2018)	Martin Ray Reilly Park (2015)	McClatchy Park (2015)
Watts Serenity Park (2015)	Breuner Marsh Restoration and Public Access (2017)	Cultural Arts District Park (2016)	Ahern - 12th Street Improvements (2011)
Marshall Community Park (2018)	San Jose Alameda Plan for the Beautiful Way (2018)		

Figure 1: Investment Sites



We compensated for the removal of infill projects by controlling for new residential construction in our modeling approach. We were therefore left with two primary investment types: 1) transit, and 2) active transportation/greening.

For each climate investment, we determined an opening date for each project based on official documents and media reports found online. We removed investments with no clear opening date and investments with an opening date after 2018 from the analysis, resulting in 238 investments in our final database. We then digitized each investment, and identified neighborhoods by locating all census tracts overlapping with a 250-foot buffer of the digitized investment footprints. Tables 1 and 2 describe the largest transit and active transportation/greening projects in our database. For a full list of investments, see Appendix A.

Matching

We carried out this analysis using propensity score matching, which applies logistic regression on a designated set of matching variables to calculate propensity scores and identify observations in the treatment and control groups, which are broadly similar. We matched investment to non-investment tracts based on the following criteria from 2006-2010 census data, chosen to reflect demographic conditions at the beginning of our study period: the share of the population that was non-white, poverty rate, rentership rate, share of the population with a college degree, median rent, population density, and proximity to the nearest major city.[1]
To ensure that comparison tracts would bear some resemblance to the largely urban environments of climate investment tracts, non-investment matched tracts were required to have a population density exceeding 500 people per square mile, which corresponds with the threshold between urban and rural population densities (USDA). We constructed a single propensity score model using tracts from all eight counties within the study areas; however, to ensure the geographic comparability of matched tracts, we used only exact matches on counties, meaning that each census tract must be matched with a comparable census tract within the same county.[2] Even after matching tracts based on demographic

Figure 2: Covariate balance from propensity score matching

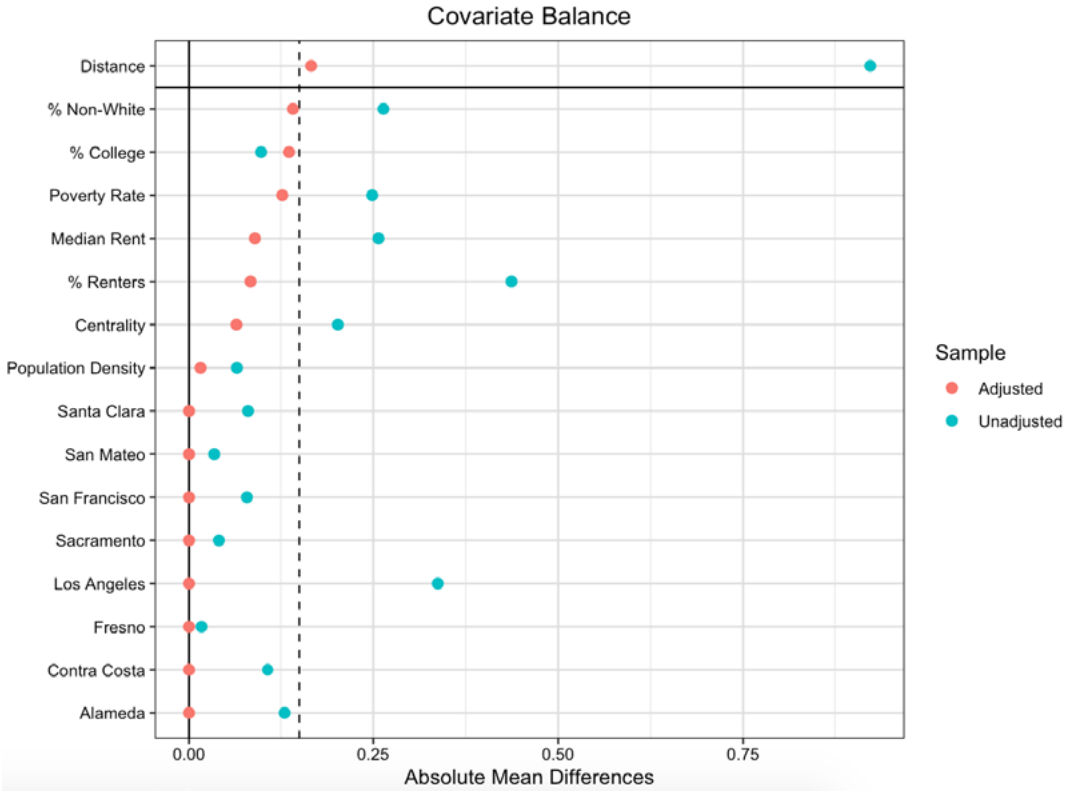
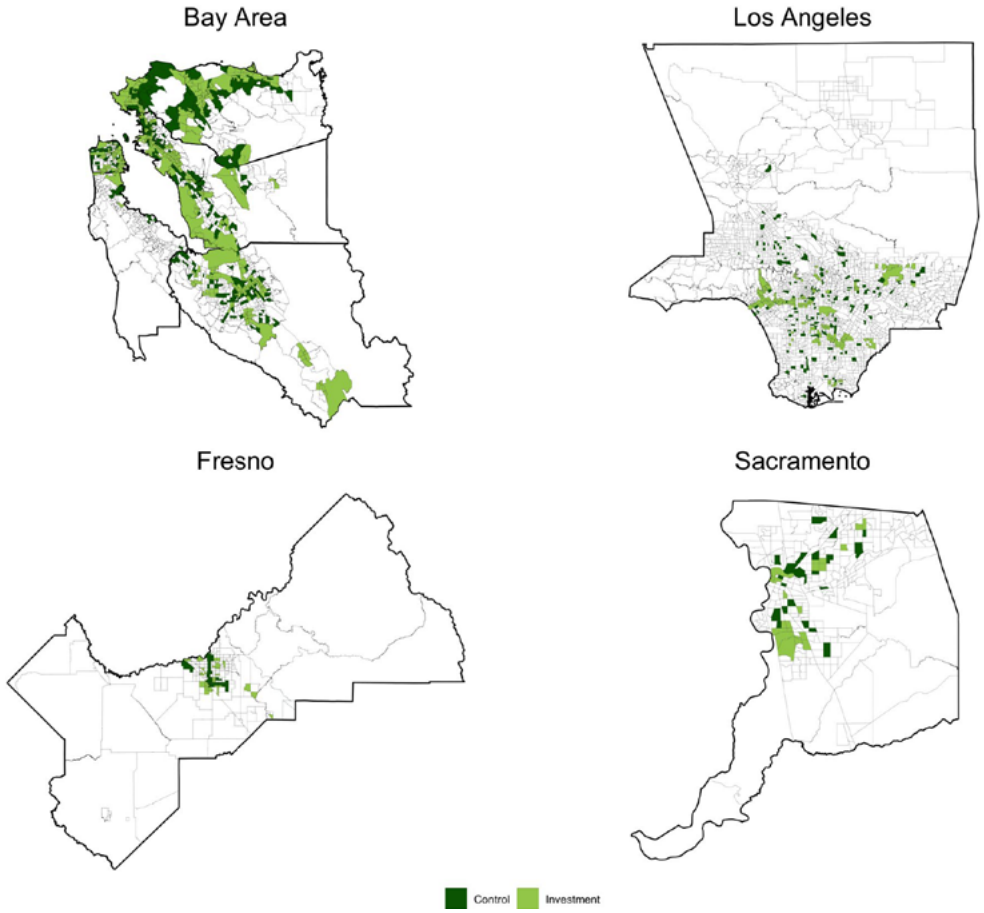


Figure 3: Investment and Control Neighborhoods



characteristics, it is possible that control tracts may be inappropriate because of contamination by similar kinds of investments as are in the treatment tracts. In order to account for this, we excluded tracts that contain these investments from our list of potential matched pairs for our sample of investment tracts (but only when the investments are in the same category, i.e., active transportation/greening or transit).[3] Through iteratively rematching the neighborhoods six more times, we produced a set of matches in which none of the control neighborhoods contain investments of the same type as the investment neighborhoods.

Propensity score matching produces a set of treatment and control tracts that are reasonably well-balanced across all seven continuous matching variables, with an absolute standardized mean difference between treatment and control groups of less than 0.15 for all matching variables (Figure 2).[4]

Migration Data

We calculated migration data using a panel of household-level location and income data from DataAxle (formerly Infogroup) covering each year between 2006 and 2019. Given data quality issues, we took a number of steps in order to improve the reliability of our subsequent analysis, including filtering for reliable data in terms of address and income, weighting data using population by income counts from the American Community Survey, and subsetting to renters only. Appendix B provides a full description of our data cleaning.

For each year that an individual household was recorded in the data, we classified it based on whether the household 1) remained in the same place from the previous observation, 2) moved out of one census tract and into another between observations, or 3) moved within the same census tract. The second category is the focus of this analysis, as we are

primarily interested in the effects of investments on displacement of households outside of their original neighborhoods. We conceptualize displacement as movements of households that exceed the normal outmigration rate of the neighborhood.

Regression Controls

We generated control variables for regression analysis using data from the US Census Bureau American Community Survey (ACS) 5-year estimates, land use data based on 2014 tax assessor data purchased from Dataquick, and the total number of new units and new subsidized units built. We constructed these last variables for the years spanning 2006 to 2019 using a combination of data from Zillow, the California Department of Housing and Community Development's Annual Progress Report, the San Francisco Planning Department's Housing Inventory, and the California Housing Partnership Corporation for 2010 census tract geographies. We used ACS 2010-2014 estimates to calculate transit ridership and the percent of households living in single-family detached homes, and calculated the changes in median home value and median gross rent based on the difference between 2015-2019 and 2010-2014 ACS estimates. We developed a spatially lagged rent measure by measuring the median gross rents for nearby census tracts multiplied by inverse squared weighted distance.

Regression analysis

We then constructed a linear probability model to examine the probability that an individual renter household will move into or out of a given census tract:[5]

Move-Out ~ Investment Type*Income Category + Year Fixed-Effects + Region Fixed-Effects + Neighborhood Controls

First, we interacted the income category of each household with the investment status of the neighborhood. We also introduced year fixed-effects, which are necessary given the significant between-year heterogeneity in the panel dataset. Finally, we included region fixed-effects and the aforementioned neighborhood-scale controls to account for underlying differences between neighborhoods and regions.

Then, we ran models to predict the average outmigration probabilities for the entire period from three years before a project opening to three years after a project opening. For control tracts, which did not have a climate investment opening, we observed household records for the same years as the investment tracts to which those tracts were matched. We then ran separate models for each individual time lag between -3 (three years before project opening) and +3 (three years after project opening) in order to observe whether trends in outmigration change over time. We constructed these models separately for each county and investment type. We then predict the probability and 90% confidence interval of outmigration for each income category in both investment and control neighborhoods. After these initial models, we ran a series of additional models for each region independently in order to examine whether there are different relationships between investment type and outmigration within different regional contexts.

We developed this methodology working in close consultation with our community partners (California Housing Partnership Corporation, Public Advocates, Leadership Counsel, and Public Counsel). At the onset of the project, we worked with partners to flag any missing investments from the dataset and identify appropriate investments for study.[6] Then, we met with partners to discuss the variables chosen for propensity score matching and selection of control tracts; it was at this meeting that partners identified the potential for "contamination," i.e., that similar investments could be occurring in control areas. This led us to manually examine every control tract to ensure that investments were not indeed occurring. Finally, we reviewed our preliminary results with partners to flag any findings that were inconsistent with experiences "on the ground"; this led us to investigate several specific cases, such as the Expo line in Los Angeles, in more detail.

Qualitative data collection and analysis

To shed light on the community engagement processes related to key investments and highlight lessons learned for coordinated anti-displacement and sustainability strategies, we conducted six case studies. We selected these in close coordination with our community partners, and represent a diversity of climate investments that generally spurred significant public engagement.

Between September 2020 and December 2021, we conducted one-on-one interviews with 61 community stakeholders across the Bay Area, Los Angeles County, and Fresno County regions to hear their perspectives on recent investments in green building, urban greening, streetscape improvements, and transit-oriented-development. Interviews were semi-structured, ranging from 30-45 minutes in length, and were conducted virtually via Zoom. We transcribed the interviews using Otter.Ai, developed a list of codes drawing from the interview themes, reviewed the interview transcripts, and coded the material using the Dedoose software. Separate research staff on the team reviewed the coded transcripts for consistency. We also used secondary materials, including professional reports, news articles, journal articles, and websites, to fill in factual information regarding the case studies.

Interactive Tool

The third component of the study is an online interactive mapping tool to provide policymakers, activists, and others with a visual illustration of the spatial relationship between climate investments and migration patterns in their communities. To create the tool, which was built using the shiny and leaflet packages in R, we mapped all of the investments in the climate investments database, including urban infill projects that were excluded from the quantitative analysis.

Quantitative Analysis Results

Data Description

Migration rates are fairly similar between control and investment tracts for each of our four study areas, providing an indication that propensity score matching was relatively successful at identifying census tracts with similar characteristics for the purposes of measuring outmigration (Figure 4).

Figure 4: Average outmigration rates for investment and control neighborhoods by year

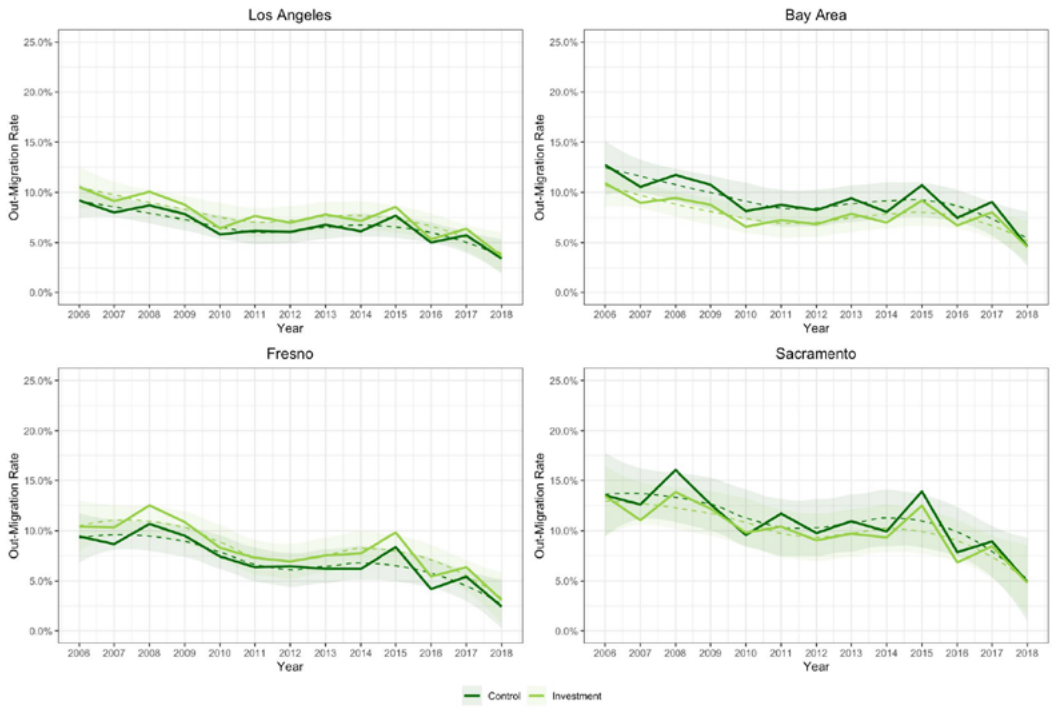
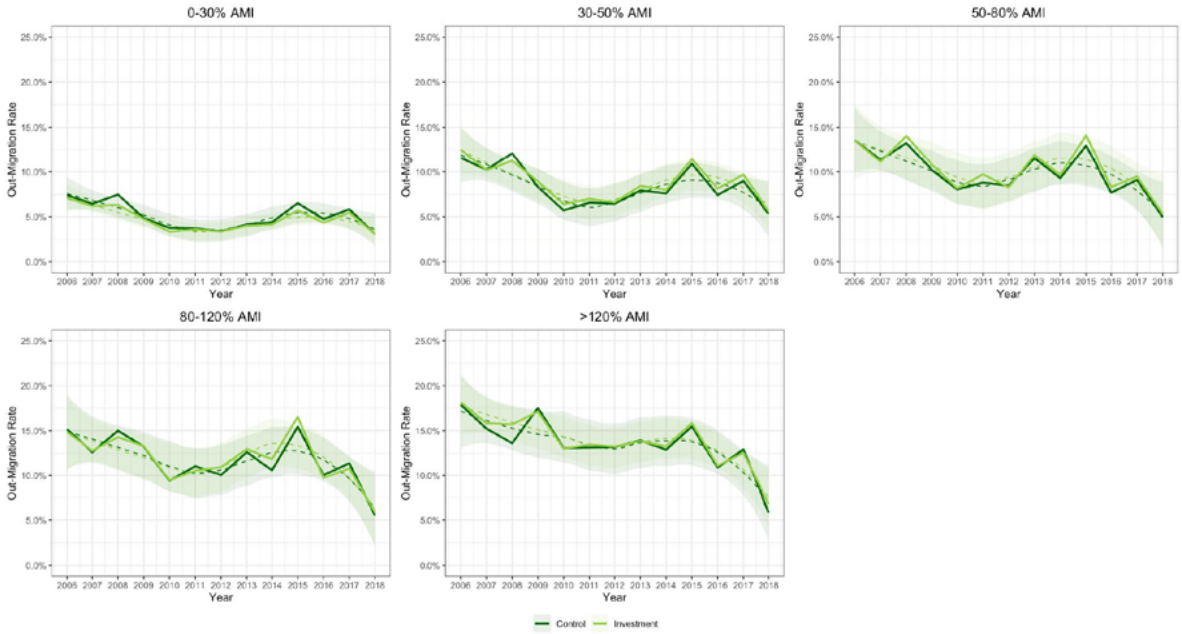


Figure 5: Average renter outmigration rates for investment and control neighborhoods by income



Migration rates are slightly higher (1-2 percentage points) in the investment tracts in Los Angeles County and Fresno County, while they are slightly lower (1-2 percentage points) in the investment tracts in the Bay Area and Sacramento County. The overall decline in migration rates observed in Figure 4 may be explained by real-world processes, fitting into a general narrative of declining migration rates that has taken place over the past several decades (Frey, 2020; Myers, Park, & Cho, 2021). On the other hand, these rates are somewhat lower than national migration statistics, which may be an artifact of the dataset: some households are not consistently tracked over time, and only households that can be tracked over time are retained. The decline in more recent years may also be partially attributed to the dataset: given that migration rates are calculated as a percentage of households that appear in any subsequent year in the dataset, fewer migrating households may be observed in 2018 because there is only one subsequent year (2019) in which that household might appear. Additionally, the fluctuations in outmigration rates between 2015 and 2018 suggest systematic biases in the structure of the migration panel. However, because these biases appear to affect all geographies relatively similarly, it is still valid to compare migration rates for different geographies.

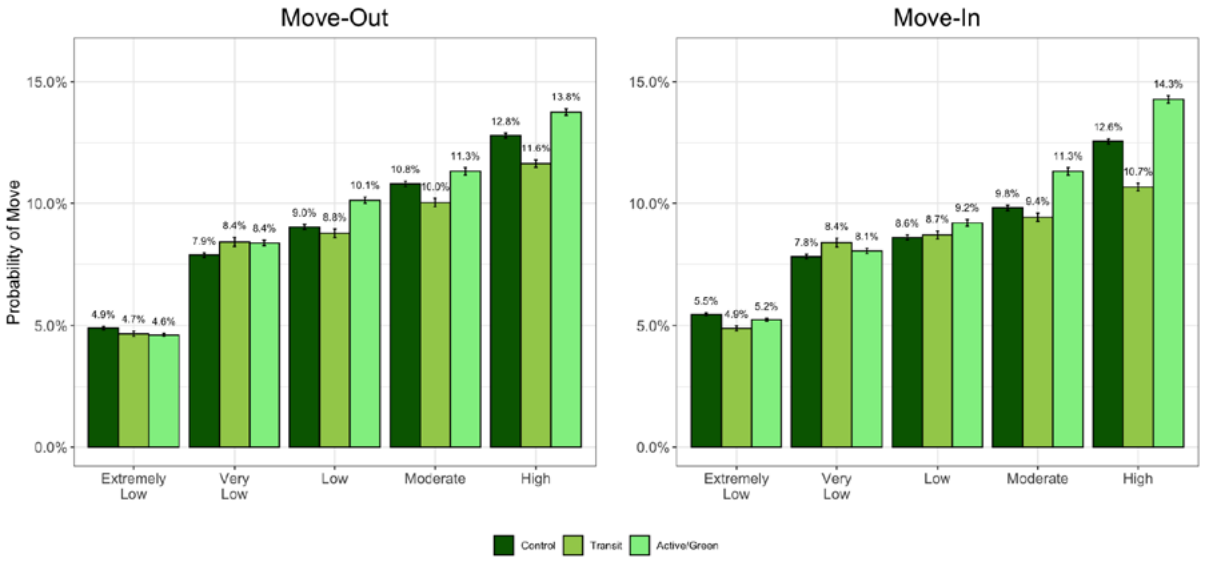
Examining outmigration rates for different income segments of the renter population demonstrates similar overall patterns of outmigration, with average migration rates that increase with income (Figure 5). This contrasts with the average migration rates for homeowners in the dataset, which stay consistent over time and largely do not differ substantially between income groups. There are a few possible explanations for this phenomenon. First, we are focused solely on moves outside of a census tract, meaning that moves within the same census tract are not captured; therefore, we may be capturing higher-income renter households that are more able to make longer-distance moves. Secondly, higher-income renters are generally more mobile than lower-income renters in general, having the resources to move frequently and at-will, and more choices of places to which to move.

Regression Results

We ran a series of models with increasing levels of complexity in order to test the underlying relationship between climate investments and probability of outmigration: 1) a model which tests for investment status, but does not differentiate between transit and active transportation/greening projects; 2) separating investments into the two aforementioned types;

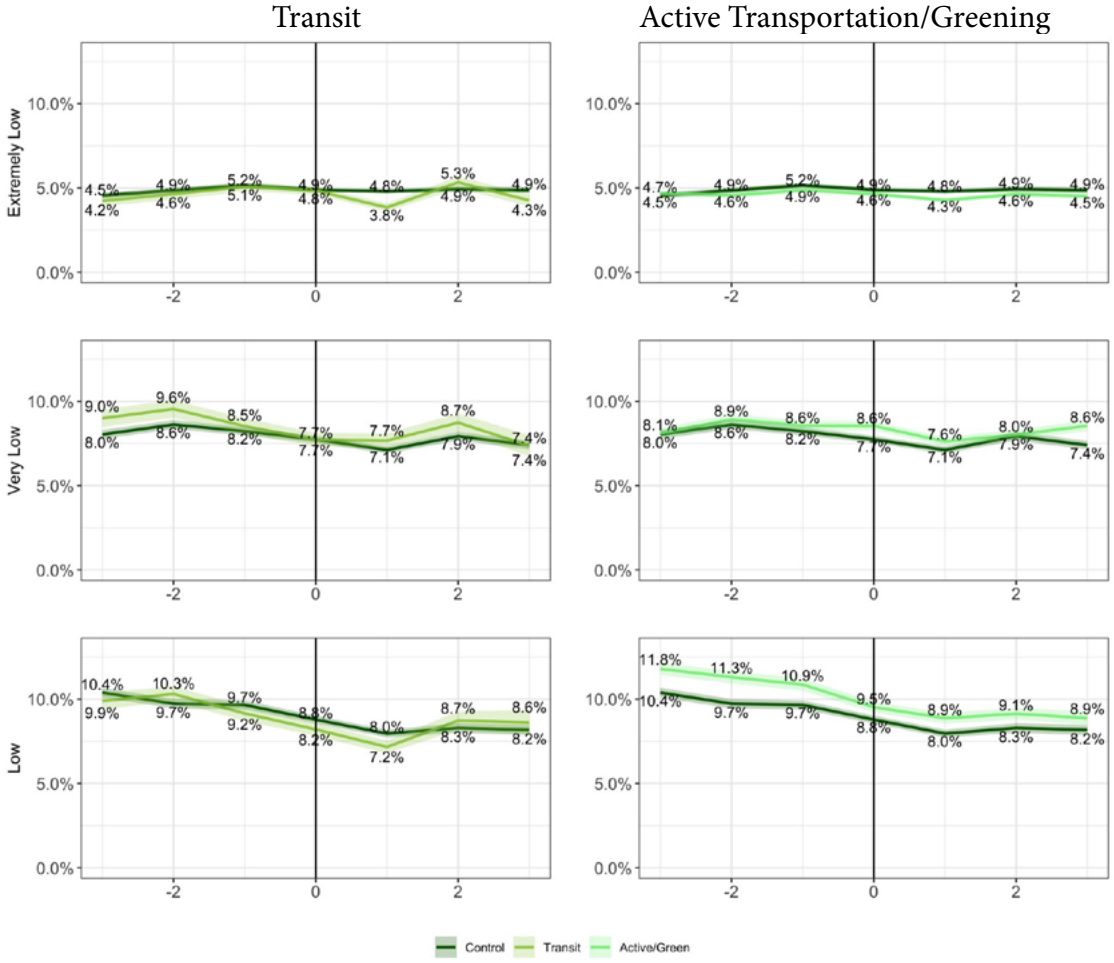
3) adding year fixed-effects to address differences in the year each project opened and the year each household was observed; 4) adding region fixed-effects to address differences between our four study regions; and 5) adding our neighborhood-level controls. Adding fixed-effects and neighborhood-level control variables do not substantially impact these key findings, although the introduction of these additional effects does reduce the magnitude of other coefficients in the model. Because the regression output can be difficult to interpret, we supplement our results with model predictions for each income category in order to demonstrate the effects of climate investments on each income category. The predicted values for our final model, including all fixed-effects and controls, are summarized in Figure C1. In short, it appears that the effects of living within a climate investment neighborhood around the time of its opening vary substantially by income group. For transit investment neighborhoods, we observe higher rates of outmigration only among VLI renter households, while for active transportation/greening neighborhoods we observe higher rates of outmigration among VLI, LI, MI, and HI households. ELI renter households do not exhibit higher rates of outmigration in either type of climate investment neighborhood (Figure 6).

Figure 6: Predicted probabilities of out- and in-migration for each income category within three years of project opening in control, transit, and active transportation/greening neighborhoods



While aggregating multiple years allows us to produce more robust estimates of migration probabilities in the years surrounding investment openings, this approach disguises any potential temporal trends. Therefore, using the full model with fixed effects and controls, we estimate a separate series of models for each individual time lag between 3 years prior to opening and 3 years after opening. We observe different temporal trends for each investment type among our three low-income categories of interest (Figure 7), leading to several interesting conclusions. First, as with the aggregate results in Figure 6, we find limited evidence for different migration rates among ELI households in investment neighborhoods, perhaps reflecting that the lowest segment of the rental market may be less impacted by investment pressures because they live in subsidized or poor quality units. Second, we find elevated levels of outmigration for VLI renters in transit investment neighborhoods in the years preceding and following the opening of transit investments, which may indicate both anticipatory effects of transit projects opening as well as increased displacement pressures once the projects have opened. Third, we see elevated levels of outmigration among LI renters in active transportation/greening neighborhoods; however,

Figure 7: Predicted probabilities of outmigration for lower-income renters in climate investment and control neighborhoods in each year



because these rates are consistently higher and exhibit the same trends as the control neighborhoods over time, it seems likely that the neighborhoods receiving such investments were already primed for higher levels of displacement, perhaps due to existing amenities. Finally, in most cases outmigration rates taper over time.

Regional Results

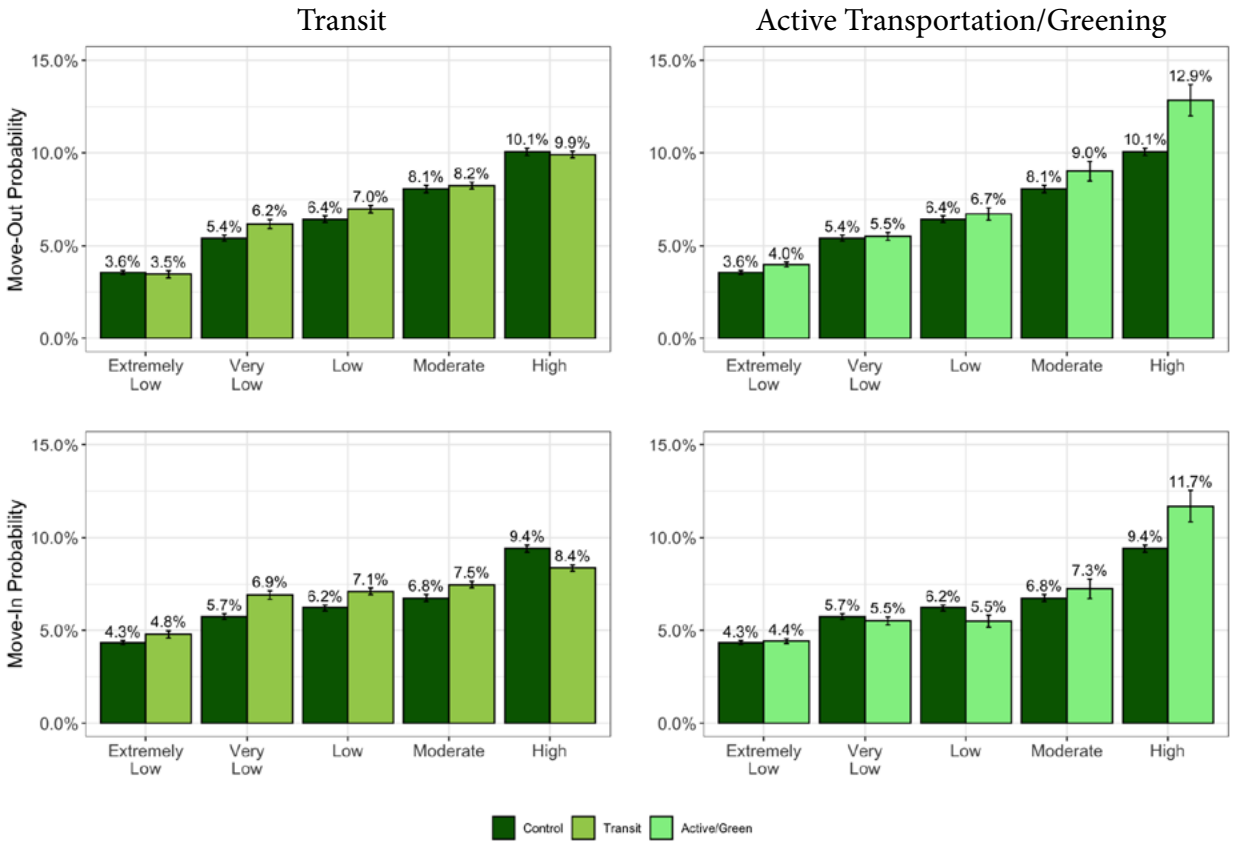
Although the above model results control for differences between regions, they cannot accurately reflect any non-linear differences in the effects of different types of climate investments within different regions. Therefore, we also run a series of models on subsets of the data, analyzing the relationship between climate investments and move-outs for each investment type within each region.[7]

Los Angeles

In Los Angeles County, both VLI and LI renter households experienced slightly higher rates of outmigration on average around the time of transit project completion (between three years before and three years after) than households in similar comparison neighborhoods (Figure 8). The effects of neighborhood-level controls in this model are negligible.

When controlling for the aforementioned neighborhood characteristics, mean outmigration rates are approximately 0.8 percentage points higher for VLI renters and 0.6 percentage points higher on average for LI renters in transit investment tracts in this time period. The latter statistic means that for a tract with 1,000 LI renter households, the transit investment was associated with the moves of

Figure 8: Predicted probabilities of out- and in-migration for each income category within three years of project opening in Los Angeles County



six additional households relative to a comparison control neighborhood. It should be noted that these neighborhoods also experienced heightened levels of in-migration among the lower-income categories during the study period, which suggests that while households are more likely to move out, there is also more turnover in these groups, so the lower-income renter populations may not have changed in size in these neighborhoods.[8]

For active transportation/greening investment neighborhoods, meanwhile, we observe slightly higher outmigration rates and substantially lower in-migration rates for lower-income households, suggesting that there may be a net outmigration effect in those neighborhoods.

While these effects are fairly small, it is important to note that the treatment effects vary significantly between different projects. One of the largest transit projects in Los Angeles during our study period was the Expo Line, which was carried out in two phases: the first segment between Los Angeles and Culver City was completed in 2012, while the second segment between Culver City and Santa Monica was completed in 2016. Examining trends in outmigration for our three segments of low-income renter households, we observe that outmigration rates for the first phase of the project were broadly similar between the treatment and control neighborhoods over the course of our study period, with small fluctuations over time. Neighborhoods along the second phase of the project, on the other hand, displayed consistently higher rates of outmigration than their non-investment counterparts (Figure 9).

Modeling trends over time, then, tells a more nuanced story. While we similarly detect evidence of higher outmigration rates for VLI and LI groups (Figure 10), the differences between those groups and the control neighborhoods are most significant two years before the opening of the project, and decrease over time. One possible explanation for this phenomenon is that those households most vulnerable to displacement

Figure 9: Average outmigration rates for the Expo Line project in Los Angeles County – Phase 1 to Culver City (completed 2012) and Phase 2 to Santa Monica (completed 2016)

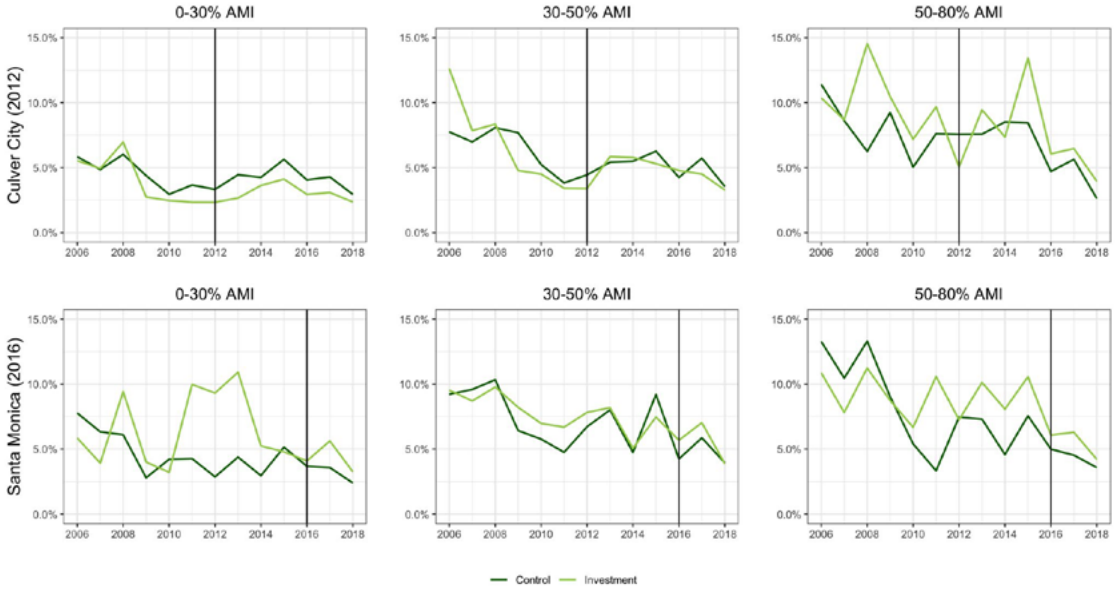
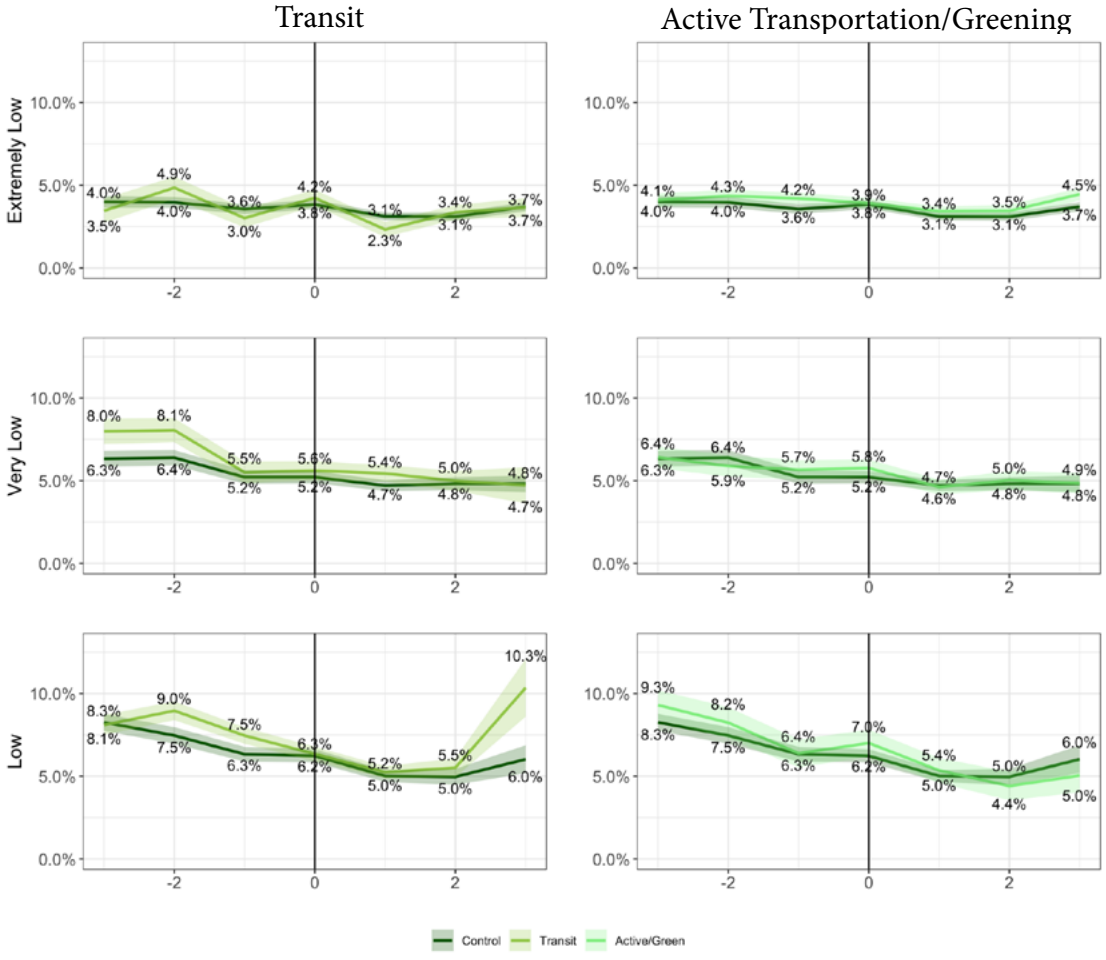


Figure 10: Predicted probabilities of outmigration for lower-income renters in climate investment and control neighborhoods in each year in Los Angeles County



are displaced first as the market anticipates the completion of the transit investment, which means that by the time the investment is completed, many of the most vulnerable households have already been displaced. It should be noted that fewer investment tracts could be observed three years after project completion due to the fact that we could not observe any move-outs after 2018, so the spike in outmigration rates at that time lag is likely a result of that smaller sample size. For active transportation/greening investments, meanwhile, we observe that the treatment and control neighborhoods broadly exhibit the same trends on average.

Bay Area

For the Bay Area, we similarly find higher rates of outmigration for VLI and LI renters in transit investment neighborhoods, and higher rates of outmigration for all income groups except ELI households in active transportation/greening investment neighborhoods (Figure 11). Outmigration rates generally exceed in-migration rates when transit investment occurs, but in-migration slightly exceeds outmigration for ELI, MI, and HI renters in the case of active transportation/greening investment.

While these results appear similar to those observed in Los Angeles, the effects may not apply to all individual investments. Whereas the Los Angeles County investments included several major extensions to the regional metro system, including the Expo Line and the Gold Line, the one major transit project completed during the study period—the Third Street Light Rail in southeast San Francisco completed in 2007—exhibits lower rates of outmigration than expected for the lower-income groups (Figure 12). It is worth noting that the amenity value of the Third Street Light Rail may be limited by its relatively slow travel time, particularly to central destinations in downtown San Francisco.

Figure 11: Predicted probabilities of out- and in-migration for each income category within three years of project opening in the Bay Area

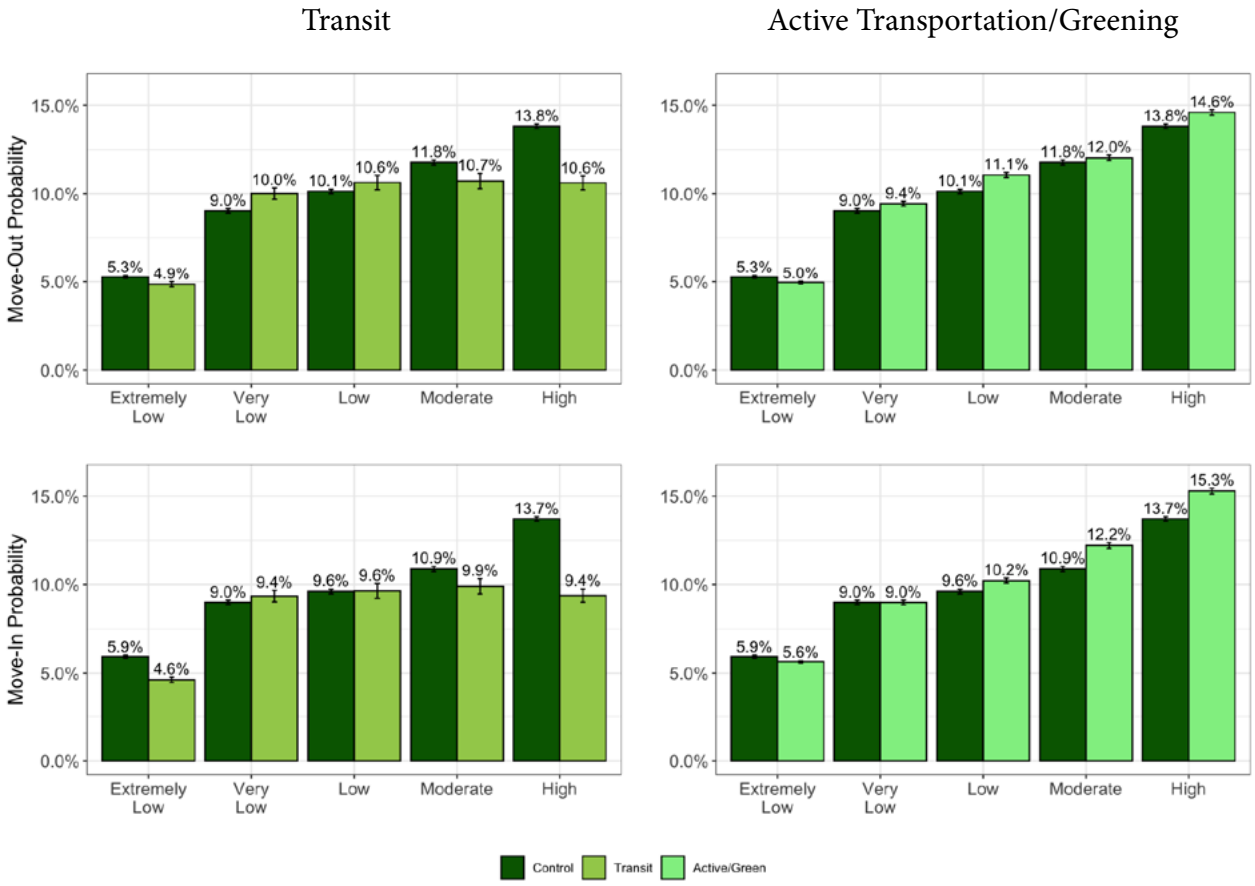


Figure 12: Average outmigration rates for the Third Street Light Rail in San Francisco County (completed 2007)

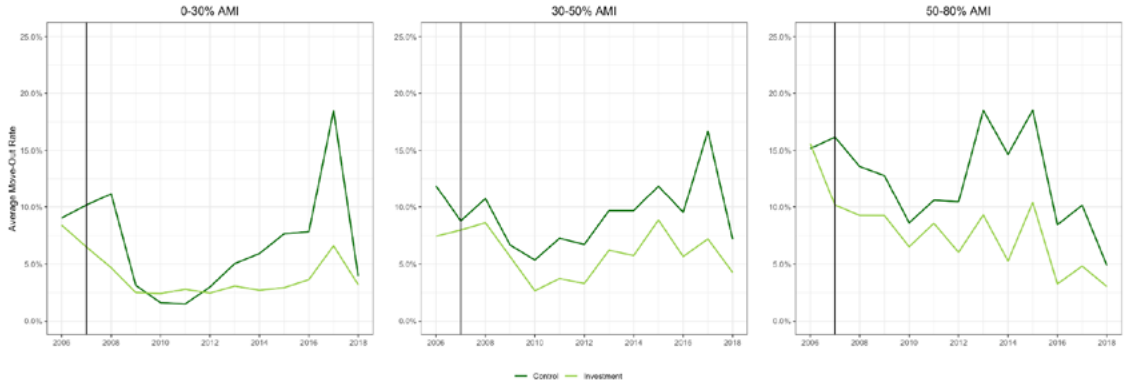
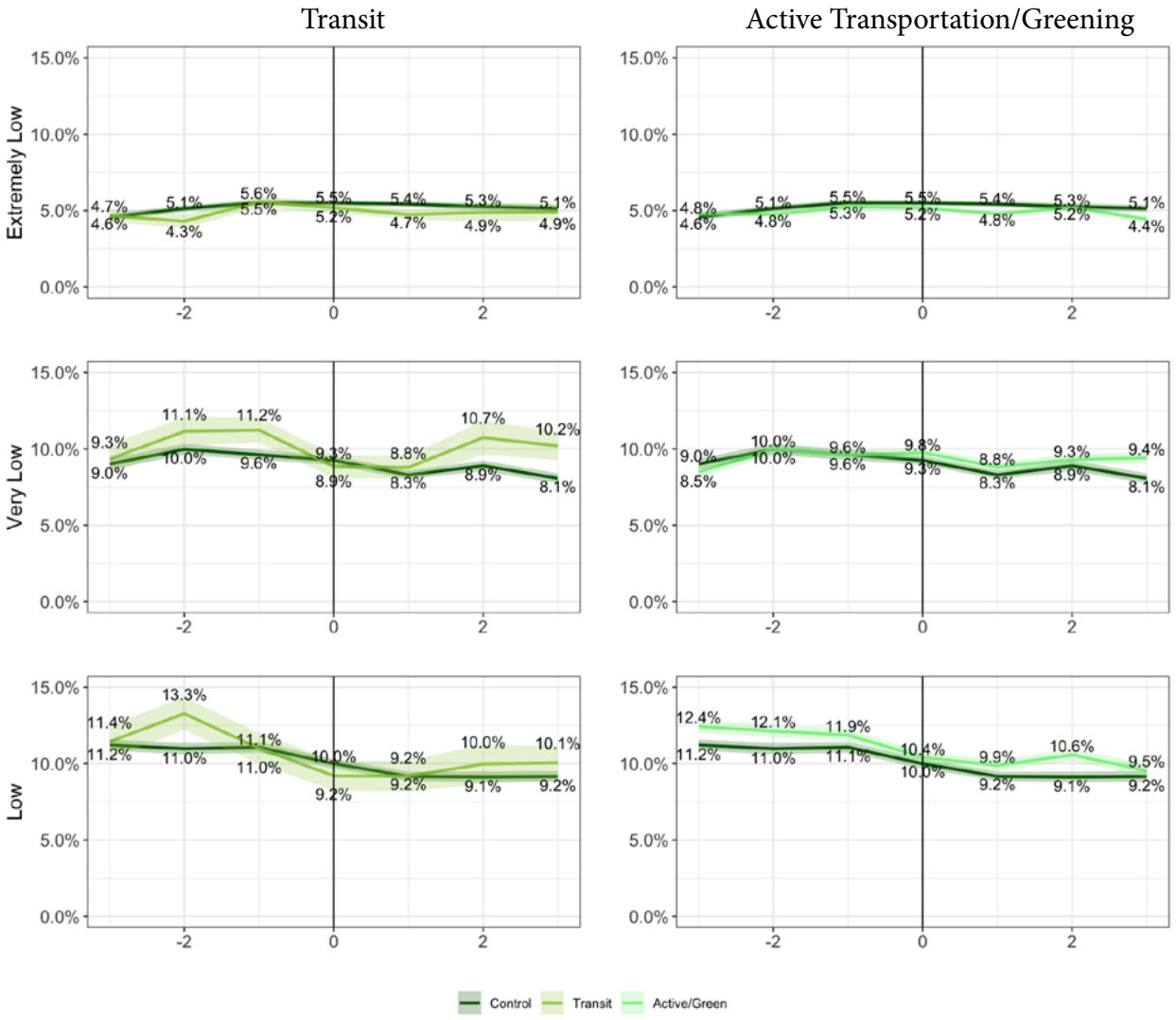


Figure 13: Predicted probabilities of outmigration for lower-income renters in climate investment and control neighborhoods in each year in the Bay Area

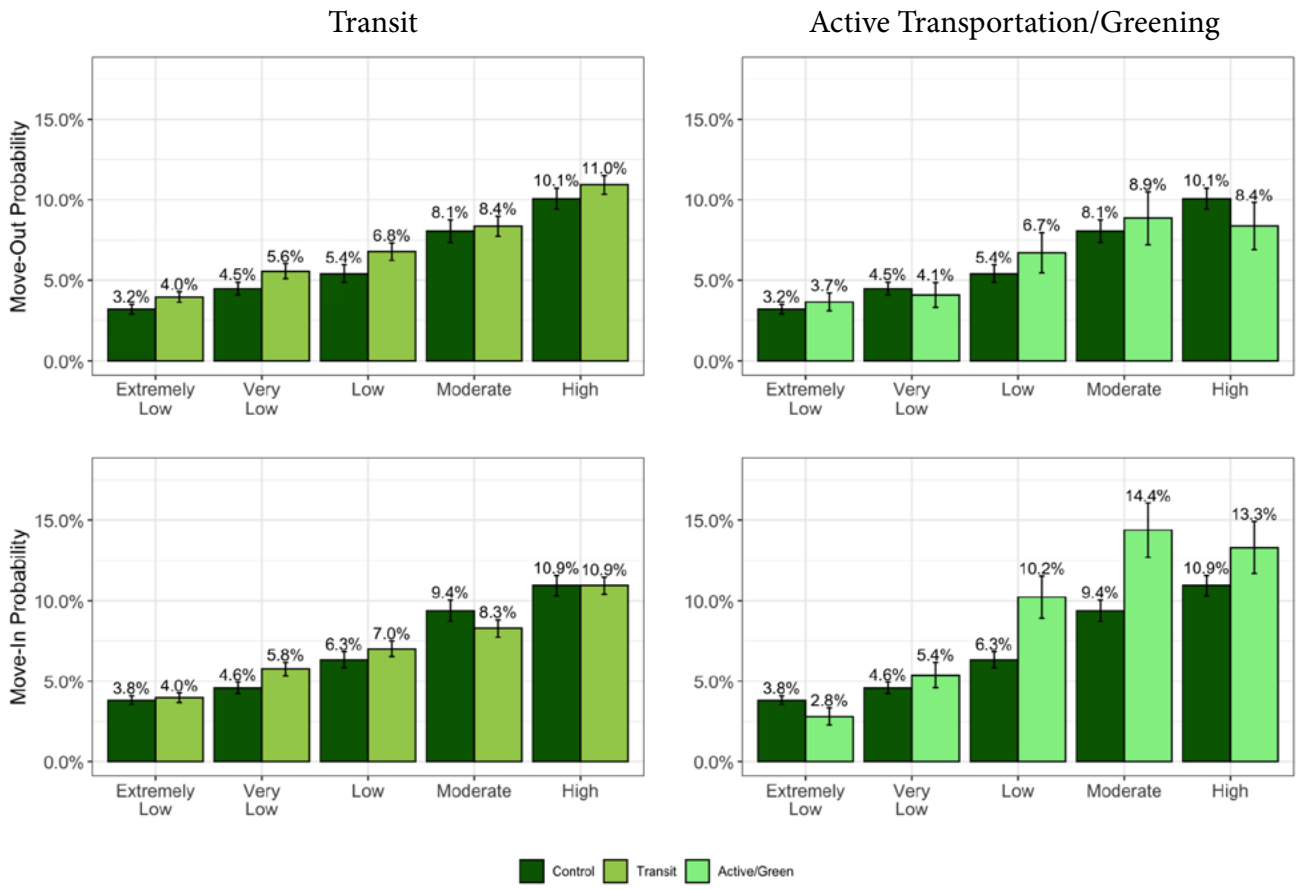


Examining the average trends for transit investments, we see that outmigration in transit investment tracts is generally fairly similar to control tracts; however, migration rates do increase in transit investment tracts two years after the completion of transit projects, suggesting a possibly delayed effect from the completion of the transit projects. For active transportation/greening projects, meanwhile, we see fairly consistent trends over time, with migration rates for ELI households staying somewhat lower than the control neighborhoods, while VLI and LI renters appear to experience higher migration rates in active transportation/greening investment tracts on average.

Fresno

In Fresno, migration effects associated with neighborhoods surrounding the city's BRT line—the only transit investment identified in the study region—are generally fairly minor, with slightly higher average probabilities of out-moves among VLI and LI households and slightly higher average probabilities of in-moves among VLI households relative to the control neighborhoods (Figure 14). Given the unique nature of the BRT line and the fact that it passes through several major corridors in the city, it is difficult to directly attribute these effects to the BRT line itself. For the active transportation/greening category, our analysis is constrained by the size of our sample: we are only able to examine four projects covering seven investment tracts, which leads to less reliable estimates and larger confidence intervals. However, the estimates that are available suggest that the differences between active transportation/greening investment neighborhoods and control neighborhoods are minimal; only ELI and LI households are more likely to move out.

Figure 14: Predicted probabilities of out- and in-migration for each income category within three years of project opening in Fresno County



Although the move-out rates are slightly higher on average in the transit investment tracts, a closer examination of the single transit investment project in Fresno (Figure 15) reveals that the outmigration rates for investment tracts largely parallel the rates in control tracts in the years leading up to the completion of the BRT improvements in 2018. This means that while there may have been a higher probability of low-income outmigration in those investment tracts, it is difficult to point to a specific anticipatory effect resulting from the BRT project.

Unfortunately, our ability to draw conclusions from the Fresno case study is limited due to the fact that we cannot see the impacts of the Fresno BRT improvements in the years following their completion in 2018, and the small sample size of active transportation/greening investments precludes a closer analysis of the temporal trends in migration rates. It will be crucial to examine the impacts of these investments—particularly larger ones such as the Fresno BRT line as well as the Fulton Street Mall Reconstruction project—in the coming years.

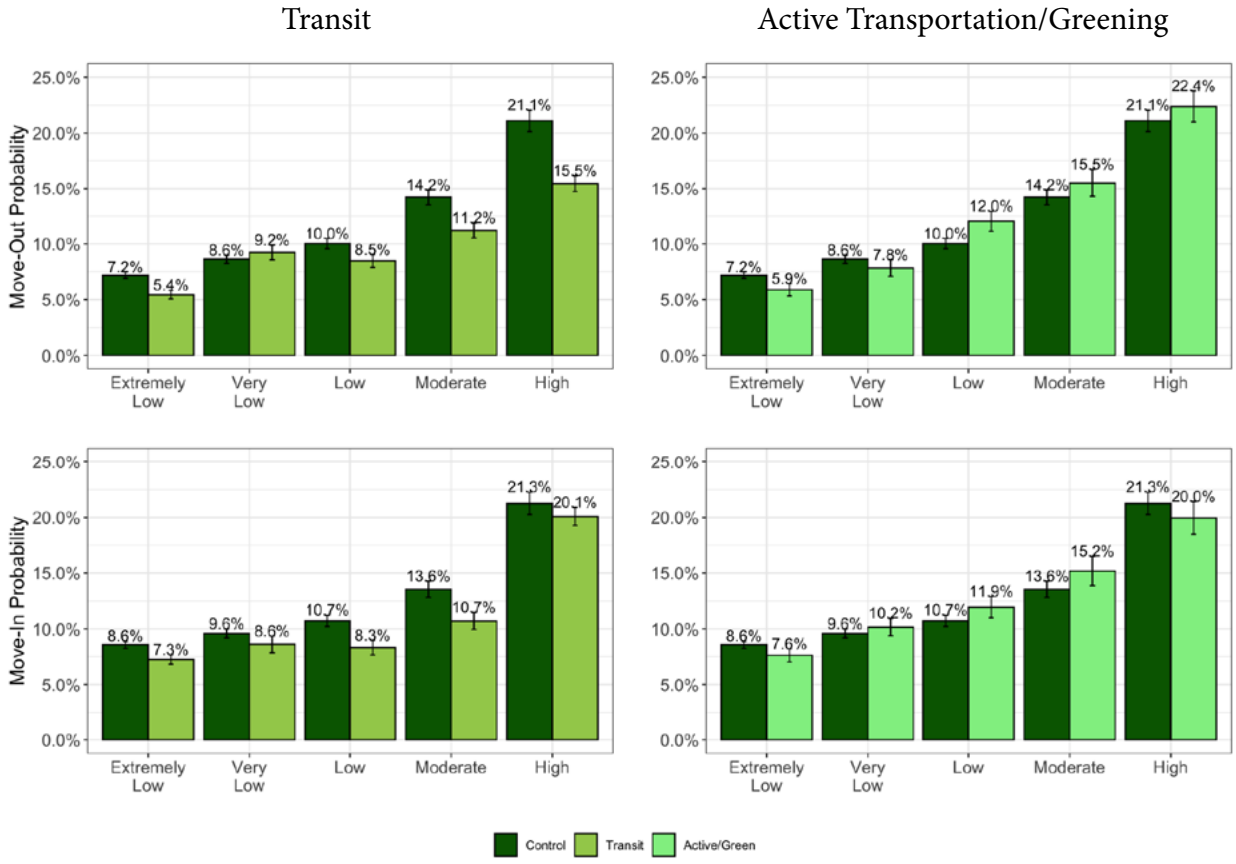
Figure 15: Average outmigration rates for Fresno BRT Improvements in Fresno County (completed 2018)

Sacramento

In Sacramento County, we observe generally similar or slightly lower rates of outmigration for ELI and VLI households in investment neighborhoods relative to the control neighborhoods (Figure 16). As with Fresno, however, these estimates are severely constrained by limited sample sizes—within Sacramento County, we observe only 6 transit investment sites covering 20 census tracts and 6 active transportation/greening investment sites covering 10 census tracts. This lack of a robust sample makes it difficult to draw any definitive conclusions, as does the relatively small scale of the investments under investigation—with the exception of the 4-station South Line Light Rail extension into southern Sacramento, most of the climate investments included are relatively small in scale.

In sum, climate investments sometimes lead to higher outmigration rates, but the impact is always minor and varies significantly by region, investment type, income group, and even project (Tables 3 and 4). Active transportation/greening investments more consistently result in outmigration than do transit investments. VLI and LI renters are particularly prone to displacement impacts, with effects on groups differing by region. When migration impacts increase, it is typically by less than one percentage point and rarely more than two percentage points; this means, for example, that in a neighborhood where 10 of 100 low-income households move out each year, now 11 or 12 will move out. For transit investments in Los Angeles and active transportation/greening in the Bay Area, some of the same income groups are in-migrating into the neighborhood at a higher rate than outmigration is occurring. However, ELI renter households generally remain in place when climate investment occurs, perhaps due to residence in subsidized housing. Particularly with

Figure 16: Predicted probabilities of out- and in-migration for each income category within three years of project opening in Sacramento County



transit investments, increases in outmigration may occur well before or after the opening, indicating anticipatory or delayed effects.

The broad conclusion from this quantitative analysis is that the specific outmigration effects associated with climate investments are small and contextually specific. While higher outmigration rates are observed among certain income groups and at certain points in time, there is no consistent relationship detected between different climate investments and outmigration rates. In a few cases, there is net positive in-migration for low-income groups instead of displacement. This could reflect the effectiveness of anti-displacement policy in the San Francisco Bay Area; the types of investments or neighborhoods could also differ between regions. We observe some anticipatory and delayed effects of the investments; once more time has elapsed since construction, it will be possible for future research to explore these impacts in more detail.

There are a number of shortcomings to this analysis which should be noted. First, the migration data panel has limitations; even after filtering down to households for which income estimates were more stable and consistent, we observe large fluctuations in outmigration rates from one year to another. While we attempt to address these inconsistencies by including year fixed-effects in our models, the fluctuations between years and between census tracts are significant enough to impact the results. Additionally, our matching strategy is relatively coarse, matching entirely based on neighborhood characteristics. This means that the baseline migration rates may differ between treatment and control neighborhoods. Future analyses would benefit from matching at the individual household level in order to increase the effectiveness of the matching.

The outmigration effects of climate investments are small and variable. This leads to two key findings: first, it is likely possible to mitigate the short-term effects via anti-displacement policies (e.g., the

Table 3: Direction of Impact of Transit Investments on Outmigration Rates, by Income Group and Region

	Extremely Low-Income	Very Low-Income	Low-Income	Moderate-Income	High-Income
Los Angeles		+	+		
Bay Area	-	+	+	-	-
Sacramento	-	+	-	-	-
Fresno		+	+		

Table 4: Direction of Impact of Active Transportation/Greening Investments on Outmigration Rates, by Income Group and Region

	Extremely Low-Income	Very Low-Income	Low-Income	Moderate-Income	High-Income
Los Angeles	+	+	+	+	+
Bay Area	-	+	+	+	+
Sacramento	-				
Fresno	+		+		

construction or preservation of affordable housing), and second, local communities can (and should) play a role in the selection of which anti-displacement policy is appropriate. This suggests an important role for community organizing. In the following section, our six case studies shed light on how communities might organize for specific anti-displacement policies.

Case study results

A series of six case studies describe key investments across the three study regions, illuminate community perspectives on the planning and implementation processes, and provide insights into both how community organizing can occur and what type of mitigations to support. This section provides a summary of the six case studies and key lessons learned. Appendix D presents the case studies in full.

Whose Downtown Fresno? Community Perspectives on the Tensions and Tradeoffs of Reinvestment

Following a history of white flight, disinvestment in the urban core, and racial and economic segregation, the City of Fresno has made downtown revitalization a central component of its urban planning agenda in recent years. Since the mid-2000s, new investments in parks, housing, transit, and streetscape improvements have transformed the downtown area, accompanied by rising rents that threaten to push priced-burdened residents—predominantly communities of color—out of their neighborhoods. However, an increased focus on community-driven planning and anti-displacement initiatives has shifted how the city approaches new investments. One example is Transform Fresno (funded by the Strategic Growth Council's Transformative Climate Communities or TCC program), a community-led process for identifying priority investments throughout the city that would create environmental and economic benefits for residents. The result is a plan for projects such as affordable housing, energy efficient improvements to existing housing, parks and green space, electric vehicle and bicycle-sharing programs, plus the construction of a Fresno City College satellite campus.

The city also established an Anti-Displacement Task Force that included many of the same participants from Transform Fresno as well as the earlier Downtown Neighborhoods Community Plan. The task force developed a citywide Displacement Avoidance Plan in 2019 and a set of community-informed policy recommendations as part of their "Here to Stay" report in 2021. Although some interviewees felt that the city has not implemented

sufficient anti-displacement policies, and that much more action is needed to build and preserve affordable housing, many felt that the increased role of residents and advocacy organizations in planning processes represents a step in the right direction.

Balancing Black Cultural Preservation with Regional Growth: Community Perspectives on the Revitalization of Crenshaw Blvd. in South Los Angeles and Inglewood

Crenshaw Boulevard, a major north-south corridor connecting central and south Los Angeles, runs through multiple neighborhoods known as epicenters of Black life in the city. These neighborhoods—namely Crenshaw, Inglewood, Leimert Park, Hyde Park, and Morningside Park—have experienced increasing displacement pressures as their Black populations decline and housing prices skyrocket. The area, a growing regional sports and entertainment hub, is experiencing an influx of major investments that have exacerbated these pressures and prompted community leaders to mobilize around issues of housing and displacement. The construction of SoFi Stadium and planned construction of the Inglewood Basketball and Entertainment Center (IBEC) in particular spurred the creation of Uplift Inglewood, a coalition of residents, businesses, faith groups, and community organizations that advocate for long-term housing stability for existing residents. The coalition started a campaign called "Homes Before Arenas" to push for community benefits from the IBEC project, ultimately achieving a $100 million from the developer plus local hiring requirements and other policies. Uplift Inglewood also successfully advocated for the passage of rent stabilization.

Another major investment along the boulevard is the Crenshaw/LAX line, an extension of the region's light rail system that runs through south Los Angeles. Before construction began on the project, Metro formed the Community Leadership Council (CLC), an advisory body composed of local community leaders and business owners, to steward the community engagement process. These individuals and other community coalitions played a key role in prioritizing residents' concerns around the project, leading to some concrete changes to the original plans. The West Angeles Community Development Corporation deepened public engagement with the process by hosting a series of workshops called "TOD University" to educate residents about planning efforts related to the light rail.

Many interviewees described Black community ownership as a fundamental model for future equitable development in the area, and noted that there are already several attempts to make this a reality. For example, resident-based coalition Downtown Crenshaw Rising started a campaign to collectively purchase the Baldwin Hills Crenshaw Plaza shopping center and transform it into housing, community spaces, and locally-owned businesses. Efforts to buy the mall, however, have not yet been successful. Another project, Destination Crenshaw—an open-air museum celebrating Black Angeleno culture in the neighborhood which would "place a cultural stamp of Blackness on Crenshaw Boulevard" and establish a precedent for community-based investment—is also in the works.

While there is hope about the future success of community ownership models, interviewees emphasized the need for these models to be paired with city- and county-wide redistributive policies that prioritize low-income BIPOC residents. Some policies mentioned include expanding targeted local hiring strategies for large-scale investments, creating more opportunities for community control of land, and prioritizing BIPOC small business in pandemic recovery efforts. While some progress has been made—for example, Los Angeles County established a $14 million pilot program in 2021 to help more community-based organizations establish Community Land Trusts (CLTs) to acquire property for affordable housing and economic development—the future is still uncertain, as the full impacts of current large-scale investments are not yet known.

Whose Parks? Community Perspectives on the Revitalization of the Los Angeles River

Many of the neighborhoods along the Los Angeles River, a 51-mile long concretized channel and the

city's main waterway, have until recently been largely industrial and lower-income. In recent years, river restoration projects and investments such as parks, bike paths and mixed-income development have begun to transform these neighborhoods, sparking concern about "green gentrification." Interviewees explained that even the announcement of new park investments has led to real estate speculation and rising housing prices. Much of the new investment, including two mixed-use projects called Taylor Yard and the Casitas Lofts, is concentrated along a stretch of the river between Elysian Park and Downtown Los Angeles. The plan for the Taylor Yard project includes a 100-acre park with community facilities, cafe and museum, plus a "transit village" with some affordable housing.

To counter the negative impacts of these new investments, environmental and anti-displacement advocates have strengthened their relationships and consolidated their efforts to simultaneously improve the physical quality of the area and keep low-income residents in place. For example, the Los Angeles Regional Open Space and Affordable Housing (LA ROSAH) collaborative published policy recommendations for incorporating affordable housing into future park investments, and the Audubon Center at Debs Park joined forces with the Southeast Asian Community Alliance and Public Counsel to publish a similar report on addressing green gentrification. Interviewees generally agreed that truly equitable development along the river will require greater alignment among advocacy groups that focus on conservation, anti-displacement, and park equity.

In response to pressure from these grassroots coalitions, government agencies have started to incorporate anti-displacement measures into their planning processes for parks and green infrastructure. In 2016, Los Angeles voters passed Measure A, a tax that provides $96.8 million annually for parks projects—one-third of which is designated specifically for high-need communities. The Regional Parks and Open Space District, the county-level agency in charge of administering the funds, is moving to incorporate anti-displacement strategies into its grant application process. The county's $14 million CLT pilot, as well as potential land banking for the development of affordable housing, may help these strategies become reality.

Transit-Oriented Development amid Regional Growth: Community Perspectives on the South Line Extension in Sacramento

The extension of the South Line light rail is part of a larger transit-oriented development (TOD) strategy in Sacramento that aims to sustainably accommodate growth by improving transit connectivity and reducing traffic congestion and automobile emissions. The TOD Action Plan and Toolkit, created in 2020 by the Sacramento Regional Transit District (SacRT) and Sacramento Area Council of Governments (SACOG), includes plans for mixed-use developments surrounding transit stations throughout the region. In addition to the construction of the South Line, the city has also expanded its multimodal transportation system by adding options like electric bicycles and scooters, and introducing an on-demand shuttle service called SmartRide. Despite the "culture of transit" the city is trying to create, some interviewees were skeptical that residents' transportation habits will change significantly, given the relative convenience of driving.

While not a lot of development has occurred around transit stations to date, the South Line runs through areas of south Sacramento that are disproportionately lower-income, have high minority populations, and may be vulnerable to displacement. The expansion of the University of California Davis Medical Center has raised concerns about rising rents in the city as well. In response to these concerns, a coalition called Sacramento Investment Without Displacement worked with the UC Regents to develop a community benefits agreement that prioritizes preservation of affordable housing as part of the expansion. Other measures taken by the city include the passage of an inclusionary zoning ordinance and the elimination of single-family zoning (which occurred months before its elimination at the state level), which could help alleviate some of the pressures that Sacramento's recent growth has put on the housing market.

From Thoroughfare to Destination: Community Perspectives on Alameda Plan for the Beautiful Way, San Jose

The Plan for the Beautiful Way is a streetscape improvement project that transformed The Alameda—a segment of the El Camino Real and the area that surrounds it—into a more walkable and bike-friendly commercial district. Interviewees were generally pleased with the level of community engagement in the process. Local religious leaders played a key role in organizing residents, and the Department of Transportation, which funded the project, established a community steering committee to guide the plan. Residents and business owners also praised the subsequent design, explaining that it has supported economic development by attracting pedestrians. While The Alameda has struggled economically during COVID-19, recent initiatives like the Second Saturday Art Walk have helped to revive the district and encourage customers to patronize local businesses.

While the streetscape improvements have not appeared to cause considerable gentrification, housing prices in the area have been rising steeply in recent years and concern about displacement was common among interviewees. The planned Google campus nearby in San Jose is currently the main source of tension around housing affordability. The Diridon Area Neighborhood Group (DANG)—a coalition of residents and neighborhood associations—has led negotiations around the campus plan, with the goal of supporting community-responsive investment that addresses resident concerns. Additionally, the City of San Jose created both a Citywide Residential Anti-Displacement Strategy and Diridon Affordable Housing Implementation Plan, which provide a guiding equity framework for the Google campus. In April 2021, Google released their $200 million community benefits plan, which includes initiatives to preserve affordable housing, services for the homeless, workforce development for adults and youth, and small business support.

Along with these more formal plans, interviewees emphasized the importance of other policies and programs that support residents and businesses. For example, institutions such as Sacred Heart Community Services have served as an important support system for housing insecure residents who are particularly vulnerable to COVID-19's economic impacts. By providing cash relief, legal support and case management to residents at risk of becoming homeless, Sacred Heart Community Services sees itself as an "anti-displacement mechanism." Pandemic recovery strategies, like San Jose's "Al Fresco" outdoor dining program and local eviction moratoria, should also be considered critical anti-displacement tools.

California's Low Income Weatherization Multi-Family Program: Progresses, Challenges, and Implications for Housing Justice

The Low Income Weatherization (LIWP) Multi-Family Program—which provides energy efficient home upgrades at low cost to property owners and no cost to low-income renters—simultaneously addresses sustainability, public health, and housing affordability goals. The program reduces greenhouse gas emissions from California's housing stock while keeping low-income families safe in their homes during increasingly intense and frequent climate and public health emergencies, such as wildfires and the COVID-19 pandemic. LIWP also provides direct economic benefits to low-income renters through energy cost savings, thereby increasing their financial resiliency and indirectly helping to prevent displacement.

Given that LIWP is not place-specific, this case study examines the overall program rather than its impact on a specific community. Because the focus of LIWP Multi-Family is on deed-restricted affordable housing properties, there are already provisions in place that protect tenants from excessive rent increases. Specifically, the program requires property owners to commit to ten years of affordability. However, the program lacks a strong enforcement mechanism and currently only has funding until 2024, after which there will be no program to enforce the affordability covenants. For low-income households in housing without deed restrictions, interviewees

explained, addressing issues of displacement would require that a separate governmental entity establish protections for low-income renters in these types of properties. Interviewees also suggested increasing education around the program and tenants' rights; making the program entirely no-cost for property owners; aligning with local hiring and green jobs-focused organizations so the program can provide employment opportunities for families served by the program; and engaging in public-private partnerships to sustain the program financially.

Key lessons learned

These case studies offer three important lessons for communities who are experiencing climate-related public investments, whether transit, active transportation, parks, or infill development.
First, **bottom-up and top-down policy-making need to occur simultaneously** in order to put anti-displacement policy in place expeditiously. As the cases of Crenshaw Boulevard, LA River, and The Alameda show, local organizing or coalition-building around anti-displacement policy or community benefits builds leadership capacity and puts pressure on the public sector. However, change occurs fastest when governments are already putting resources or programs in place. Thus Downtown Crenshaw Rising's push for community ownership may become formalized via LA County's CLT pilot program; organizing around the LA River is met by the parks district's formal incorporation of anti-displacement strategies, and the Diridon Area Neighborhood Group's actions found support via San Jose's Citywide Residential Anti-Displacement Strategy. In some cases, community organizing is spurring implementation of the city or county strategies, but in others, these processes are occurring simultaneously and create mutual reinforcement.

Second, **either organized efforts to resist private development or incorporation into formal government policy-making processes play a critical role in increasing critical community capacity.** Formal roles in the Anti-Displacement Task Force and Transform Fresno bolstered community capacity in Fresno; Metro formed the Community Leadership Council for the Crenshaw/LAX line; and a community steering committee helped shape the Alameda Plan for the Beautiful Way. New capabilities have also formed in reaction to developments in San Jose (Google), Sacramento (UC Davis Medical Center), and Los Angeles (SoFi Stadium). In all of these cases, new leadership emerged—whether in response to a development project proposal or through official involvement in government processes—which then helped the community engage in a more sophisticated discussion about climate investment and anti-displacement policy.
And third, **education about climate investments, anti-displacement policies, and tenants' rights will help to find consensus-based approaches.** Los Angeles provides two examples of educational efforts that helped to set the stage for discussions about displacement: TOD University, which educated residents about light rail in West Los Angeles, and numerous organizations publishing recommendations for addressing green gentrification and affordable housing needs around the LA River. Likewise, the publication of the Displacement Avoidance Plan in Fresno has helped provide a framework for future organizing around climate investments. Each effort like this empowers the community to develop thoughtful positions as new investments arise.

Interactive Tool

This project culminated with the development of an interactive tool to help policymakers and communities better understand the relationship between climate investments and household mobility. For each investment, we included a pop-up that lists the name of the project, the year construction started, the year the project went into operation, the type of project (transit, urban infill, or active transportation/greening), project cost (grouped into categories; not exact numbers), and the program that funded the project. The tool also shows a choropleth map of migration data by census tract, allowing the user to filter based on the (1) household type (renters only or both renters and owners); (2) type of migration (net in-migration, in-migration or outmigration); (3) time period (2006-2010, 2011-2014, 2015-2019 or 2006-2019); and (4) the income category of movers

(extremely low, very low, low, moderate, and high). The user can click on each census tract to see a set of demographic and housing-related ACS variables, for 2019 as well as changes between 2010 and 2019. Lastly, the tool maps "bubbles" that correspond in size to the number of market-rate and subsidized units, respectively, built by census tract in the time period selected by the user.

Conclusion

Investments meant to mitigate climate change have unintended consequences, sometimes increasing outmigration rates. Yet, these effects are small and contextually specific. This then creates both an imperative and a space for action. If impacts are small, they are likely mitigable. And if they vary by region, investment type, income group, and even project, it will be important to engage local communities in determining the exact shape that this mitigation should take.

Just for example, above we presented the example of an increase in outmigration of 0.8 percent for VLI renter households near new transit in Los Angeles, 0.6 percent for LI, and 0.1 percent for MI. For a tract with 1,000 such households in each of these three groups, transit investment would be associated with the moves (i.e., displacement) of eight additional VLI, six LI, and one MI households within the three years before and three years after opening. Although we were not able to analyze a longer time period, we did find that there were anticipatory and lagging effects of investments, so the number of households displaced would likely be higher (though the exact number would depend on the local context). This means that mitigating the impact of a new transit station in this neighborhood would require the construction or preservation of a mid-size apartment building.

Given the variation from project to project, neighborhood to neighborhood, this outcome should not be used as a formula, but rather as a baseline for discussion. Local contextual factors—for example, the anti-displacement policies in place and the vulnerability of the existing population—will determine whether displacement is lower or higher in a particular case. But these numbers give some dimensions to the problem, which then can form the basis of community and policymaker discussions. Likewise, given the variety of neighborhoods currently receiving climate-related investments, the type of mitigation applied will vary. In previous work, we describe the types of anti-displacement policies that will work in different contexts (Chapple & Loukaitou-Sideris, 2021). In terms of cost-effectiveness, it is clear that preserving existing affordable units will cost almost half as much as building new (Preserving Affordable Rental Housing, 2013). But either way, one promising mechanism, raised in several of our interviews, is the community land trust. Not only is there growing momentum towards CLTs (as evidenced by the Crenshaw Boulevard case), but also the small scale of displacement impacts make CLTs a viable alternative. Most CLTs are comprised of just one building or subdivision, or a set of scattered-site units in close proximity (Dodson, 2018 & Meehan, 2014). Climate-related public investments typically occur where land is either already in public ownership or can be readily acquired. By transferring some land to a community-run nonprofit, the public sector can proactively mitigate the unintended consequences of its climate change mitigation.

About the Authors

Karen Chapple, Ph.D., is Professor Emerita of City & Regional Planning at UC Berkeley, and Director of the School of Cities/Professor of Geography & Planning at the University of Toronto.

Alex Ramiller, M.A., is a Ph.D. student in City and Regional Planning and UC Berkeley.

Renee Roy Elias, PhD is a Senior Consultant to the Center for Community Innovation and the Urban Displacement Project.

Julia Greenberg, M.P.P., is Research Manager at the Urban Displacement Project at UC Berkeley.

Jae Sik Jeon, Ph.D., is Assistant Professor of Real Estate Studies at Konkuk University.

Acknowledgements

The research team would like to offer our deepest thanks to numerous individuals who helped make this project possible. Thanks to Sam Tepperman-Gelfant (Public Advocates), Shashi Hanuman (Public Counsel), Faizah Malik (Public Counsel), Grecia Elenes (Leadership Counsel), and Dan Rinzler (California Housing Partnership) for their feedback on the quantitative analysis. We are grateful for the research assistance of Elizabeth Garcia, Ben Satzman, Alyssa Suzukawa, Navid Goodarzi, Michelle Hernandez, and Augustina Ullman, who created the spatial database of climate investments for the analysis and tool. We are grateful to Miriam Zuk, Anna Cash, and Shazia Manji for assistance in research design in the project's early phase. This study was funded by the California Strategic Growth Council's Climate Change Research Program.

About UDP

The Urban Displacement Project (UDP) is a research and action initiative of the University of California Berkeley and the University of Toronto. UDP conducts community-centered, data-driven, applied research toward more equitable and inclusive futures for cities. Our research aims to understand and describe the nature of gentrification, displacement, and exclusion, and also to generate knowledge on how policy interventions and investment can support more equitable development.

About IGS

The Institute of Governmental Studies is California's oldest public policy research center. As an Organized Research Unit of the University of California, Berkeley, IGS expands the understanding of governmental institutions and the political process through a vigorous program of research, education, public service, and publishing.

Endnotes

1 Centrality was measured in terms of distance to the closest of: Fresno, Los Angeles, Oakland, Sacramento, San Francisco, and San Jose. Census tracts located in or immediately adjacent to these jurisdictions received a centrality measure of zero.

2 In other words, while propensity scores are generated based on all tracts from the study areas, matches are selected by identifying tracts with the closest scores that are also located within the same county.

3 These potentially "contaminating" investments include the investments that were under construction but not yet completed as of 2018, as well as the eight-station Gold Line extension to East Los Angeles completed in 2009 (the only major transit investment completed since 2006 that is not included in our climate investment database).

4 A commonly-used measure of propensity score matching balance – absolute difference in mean values between treatment and control groups divided by pooled standard deviation of all observations.

5 While binomial logit models are more commonly utilized for binary outcomes (i.e. moved/didn't move), linear probability models provide more readily interpretable regression terms while producing similar outcomes.

6 Initially we had planned to study just a subset of investments, and our partners selected these carefully. However, we subsequently realized that for statistical robustness we needed a large sample size, so we ultimately included every investment in the analysis.

7 Given that propensity score matching was conducted on our full dataset including all regions, subsets are not necessarily as well balanced across the matching covariates as the dataset as a whole.

8 Predicted outmigration and in-migration rates can be compared between investment and control neighborhoods, but we advise caution in comparing those rates directly with one another as they are calculated in slightly different ways. Outmigration rates are calculated on the basis of only those households that appear in future years in the data, and in-migration rates are calculated based on only those households that appear in previous years in the data.

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Appendix A – Complete Climate Investments Database

Note: The urban infill investments, as well as investments that opened after 2018, were included in the interactive mapping tool, but not the quantitative analysis.

Table A1: Climate Mitigation Projects in Los Angeles by Type (Opening Year)

Transit	Fixed Route Bus Transit Operations route 15 (2017) Fixed Route Bus Transit Operations route 17 (2017) Metro Exposition Extension (17th St/SMC Station) (2016) Metro Exposition Extension (26th St/Bergamot Station) (2016) Metro Exposition Extension (Downtown Santa Monica Station) (2016) Metro Exposition Extension (Expo/Bundy Station) (2016) Metro Exposition Extension (Expo/Sepulveda Station) (2016) Metro Exposition Extension (Palms Station) (2016) Metro Exposition Extension (Westwood/Rancho Park Station) (2016) Metro Gold Line Foothill Extension, Phase 2A (APU/Citrus College Station) (2016) Metro Gold Line Foothill Extension, Phase 2A (Arcadia Station) (2016) Metro Gold Line Foothill Extension, Phase 2A (Azusa Downtown Station) (2016) Metro Gold Line Foothill Extension, Phase 2A (Duarte Station) (2016) Metro Gold Line Foothill Extension, Phase 2A (Irwindale Station) (2016) Metro Gold Line Foothill Extension, Phase 2A (Monrovia Station) (2016) Mid City/Expo LRT (Culver City Station) (2012) Mid City/Expo LRT (Expo Park/USC Station) (2012) Mid City/Expo LRT (Expo/Crenshaw Station) (2012) Mid City/Expo LRT (Expo/La Brea Station) (2012) Mid City/Expo LRT (Expo/Vermont Station) (2012) Mid City/Expo LRT (Expo/Western Station) (2012) Mid City/Expo LRT (Farmdale Station) (2012) Mid City/Expo LRT (Jefferson/USC Station) (2012) Mid City/Expo LRT (La Ciniega/Jefferson Station) (2012) Mid City/Expo LRT (LATTC/Ortho Institute Station) (2012) Perris Valley Line Feeder Bus Service is an expansion of the existing 91 Line - Operating Assistance (route 19) (2014) Regional Transit Center (2022) Route 22 Extension Continuation Project (2018)

Table A1: Climate Mitigation Projects in Los Angeles by Type (Opening Year)

Active transportation/ greening	Pedestrian Plaza Improvements (2015) 111th Place Neighborhood Park (2016) Albion Riverside Park (2019) Benito Juarez Park (2015) Bicentennial Park Renovation (2017) Carlton Way Pocket Park (2015) Center Park Expansion (2017) Compton Creek-Washington Elementary Natural Park (2013) Cougar Park (2015) Craftsman Park (2014) Drake/Chavez Soccer Fields and Parkway (2018) Faith and Hope Veterans Park (2016) Franklin / Ivar Park (2017) Garvey Aquatic Center (2011) Gladys Jean Wesson Park (2014) Gumbiner Park (2017) Jacaranda Park (formerly 98th Street Community Park) (2017) La Mirada Park (2014) Lynwood Linear Park (2016) Madison Avenue Park (2020) Marsh Park (2014) Marshall Community Park (2018) Maryland Avenue Park (2014) MudTown Farms (NA) Nevin Avenue Elementary School Park (TBD) New Park - Western/Gage (2021) Ord & Yale Street Park (NA) Orizaba Park & Community Center (2014) Pacoima Wash Greenway - El Dorado Park (TBD) Patton Street Park and Garden (2015) Rudolph Park (Larch Avenue Park) (2016) Salud Park (2014) Slauson-Wall Park (2022) South Victoria Avenue Park (2019) State Street Park (2017) Terasaki Budokan Recreation Center/Park (2021) Vermont Miracle Park (2017) Watts Serenity Park (Monitor Ave) (2015) Wellness Center Park and Fitness Center (2015) West Adams Heights Park (2015) West Lakeside Street Park (NA) York-Avenue 50 Park (2017) Yvonne Burke-John D. Ham Park & Community Center (2017)

Table A1: Climate Mitigation Projects in Los Angeles by Type (Opening Year)

Urban infill	127th Street Apartments (2018) 1st and Soto TOD (Cielito Lindo) Apartments (2018) 5400 Hollywood Family Apartments (2016) 7th & Witmer Apartments (2019) Anchor Place (2017) Blossom Plaza (2016) Blue Hibiscus (2018) Boyle Hotel Apartments (2012) Cielito Lindo Apartments Phase II (fka 1st and Soto TOD Apartments Phase 2) (2020) Coronel Apartments (2019) Crenshaw Villas (2018) El Segundo Boulevard Apartments (2018) Immanuel Senior Housing (2017) Jordan Downs Phase 1B (fka MD Jordan Downs) (2020) Las Ventanas TOD Apartments (2021) LDK Senior Apartments (2016) Marmion Way Apartments (2016) Meridian Apartments (2017) Mosaic Gardens at Westlake (2018) Norwood Learning Village (2018) PATH Metro Villas Phase 2 (2020) Rio Vista Apartments (Taylor Yard Village) (2015) RiverPark Homes (Taylor Yard Village) (2015) Roland Curtis Gardens East (2019) Rolland Curtis West (2019) Santa Cecilia Apartments (2017) Selma Community Housing (2016) Six Four Nine Lofts (2021) South West View Apartments (Ybarra Village Apartments) (2020) Sun Valley Senior Veterans Apartments and the Sheldon Street Pedstrian Improvements (2019) Swansea Park Senior Apartments Phase 2 (2020) Sylmar Court Apartments (2017) Taylor Yard Apartments (Taylor Yard Village) (2015) Taylor Yard Senior Housing (Casa Salazar) (2017) Taylor Yard Village (2017) The Exchange at Gateway (El Monte Transit Village) (2015) The Paseo at Californian (2016) Washington 722 TOD (2017) Winnetka Senior Apartments (2016)

Table A2: Climate Mitigation Projects in the Bay Area by Type (Opening Year)

Transit	Balboa Park Station Area and Plaza Improvements (2017) Balboa Park Station Improvements Eastside Connections (2018) BART - Oakland Airport Connector (Coliseum Station) (2014) BART - Oakland Airport Connector (Oakland International Airport Station) (2014) BART Ashby Elevator (2011) BART eBART Project (Antioch Station) (2018) BART eBART Project (Pittsburg Center Station) (2018) BART Pittsburgh / Bay Point Station Improvements (2015) BART Warm Springs Extension (2017) Caltrain Station Improvements (San Jose Diridon Station) (2012) Caltrain Station Improvements (Santa Clara Station) (2012) Central San Rafael/SRTC Commuter Ferry Shuttle (2018) Concord Intermodal Improvements (2019) Martinez Shuttle (2015) Martinez Shuttle: Route 3 (2015) Metro Hopper Expansion route 4 (2018) Metro Hopper Expansion route 1 (2018) Metro Hopper Expansion route 2 (2018) Metro Hopper Expansion route 5 (2018) Metro Hopper Expansion route 6 (2018) Metro Hopper Expansion route 9 (2018) Metro Hopper Expansion route 3 (2018) Mission Bay Loop (2019) Pacheco Transit Hub (2014) Richmond Eastside Intermodal Improvements (2017) Richmond Intermodal Station (Phase 3) (2007) San Leandro BART Station Terminus (2020) SCVTA Santa Clara/Alum Rock Corridor BRT (2017) SFMTA Third Street Light Rail (2007) Transbay Term/Caltrain Downtown Ext - Ph.1 (2018) Van Ness BRT (2021)

Table A2: Climate Mitigation Projects in the Bay Area by Type (Opening Year)

Active transportation/ greening	16th St Mission Station N.E. Plaza Improvements (2006) 24th Street/Mission BART Plaza Pedestrian Imps. (2014) 66th Avenue Streetscape Improvement Project (2011) 7th Street,W. Oakland Transit Village Improvements (2019) American Canyon: Theresa Ave Sidewalk Imp Phase 3 (2015) Antioch Ninth Street Preservation (2016) Ashland Avenue Bicycle/Ped Improvements (2018) Bailey Road Transit Access Improvements (2014) Bay Street Streetscape & Parking Project (2010) Bay Trail Bridge at Oyster Bay Slough (2010) Bayfront Park Recretional Bay Access Pier Rehab (2017) Berkeley Santa Fe RR Bike/Ped Path (2012) Boeddeker Park & Clubhouse (2014) Bolinas Avenue and Sir Francis Drake Intersection (2016) Borregas Ave/US 101/SR 237 Bike/Ped Bridges (crossing 101) (2009) Borregas Ave/US 101/SR 237 Bike/Ped Bridges (crossing 237) (2009) Boyd Road/Elinora Drive SRTS Sidewalk Installation (2016) Broadway Streetscape Improvements, Phase II (2008) Breuner Marsh Restoration and Public Access (2017) Buchanan/Marin Bicycle and Pedestrian Path (2014) Buena Vista Park (2017) Campbell Avenue Portals Bike/Ped Improvements (2016) Campbell Winchester Blvd Streetscape Phase II (NA) Capitol Expressway ITS and Bike/Ped Improvements (2021) CARE Community Center (2019) Central Richmond Greenway (East Segment) (2010) Cesar Chavez Park (2014) Chinatown Pedestrian Oriented Improvements (2006) Citywide School Crossing Enhancement Project (2015) Coliseum Transit Hub Streetscape Improvements (2007) Concord- Monument Blvd/Meadow Ln Pedestrian Improv (2011) Contra Costa Blvd. Improvement (Beth to Harriet) (2017) Cross Alameda Trail (2020) Danville Various Streets and Roads Preservation (2019) Del Monte Park Phase I (2019) Depot Street Capital Improvements (2007) Detroit Avenue Bicycle and Pedestrian Improvements (2016) Divisadero Streetscape and Ped. Improvements (2010) Downtown Berkeley BART Plaza/Transit Area Imps. (2018) Duane Avenue Roadway Preservation (2016) Dublin Boulevard Preservation (2019) Durant Mini Park Improvement (2015)

Table A2: Climate Mitigation Projects in the Bay Area by Type (Opening Year)

Active transportation/ greening	East Lake Streetscape & Pedestrian Enhancement (2005) El Camino Real & Victoria Ave Pedestrian Crossing (2013) El Cerito Central Ave & Liberty St Streetscape Imp (2013) Elm Park Expansion and Renovation (2015) Enterprise Drive Complete Streets and Road Diet (2017) Fairmount St. Pedestrian & Streetscape Improvements (2019) Foothill Expressway Loyola Bridge Bicycle Imp. (2016) Fremont CBD/Midtown Streetscape (2016) Fruitvale Transit Village Phase II-A (2019) Gilroy 6th Street Streetscape West/East (2012) Gilroy New Ronan Channel and Lions Creek Trails (2012) Golf Club Rd Roundabout and Bike/Ped Improvements (2018) Golden Gate Recreation Center Expansion (2016) Great Meadow Bike Path Safety Improvements Project (2020) Hampton Rd Streetscape (2011) Hayward - Industrial Boulevard Preservation (2014) Healdsburg Various Streets & Roads Rehabilitation (2015) Hearst Avenue Complete Streets (2017) Helms Community Center (2014) Hendy Ave Complete Street Improvements (2016) Hillcrest Park & Ride Improvements (2014) Hilltop Park Renovation (2018) In Chan Kaajal Park (17th & Folsom Park) (2017) Inner Sunset Traffic Calming & Transit Enhancement (2014) International Boulevard Improvement Project (2017) Iron Horse Trail Extension in Downtown Livermore (TBD) Iron Horse Trail Over-crossing at Treat (2010) Ivy Drive Pavement Rehabilitation (2017) Jackson Ave Bicycle and Pedestrian Improvements (2017) Jan Park (2012) Lafayette Downtown Bike/Pedestrian Improvement & Streetscape (2015) Lake Merritt BART Bikeways (2017) Laurel Streetscape Improvement Project (2005) Leland Avenue Streetscape Improvements (2010) Livermore Relocation and Restoration of R/R Depot (2018) Lower Guadalupe River Trail (2013) Mansell Corridor Complete Streets (2017) Martinez - Marina Vista Streetscape (2011) Midtown Transportation & Streetscape Improvements (2011) Milpitas Abel Street Pedestrian Improvements (2013) Montalvin Manor Pedestrian & Transportation Access Improvements (2014) Monterey Road Preservation (2018)

Table A2: Climate Mitigation Projects in the Bay Area by Type (Opening Year)

Active transportation/ greening	Monterey Streetscape - 4th to 6th St. (2007) Monterey Streetscape Imps. - 6th to 7th Streets (2004) Moraga Rd SRTS Bicycle and Ped Improvements (2019) Moraga Rd SRTS Bicycle and Ped Improvements (school safety) (2019) Moraga Various Streets and Roads Preservation (2018) Morgan Hill - Third Street Promenade (2010) Mountain View Castro Street Complete Streets (2018) Napa:Lincoln Ave Bike Lane - Jefferson to Railroad (2012) Nisich Park (2011) Nob Hill Bike Path (2009) Oakland - Latham & Telegraph Pedestrian Imps. (2013) Oakland - MacArthur Blvd Streetscape (2014) Oakland Complete Streets (2018) Oakland: High/Ygnacio/Courtland Bike/Ped Imprvmnts (2019) Ohlone Greenway Station Area Bike/Ped Improvements (2019) Park St. Streetscape & Santa Clara Ave Transit Hub (2006) Peladeau Park and Greenway (2018) Phelan Loop Pedestrian and Street Beautification (2016) Pittsburg Multimodal Transit Station Access Imps. (2018) Pittsburg N. Parkside Dr. Bike Lanes and Sidewalks (2015) Pleasant Hill - Contra Costa Blvd. Preservation (2016) Pleasanton - Foothill/I-580 IC Bike/Ped Facilities (2014) Port Chicago Hwy/Willow Pass Rd Bike Ped Upgrades (2017) Prospect Rd Complete Streets (2022) Rainbow Recreation Center Expansion (2019) Randolph/Farallones/Orizaba/Transit Access Pedestrian Safety Project (2015) Richmond Barrett Avenue Bicycle Lanes (2017) Richmond BART Station Intermodal Improvements (2018) Richmond Greenway and Bikeway (Phase I) (2007) Roberto Antonio Balermino Park (2015) Rumrill Park (2015) Sacramento County - El Camino Ave. Phase 2 - Street and Sidewalk Improvements (2016) San Fernando Light-Rail Station Plaza (2005) San Fernando Street Enhanced Bikeway & Ped Access (2015) San Francisco - Folsom Streetscape and Rehab (2021) San Francisco - Marina Green Bicycle Trail Imps. (2013) San Francisco Cargo Way Bay Trail Bike Lanes (2012) San Francisco Market & Haight St.Transit/Ped Imps (2014) San Jose - San Carlos Multimodal Phase 2 (2016) San Jose: Alameda - A Plan for the Beautiful Way (Phases 1 & 2) (2018) San Leandro Boulevard Preservation (2016) San Leandro Downtown-BART Pedestrian Interface (2014)

Table A2: Climate Mitigation Projects in the Bay Area by Type (Opening Year)

Active transportation/ greening	San Pablo Avenue Streetscape (2010) San Tomas Aquino Creek Reach 4 New Trail (2019) San Tomas Aquino Creek Spur Trail Improvements (2019) San Tomas Aquino Spur Multi-Use Trail Phase 2 (2019) Santa Clara Caltrain Station Bike/Ped Tunnel (2017) Santa Clara County - Almaden Expressway Bike/Pedestrian Impprovements (2012) Santa Clara Various Streets and Roads Preservation (2020) Santa Clara VTA Blossom Hill/Monterey Hwy. Ped O/C (2023) Saratoga - DeAnza Bike/Ped Trail - Joe's Trail (NA) Saratoga Village Pedestrian Enhancements (2019) Sebastopol Various Streets and Roads Preservation (2016) SF- Broadway Chinatown Complete Streets (2018) SF Bay Trail, Pinole Shores to Bay Front Park (2018) SFMTA Persia Triangle Improvements (2016) So. Abel & So. Main Streetscape Improvements - Phase 1 (2011) South Hayward BART Area/Dixon Street Streetscape (2015) South of Market Alleyways Improvements, Phase 2 (2015) St. Charles St. Ped & Bike Project (2007) St. Johns Bikeway and Pedestrian Improvements (2017) Stevens Creek Blvd Preservation (2015) Sunnyvale-Murphy Ave Streetscape Revitalization (2014) Sunnyvale Downtown Streetscape (2014) Tasman/Fair Oaks Area Enhancements (2010) Tenderloin/UN Plaza/Civic Center Ped Improvements (2013) Transit Access Improvement - Meekland (2019) Union City Blvd Corridor Bicycle Imp, Phase 1 (2014) Unity Park (2018) Upper Penitencia Creek Multi-Use Trail (2020) Valencia Streetscape Improvements (2011) Virginia Avenue Sidewalks (2017) W. Dublin BART Station Corridor Bike/Ped Enh. (2013) W. Estudillo St. Streetscape & BART Connections (2014) W. Oakland Bay Trail: Mandela Pkwy & 8th St. (2008) W. Texas St. Gateway Project (2021) Walnut Creek - North Main Street Preservation (2018) Webster Renaissance Project (2005) West Dublin BART Golden Gate Drive Streetscape (2014) West Little Llagas Creek Trail Phase II (2014) Westborough Blvd. Bicycle Lanes Improvements (2019) West Oakland Park and Urban Farm (2016) West Oakland Youth Center (2015)

Table A2: Climate Mitigation Projects in the Bay Area by Type (Opening Year)

Urban infill	1036 Mission Street (2018) 1110 Jackson (Prosperity Place Apartments) (2017) 1950 Mission Street (2021) 3706 San Pablo Avenue (2019) 455 Fell Street (2019) Alice Griffith Housing Development (2017) Bill Sorro Community (2017) Booker T Washington Apartments (2017) Camino 23 (2019) Central Commons (2019) Charlotte Drive Apartments (2016) Civic Center 14 TOD Apartments (2018) Coliseum Connections (2019) Donner Lofts (2016) Downtown Hayward Senior Apartments (2017) Dublin Veterans Family Apartments (2017) Ed Roberts Campus (2011) Eddy & Taylor Family Housing (2019) El Cerrito Senior Mixed Use Apartments (Hana Gardens) (2018) Grayson Street Apartments (2019) Harper Crossing (2017) Laurel Grove (Park Avenue Family Apartments) (2018) MacArthur Transit Village (Phases I-II) (2016) MidPen Armory Homeless & Family Apartments (Onizuka Crossing) (2016) Miraflores Senior Housing (2018) Mission Bay South Block 6 East (2019) Redwood Hill Townhomes (2019) Renascent Place (fka Renascent San Jose) (2020) Riviera Family Apartments (2019) Second Street Studios (2019) Transbay Block 7 (222 Beale Street) (2018) Union City BART East Plaza Enhancements (2017)

Table A3: Climate Mitigation Projects in Fresno by Type (Opening Year)

Transit	BRT Improvements (2018)
Active transportation/ greening	Fulton Mall Reconstruction Project (2017) Cultural Arts District Park (2016) Martin Ray Reilly Park (2015) Parlier City Park (Heritage Park) (2019) Universally Accessible Park (Inspiration Park) (2015)
Urban infill	1612 Fulton (Granville developments) (2013) Brio on Broadway (Granville developments) (2015) Bungalow Court (Granville developments) (2012) Crichton Place (Granville developments) (2014) Fulton Village (Granville developments) (2012) Hotel Fresno (2021) Las Palmas de Sal Gonzales, Sr. Apartments (fka Kings Canyon Connectivity Project) (2019) The Lede (Granville developments) (2016) Van Ness Cottages (Granville developments) (2011)

Table A4: Climate Mitigation Projects in Sacramento by Type (Opening Year)

Transit	South Line Phase 2 Light Rail Extension Project (2015) South Sacramento Corridor Light Rail Extension Phase 2 (Center Parkway Station) (2015) South Sacramento Corridor Light Rail Extension Phase 2 (Cosumnes River College Station) (2015) South Sacramento Corridor Light Rail Extension Phase 2 (Franklin Station) (2015) SRTD South Line Phase II - CRC Parking Facility (2013) YCTD West Sacramento Pilot Project (2018)
Active transportation/ greening	Ahern-12th Street Improvements (2011) Arcade Creek Park Preserve Development (2014) Artivio Guerrero Park (2015) McClatchy Park (2015)
Urban infill	Mather Veterans Village (2016)

Appendix B – Data Axle (Infogroup) Data Cleaning

First, in order to ensure that we only include households with a reliable geographic location, we filter to include only households for which approximate location (such as street name) was identifiable. Next, accounting for variability in the income estimates provided within the household-level data, we construct a subset of the data for which income identification is more reliable. Based on Infogroup's income variable, which is listed for each household-year combination, we categorized households into five different income groups: extremely low-income (ELI), very low-income (VLI), low-income (LI), moderate-income (MI), and high-income (HI). The first step in this process was to compare households' Infogroup-provided incomes with the Area Median Income (AMI) in the given county and year, which was calculated using the 1-Year estimates from the American Community Survey (ACS) 1-Year county estimates. Households whose incomes were less than or equal to 30% of the county- and year-specific AMI were assigned a "rank" of 1; households with incomes between 30% and 50% of the AMI were assigned a rank of 2; households with incomes between 50% and 80% of the AMI were assigned a rank of 3; households with incomes between 80% and 120% were assigned a rank of 4; finally, households with incomes above 120% of the AMI were assigned a rank of 5.

Next, to account for an unrealistic amount of fluctuation in households' incomes over time (likely a result of poor data quality), we "smoothed" the dataset using the following method:

- If a household occupies only one income category for all of the years in which it appears in the dataset, it is assigned that income category for all observations
- If a household occupies two "adjacent" income categories (i.e., the difference between the ranks equals one), it is assigned the most common income category in which it appears. If the household appears an equal number of times in two adjacent income categories, it is assigned to the income category with the higher rank
- If a household occupies more than two income categories or occupies two "non-adjacent" income categories, the household is removed from the dataset entirely

We then filtered the dataset to include only renter households. Tenure status (owner or renter) was derived from estimates provided by Infogroup, which rated each household on a scale from 0 to 9, with 0 representing a confirmed renter household, 9 representing a confirmed owner household, and values in between for households where status was imputed by Infogroup. The optimal threshold for classifying households as renters or owners was determined by comparing the share of renter households in each tract within the study regions for 2015-2019 with the share of renters in each tract according to 2015-2019 ACS estimates. Using a threshold tenure score of 6 and below for renter households was found to produce tract-level rentership shares that were closest to ACS estimates.

Only households for which observations are available in subsequent years are included in analyses of move-outs, while only cases for which observations in prior years are available are included in analyses of move-ins. If observations are not available in the years immediately before and/or after the year in question, the closest available year is used. For example, for a household only observed in 2011 and 2014, move-out status for 2011 is determined by looking at whether the household had moved to a different census tract by 2014; likewise, move-in status for 2014 is determined by looking at whether the household had moved since 2011. For this reason, outmigration and in-migration rates are not directly comparable for individual years – the outmigration rate in a given year reflects the percentage of households observed in a future year that moved out of a tract by the following year, whereas the in-migration rate reflects the percentage of households observed in a previous year that moved into the tract since their last recorded location.

Appendix C

Table C1: Correlation Matrix

	Transit Ridership	% Single-Family	House Value Change	Gross Rent Change	Rent Gap	% Commercial	New Subsidized Units	New Market-Rate Units
Transit Ridership	1.000	-0.453	0.079	-0.077	0.159	0.372	0.101	0.150
% Single-Family	-0.453	1.000	-0.099	-0.016	-0.228	-0.481	-0.196	-0.231
House Value Change	0.079	-0.099	1.000	0.341	-0.096	-0.004	0.020	0.014
Gross Rent Change	-0.077	-0.016	0.341	1.000	-0.234	-0.102	-0.059	0.165
Rent Gap	0.159	-0.228	-0.096	-0.234	1.000	0.197	0.131	-0.122
% Commercial	0.372	-0.481	-0.004	-0.102	0.197	1.000	0.101	0.149
New Subsidized Units	0.101	-0.196	0.020	-0.059	0.131	0.101	1.000	0.292
New Market-Rate Units	0.150	-0.231	0.014	0.165	-0.122	0.149	0.292	1.000

Figure C1: Full linear probability model results (effect of investment on a given income category is determined by whether the difference between the investment term ("Investment", "Transit", "Active/Green") and the term for its interaction with the income category is positive or negative

	Model 1	Model 2 (Investment Type)	Model 3 (Year FE)	Model 4 (Region FE)	Model 5 (Controls)
Predictors	*Estimates*	*Estimates*	*Estimates*	*Estimates*	*Estimates*
Intercept	0.131 *** (0.001)	0.131 *** (0.001)	0.176 *** (0.002)	0.154 *** (0.002)	0.170 *** (0.002)
Investment	-0.003 *** (0.001)				
Transit		-0.023 *** (0.001)	-0.020 *** (0.001)	-0.010 *** (0.001)	-0.012 *** (0.001)
Active/Green		0.013 *** (0.001)	0.015 *** (0.001)	0.010 *** (0.001)	0.010 *** (0.001)
Income (Extremely Low)	-0.083 *** (0.001)	-0.083 *** (0.001)	-0.082 *** (0.001)	-0.081 *** (0.001)	-0.079 *** (0.001)
Income (Very Low)	-0.052 *** (0.001)	-0.052 *** (0.001)	-0.051 *** (0.001)	-0.050 *** (0.001)	-0.049 *** (0.001)
Income (Low)	-0.041 *** (0.001)	-0.041 *** (0.001)	-0.039 *** (0.001)	-0.038 *** (0.001)	-0.038 *** (0.001)
Income (Moderate)	-0.021 *** (0.001)	-0.021 *** (0.001)	-0.020 *** (0.001)	-0.019 *** (0.001)	-0.020 *** (0.001)
Investment * Income (Extremely Low)	0.000 (0.001)				
Investment * Income (Very Low)	0.006 *** (0.001)				
Investment * Income (Low)	0.007 *** (0.001)				
Investment * Income (Moderate)	0.000 (0.001)				
Transit * Income (Extremely Low)		0.019 *** (0.001)	0.016 *** (0.001)	0.006 *** (0.001)	0.009 *** (0.001)
Transit * Income (Very Low)		0.019 *** (0.002)	0.019 *** (0.002)	0.014 *** (0.002)	0.017 *** (0.002)
Transit * Income (Low)		0.010 *** (0.002)	0.010 *** (0.002)	0.008 *** (0.002)	0.009 *** (0.002)
Transit * Income (Moderate)		0.004 * (0.002)	0.004 * (0.002)	0.004 * (0.002)	0.004 * (0.002)
Active/Green * Income (Extremely Low)		-0.016 *** (0.001)	-0.018 *** (0.001)	-0.016 *** (0.001)	-0.012 *** (0.001)
Active/Green * Income (Very Low)		-0.007 *** (0.001)	-0.010 *** (0.001)	-0.006 *** (0.001)	-0.005 *** (0.001)
Active/Green * Income (Low)		0.001 (0.001)	-0.002 (0.001)	0.000 (0.001)	0.001 (0.001)
Active/Green * Income (Moderate)		-0.004 ** (0.001)	-0.005 *** (0.001)	-0.005 *** (0.001)	-0.004 ** (0.001)
% Transit Ridership					-0.000 *** (0.000)
% Single-Family					-0.000 *** (0.000)
House Value Change					-0.000 *** (0.000)
Rent Change					0.000 *** (0.000)
Rent Gap					-0.000 *** (0.000)
% Commercial					-0.027 *** (0.002)
New Subsidized Units (2006-2019)					0.000 (0.000)
New Market-Rate Units (2006-2019)					-0.000 *** (0.000)
Sacramento				0.034 *** (0.001)	0.034 *** (0.001)
Bay Area				0.021 *** (0.001)	0.016 *** (0.001)
Los Angeles				-0.002 * (0.001)	-0.008 *** (0.001)

** p<0.05 ** p<0.01 *** p<0.001*

Figure C2: Linear probability model results by time relative to project opening

	3 Years Before	2 Years Before	1 Year Before	Opening Year	1 Year After	2 Years After	3 Years After
Intercept	0.153 ***	0.165 ***	0.183 ***	0.137 ***	0.156 ***	0.154 ***	0.079 ***
	(0.007)	(0.006)	(0.004)	(0.006)	(0.005)	(0.013)	(0.006)
Transit	-0.007 *	-0.004	-0.016 ***	-0.012 ***	-0.019 ***	-0.018 ***	0.023 ***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.005)	(0.006)
Active/Green	0.016 ***	0.010 ***	0.010 ***	0.010 ***	0.015 ***	-0.003	0.021 ***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Income (Extremely Low)	-0.095 ***	-0.091 ***	-0.087 ***	-0.072 ***	-0.064 ***	-0.077 ***	-0.061 ***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Income (Very Low)	-0.060 ***	-0.054 ***	-0.056 ***	-0.043 ***	-0.040 ***	-0.047 ***	-0.035 ***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
Income (Low)	-0.037 ***	-0.043 ***	-0.042 ***	-0.033 ***	-0.032 ***	-0.043 ***	-0.028 ***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
Income (Moderate)	-0.026 ***	-0.020 ***	-0.020 ***	-0.016 ***	-0.015 ***	-0.027 ***	-0.014 ***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
Transit * Income (Extremely Low)	0.004	0.001	0.015 ***	0.012 ***	0.010 **	0.022 ***	-0.030 ***
	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.005)	(0.006)
Transit * Income (Very Low)	0.016 ***	0.013 **	0.019 ***	0.012 **	0.025 ***	0.026 ***	-0.024 **
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.006)	(0.007)
Transit * Income (Low)	0.002	0.009 *	0.011 **	0.006	0.012 **	0.022 ***	-0.019 *
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.006)	(0.008)
Transit * Income (Moderate)	0.002	-0.006	0.007	0.003	0.010 *	0.022 ***	-0.039 ***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.006)	(0.008)
Active/Green * Income (Extremely Low)	-0.014 ***	-0.013 ***	-0.013 ***	-0.013 ***	-0.020 ***	-0.000	-0.024 ***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Active/Green * Income (Very Low)	-0.015 ***	-0.007	-0.007 *	-0.002	-0.010 **	0.004	-0.009 *
	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.004)	(0.004)
Active/Green * Income (Low)	-0.002	0.006	0.002	-0.003	-0.006	0.011 **	-0.014 **
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Active/Green * Income (Moderate)	-0.000	-0.010 *	-0.003	-0.008 *	-0.013 ***	0.001	-0.006
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
% Transit Ridership	-0.000 ***	-0.000 ***	-0.000 ***	-0.000 ***	-0.000 ***	-0.000 ***	-0.000 *
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
% Single-Family	-0.000 ***	-0.001 ***	-0.000 ***	-0.000 ***	-0.000 ***	-0.000 ***	-0.000 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
House Value Change	-0.000 ***	-0.000 ***	-0.000 ***	-0.000 ***	-0.000 ***	-0.000 ***	-0.000 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Rent Change	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Rent Gap	-0.000 ***	-0.000 ***	-0.000 ***	-0.000 ***	-0.000 ***	-0.000 ***	-0.000 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
% Commercial	-0.046 ***	-0.029 ***	-0.028 ***	-0.021 ***	-0.014 **	-0.010	-0.057 ***
	(0.005)	(0.005)	(0.005)	(0.004)	(0.005)	(0.006)	(0.006)
New Subsidized Units (2006-2019)	0.000	-0.000	0.000 *	-0.000	-0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
New Market-Rate Units (2006-2019)	-0.000 ***	-0.000 ***	-0.000 ***	-0.000 ***	0.000 ***	0.000 ***	0.000 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Sacramento	0.043 ***	0.043 ***	0.045 ***	0.035 ***	0.032 ***	0.031 ***	0.039 ***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.006)	(0.005)
Bay Area	0.009 ***	0.024 ***	0.020 ***	0.015 ***	0.017 ***	0.024 ***	0.028 ***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.004)	(0.005)	(0.005)
Los Angeles	-0.010 ***	-0.002	-0.008 ***	-0.010 ***	-0.006	0.000	0.001
	(0.003)	(0.003)	(0.002)	(0.002)	(0.004)	(0.005)	(0.005)

** p<0.05 ** p<0.01 *** p<0.001*

Figure C3: Region-specific Outmigration Models

	Los Angeles	Bay Area	Fresno	Sacramento
Intercept	0.146 *** (0.008)	0.192 *** (0.002)	0.094 *** (0.008)	0.304 *** (0.020)
Transit	-0.002 (0.002)	-0.032 *** (0.002)	0.009 (0.005)	-0.056 *** (0.007)
Active/Green	0.028 *** (0.005)	0.008 *** (0.001)	-0.017 (0.010)	0.013 (0.010)
Income (Extremely Low)	-0.065 *** (0.001)	-0.085 *** (0.001)	-0.068 *** (0.004)	-0.139 *** (0.006)
Income (Very Low)	-0.046 *** (0.002)	-0.048 *** (0.001)	-0.056 *** (0.005)	-0.125 *** (0.006)
Income (Low)	-0.036 *** (0.002)	-0.037 *** (0.001)	-0.047 *** (0.005)	-0.111 *** (0.006)
Income (Moderate)	-0.020 *** (0.002)	-0.020 *** (0.001)	-0.020 *** (0.006)	-0.069 *** (0.007)
Transit * Income (Extremely Low)	0.001 (0.002)	0.028 *** (0.003)	-0.001 (0.006)	0.039 *** (0.008)
Transit * Income (Very Low)	0.009 *** (0.002)	0.042 *** (0.003)	0.002 (0.006)	0.062 *** (0.008)
Transit * Income (Low)	0.007 ** (0.002)	0.037 *** (0.003)	0.005 (0.007)	0.041 *** (0.008)
Transit * Income (Moderate)	0.003 (0.002)	0.022 *** (0.003)	-0.006 (0.008)	0.026 ** (0.009)
Active/Green * Income (Extremely Low)	-0.024 *** (0.005)	-0.011 *** (0.001)	0.021 * (0.010)	-0.026 * (0.011)
Active/Green * Income (Very Low)	-0.027 *** (0.005)	-0.004 * (0.002)	0.013 (0.011)	-0.021 (0.011)
Active/Green * Income (Low)	-0.025 *** (0.006)	0.001 (0.002)	0.030 ** (0.011)	0.007 (0.012)
Active/Green * Income (Moderate)	-0.018 ** (0.006)	-0.005 ** (0.002)	0.025 (0.013)	0.000 (0.013)
% Transit Ridership	-0.000 *** (0.000)	-0.000 *** (0.000)	-0.001 (0.000)	0.000 (0.000)
% Single-Family	-0.000 *** (0.000)	-0.000 *** (0.000)	0.000 (0.000)	-0.001 *** (0.000)
House Value Change	-0.000 *** (0.000)	-0.000 *** (0.000)	0.000 (0.000)	-0.000 * (0.000)
Rent Change	0.000 *** (0.000)	0.000 *** (0.000)	0.000 ** (0.000)	0.000 *** (0.000)
Rent Gap	-0.000 *** (0.000)	-0.000 *** (0.000)	-0.000 (0.000)	-0.000 *** (0.000)
% Commercial	0.005 (0.004)	-0.044 *** (0.002)	0.025 ** (0.008)	-0.060 *** (0.010)
New Subsidized Units (2006-2019)	-0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)	
New Market-Rate Units (2006-2019)	0.000 *** (0.000)	-0.000 *** (0.000)	-0.000 * (0.000)	
Observations	710285	1924254	85015	116760

** p<0.05 ** p<0.01 *** p<0.001*

Figure C4: Region-specific in-migration models

	Los Angeles	Bay Area	Fresno	Sacramento
Intercept	0.109 *** (0.008)	0.140 *** (0.002)	0.082 *** (0.008)	0.272 *** (0.023)
Transit	-0.010 *** (0.001)	-0.043 *** (0.002)	-0.000 (0.005)	-0.012 (0.008)
Active/Green	0.023 *** (0.005)	0.016 *** (0.001)	0.024 * (0.010)	-0.013 (0.011)
Income (Extremely Low)	-0.051 *** (0.001)	-0.078 *** (0.001)	-0.071 *** (0.004)	-0.127 *** (0.006)
Income (Very Low)	-0.037 *** (0.001)	-0.047 *** (0.001)	-0.064 *** (0.004)	-0.117 *** (0.007)
Income (Low)	-0.032 *** (0.002)	-0.041 *** (0.001)	-0.046 *** (0.005)	-0.105 *** (0.007)
Income (Moderate)	-0.027 *** (0.002)	-0.028 *** (0.001)	-0.016 ** (0.005)	-0.077 *** (0.007)
Transit * Income (Extremely Low)	0.015 *** (0.002)	0.030 *** (0.003)	0.002 (0.005)	-0.001 (0.008)
Transit * Income (Very Low)	0.022 *** (0.002)	0.047 *** (0.003)	0.012 * (0.006)	0.002 (0.009)
Transit * Income (Low)	0.019 *** (0.002)	0.044 *** (0.003)	0.007 (0.006)	-0.012 (0.009)
Transit * Income (Moderate)	0.018 *** (0.002)	0.034 *** (0.003)	-0.011 (0.007)	-0.017 (0.010)
Active/Green * Income (Extremely Low)	-0.022 *** (0.005)	-0.019 *** (0.001)	-0.033 ** (0.011)	0.004 (0.011)
Active/Green * Income (Very Low)	-0.025 *** (0.005)	-0.016 *** (0.002)	-0.015 (0.011)	0.019 (0.012)
Active/Green * Income (Low)	-0.030 *** (0.006)	-0.010 *** (0.002)	0.015 (0.012)	0.025 * (0.013)
Active/Green * Income (Moderate)	-0.018 ** (0.006)	-0.002 (0.002)	0.026 (0.014)	0.029 * (0.014)
% Transit Ridership	-0.000 *** (0.000)	-0.000 *** (0.000)	-0.001 *** (0.000)	-0.001 *** (0.000)
% Single-Family	0.000 (0.000)	0.000 *** (0.000)	0.000 *** (0.000)	-0.000 *** (0.000)
House Value Change	0.000 *** (0.000)	-0.000 *** (0.000)	0.000 (0.000)	0.000 *** (0.000)
Rent Change	0.000 *** (0.000)	0.000 *** (0.000)	0.000 *** (0.000)	0.000 *** (0.000)
Rent Gap	-0.000 *** (0.000)	-0.000 *** (0.000)	0.000 *** (0.000)	-0.000 *** (0.000)
% Commercial	0.007 * (0.004)	-0.018 *** (0.002)	0.088 *** (0.007)	-0.048 *** (0.010)
New Subsidized Units (2006-2019)	-0.000 (0.000)	0.000 *** (0.000)	0.000 (0.000)	
New Market-Rate Units (2006-2019)	0.000 *** (0.000)	0.000 *** (0.000)	-0.000 *** (0.000)	
Observations	777148	1921953	105746	107873
			* p<0.05	** p<0.01	*** p<0.001

Appendix D: Case Studies

1. From Thoroughfare to Destination: Community Perspectives on The Alameda's Plan for the Beautiful Way in San Jose
2. Transit-Oriented Development and Regional Growth: Community Perspectives on the South Line Extension in Sacramento
3. California's Low-Income Weatherization Multi-Family Program: Successes, Challenges, and Implications for Housing Justice
4. Whose Parks? Community Perspectives on the Revitalization of the Los Angeles River
5. Whose Downtown Fresno? Community Perspectives on the Tensions and Tradeoffs of Reinvestment
6. Balancing Black Cultural Preservation with Regional Growth: Community Perspectives on the Revitalization of Crenshaw Boulevard in South Los Angeles and Inglewood