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16. ABSTRACT

A complicated array of state and federal affordable housing policies, incentives and financing programs guide the siting and constructing of hundreds of thousands of new housing units in California every Housing Element Cycle. It is not known how all these programs combine together to influence the siting of affordable housing development in neighborhoods associated with lower vehicle miles traveled (e.g. transit-rich, and amenity accessible). This research is developing and examining affordable housing produced across three of California's MPOs to answer the following questions: 1) which supply side housing policies are best at locating new affordable housing in neighborhoods associated with lower VMT, 2). How do existing demand side policies, like Section 8 vouchers, perform in enabling residents to afford to live in neighborhoods associated with lower VMT, and 3) how would bringing housing policy in line with SB 375 goals alter the costs of constructing affordable housing and providing vouchers? The results of analysis will serve as a guide for future reforms to state and federal housing policies aimed at bringing them in line with the goals of SB 375 and other major "smart growth" legislation.

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The Effect that State and Federal Housing Policies Have on Vehicle Miles of Travel

November 2016

A Research Report from the National Center for Sustainable Transportation

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About the National Center for Sustainable Transportation

The National Center for Sustainable Transportation is a consortium of leading universities committed to advancing an environmentally sustainable transportation system through cutting-edge research, direct policy engagement, and education of our future leaders. Consortium members include: University of California, Davis; University of California, Riverside; University of Southern California; California State University, Long Beach; Georgia Institute of Technology; and University of Vermont. More information can be found at: ncst.ucdavis.edu.

Disclaimer

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NCST

The Effect That State and Federal Housing Policies Have on Vehicle Miles of Travel

A National Center for Sustainable Transportation Research Report

November 2016

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The Effect That State and Federal Housing Policies Have on Vehicle Miles of Travel

EXECUTIVE SUMMARY

This report examines the ability of existing and proposed affordable housing policies to align with sustainable transportation goals in California. First, we compare the ability of Low Income Housing Tax Credit (LIHTC), Redevelopment and inclusionary funded projects to locate in neighborhoods with transit access to employment versus market rate production in the same period. We find tax credit funded units outperform market rate production with respect to job accessibility via transit, and we attribute this to the scoring criteria of California's tax credit allocating body, the Tax Credit Allocation Committee (TCAC). However, we find this may have come at the cost of concentrating new affordable housing in areas with higher poverty rates. At the federal level, we measure how a change in the determination of maximum payouts for Section 8 housing vouchers, known as Fair Market Rents (FMRs), alters the ability of voucher holders to access transit and jobs rich neighborhoods. The results show that changing to "Small Area" FMRs, which are determined at the ZIP code scale, dramatically improves voucher holders' access to jobs rich neighborhoods. This benefit comes at the cost of nearly eliminating voucher accessibility in neighborhoods that are currently accessible. And finally, at the state level, an analysis is conducted to determine if California's emphasis on promoting affordable housing in transit and jobs rich neighborhoods is increasing the cost of affordable housing development. The modeling results indicate that affordable housing near transit stops is not significantly more expensive, but that costs increase slightly for projects in jobs rich neighborhoods. Participation in the state's Transit Oriented Development (TOD) housing program does not significantly impact costs. The results of this research are intended to inform policy makers at every level of government on how best to continue to integrate transportation and housing policies without sacrificing the primary purpose of our affordable housing policies: to house people.

Introduction

Integrating housing and transportation planning is a critical component of addressing emissions from the transportation sector over the long term. Spatial imbalances between the locations of jobs and housing, for example, contribute to dramatically longer commute times and commute challenges for growing regions (1, 2). The proximity of housing to residents' destinations and its impact on the ability of residents' to access amenities without a car can have a critical impact on travel behavior (3, 4).

Yet only recently has the integration of housing and transportation policy become a major focus of state and federal governments. In California, the passage of SB 375 in 2008 was hailed as major landmark in this trend; the law requires the state's metropolitan planning organizations (MPOs) to include a "sustainable communities strategy" as part of their regional transportation plans (5). Under SB 375, these plans are intended to better link housing and transportation to reduce vehicle miles traveled (VMT), ultimately reducing carbon emissions from transportation. At the federal level, the Obama administration ushered in a series of policies and programs aimed at promoting "sustainable communities." This effort includes offering planning grants for integrating transportation and housing while revamping the HOPE VI program into the more sustainable-transportation oriented Choice Neighborhoods Initiative (6, 7). The Obama administration also introduced new competitive criteria to promote transit access in the Section 811 and 202 programs, which finance supportive housing and senior affordable housing respectively (8, 9).

This emerging set of transportation and housing policies is rooted in the understanding that land use exhibits a significant impact on travel behavior. Early researchers struggled to separate the effects of land use on travel behavior from the propensity of individuals to self-select into the kinds of neighborhoods which would allow them to travel as they please (10, 11). Subsequent studies accounting for self-selection still find that land use plays a critical role (12, 13). And the latest set of studies, which seeks to address self-selection and the spatial issues in modeling travel behavior, find the existing literature may be greatly underestimating the importance of land use in predicting travel behavior (14, 15). Regardless of the effect size, policy makers have already begun taking action.

Integrating housing with transportation and land use planning goals generally follows two overarching approaches: increasing the proximity of new housing to employment and other destinations, and increasing housing production along rail lines, commonly referred to as transit-oriented development (TOD). For policy evaluation, these two approaches require the utilization of different planning metrics to evaluate success. Focusing on increasing the proximity of new housing to employment and other destinations is generally aimed at relieving jobs-housing imbalances (2, 16). Traditional jobs-housing metrics, however, may not reflect the job accessibility of low wage or low skill households that are intended to benefit from affordable housing: the jobs they can access will exhibit different patterns of concentration across space than other high wage jobs (17, 18). Scholars have advanced new metrics utilizing the most detailed available Census data to measure jobs-housing "fit", the balance between low wage workers and jobs accessible to low wage workers within a given geography (1).

Measuring the success of transit-oriented development (TODs) and integrating affordable housing with public transit systems require a different metric for evaluating success. Public agencies are increasingly evaluating housing projects' worthiness based on proximity to fixed route transit stops and the strength of the multimodal connectivity between those stops and surrounding neighborhoods (19, 20).

Our research focuses on these primary metrics to evaluate the effectiveness of current and proposed housing policies in increasing low income households' access to communities in which they can reduce their vehicle miles traveled (VMT). We answer the question: **how are current affordable housing policies, programs and strategies enabling low income households served by these programs to access jobs and transit rich communities?**

Chapter 1 reviews the literature on links between affordable housing and transportation policies. Efforts to align affordable housing with transit, job and amenity access are almost exclusively tied to state and federal supply side affordable housing programs. There is almost no effort by policy makers to align demand side voucher programs with transit and jobs access, this despite a rich literature indicating that public transit access is a key concern of voucher program participants when searching for new homes.

Chapter 2 examines the ability of affordable housing programs to outperform new market rate housing development with respect to placing housing near medical facilities, public transportation, grocery stores and good schools. We find affordable housing programs outperform the market with respect to transport and grocery access, but not schooling or medical facilities generally. Among affordable housing for seniors, however, senior projects significantly outperform market rate production in placing new units near grocery stories and public transit.

Chapter 3 explores the relationship between policy scale and the ability of demand side housing voucher programs to enable participants to access jobs and transit rich communities. HUD is currently exploring changing the scale at which housing voucher maximum payouts are calculated, moving from the metropolitan area scale to the ZIP code scale. Given the spatially-auto-correlated nature of rents, we hypothesize that the use of finer geographic scales in setting voucher maximums increases voucher holders' access to high opportunity, jobs rich communities. The results show dramatic improvements in voucher access to jobs rich neighborhoods resulting from re-scaling voucher maximum payouts to the zipcode level.

Finally, Chapter 4 takes advantage of a unique data set of affordable housing project budgets to examine the effect proximity to rail stations, job access and participation in the state of California's TOD program on the per unit cost of affordable housing development. No significant effects are found, with the exception of jobs housing balance. We find a confluence of other factors, including wage requirements, underground parking and the scale of projects are more significant drivers of affordable housing development costs.

The results in these chapters will assist affordable housing policy makers at the local, regional, state and federal levels in identifying what levers they have to increase affordable housing in high opportunity, jobs-rich neighborhoods. The research also addresses a number of important gaps in current research. Chapter 3 offers major insights on the potential for HUD's proposed

"Small Area Fair Market Rents" to transform the effectiveness of the Section 8 voucher program. The last chapter on affordable housing costs also holds implications for policy making beyond the issue of transit access for affordable housing. Several states have conducted analysis evaluating cost-drivers in affordable housing production (21, 22). Our results expand on these efforts and offer new insights into what is, and what is not increasing the cost of tax credit financed affordable housing.

Chapter 1: Literature Review

With the passage of California Senate Bill 375 (SB 375), California's regions are beginning to at least attempt coordinated planning of housing and transportation (5). However, moving from integrating planning to actual built communities that reflect the integrating planning requires sophisticated understanding of the mechanisms through which housing markets and transportation systems endogenously drive each other. A large body of literature concerning the role of transportation infrastructure in inducing land-use change already exists (23–25). This paper flips the topic around, tying together the theoretical mechanisms through which housing policies may help induce shifts in residents' travel behavior. The paper is limited to the realm of affordable housing policy, the most significant arena wherein government intervenes in housing markets besides monetary and tax policy. We document significant need for research on whether or not the many spatially oriented and transportation-specific elements present in a wide array of affordable housing policies and programs have any effect at all on residents' travel patterns. We also call for research that examines the costs that these transportation approaches may have on affordable housing programs.

Based on our review of the literature, we categorize the policies, incentives and elements of housing programs which may alter residents' transport options and preferences using two categories of mechanisms through which we hypothesize they are most likely to impact residents travel behavior. The first group fall under the proximity mechanism. These are policies or programs that increase the proximity of affordable housing to key travel destinations. The second group falls into what we will refer to as the infrastructure mechanism; these programs and policies tie new affordable housing to multimodal infrastructure development. The mechanisms are detailed below:

- Proximity Mechanism. These housing policies, programs and incentives increase housing construction near key travel destinations, regardless of modal infrastructure considerations. Theoretically, VMT declines as residents' trip lengths are shortened and mode shifts to active travel occur. This category can also include land use decisions that prevent or constrain the construction of new affordable housing when the housing is too far away from existing amenities. These policies might include requirements, for example, that new affordable housing be built in low-poverty, jobs rich communities. The most common focus of these policies is on proximity to jobs, and thus is concerned with improving jobs-housing balance or, in the case of access to low-wage work, alleviating spatial mismatch. These policies are primarily implemented at the state, local and regional scale.
- Infrastructure Mechanism. This set of policies ties housing development to the availability of transportation infrastructure (usually transit), or links the financing of new affordable housing to investments in non-auto transportation modes. These policies can influence VMT by altering residents' mode of travel. This category encompasses efforts to concentrate housing development in transit-rich and walking and cycling friendly communities and can include policies that reduce affordable housing projects commitments to automobile infrastructure like parking. Policies

impacting VMT through the infrastructure mechanism can be found at every scale of government from local zoning incentives to the federal redevelopment programs.

This review examines affordable housing policies hypothesized to impact VMT through each of the two mechanisms by the scales at which they are implemented: national, state, regional and local government. We discuss the policies, their intent, and highlight evidence of their impact on vehicle miles traveled, noting gaps in our understanding. Where evident, the financial costs of these policies and their cost-effectiveness relative to other housing policies are reviewed.

Proximity Mechanism

Housing policies designed to decrease VMT through proximity do so by reducing the distance between housing and households' destinations, including work, shopping, school and public services. Practically speaking, this often takes the form of reducing jobs-housing imbalance, which has been identified as being strongly associated with what scholars term "excess commuting" (2, 26). The imbalance of low wage jobs to affordable housing is strongly associated with longer commute distances among low wage workers (1). Although jobs-housing balances has been a stalwart metric in transportation planning, some have argued that the jobs-housing balance may attain equilibrium over time, thus negating the need for the metric, at least in transportation, (27) and that regional travel demand modeling suggests it may be easier for policy to steer the location of housing than jobs (16, 28).

Low income housing policies which reduce VMT by reducing jobs-housing imbalance are specifically addressing spatial mismatch, a problem first invoked by William Julius Wilson to describe the mismatch between the location of low-skilled labor in urban cores and the growth of low-wage jobs in sprawling, segregated suburbs (29). Addressing mismatch, and its associated excess commuting has potential to reduce VMT and improve quality of life for low income households; low income commuters have some of the longest commute times (30) and commutes time are also increasing the fastest among low-income commuters (31).

National Policies and the Proximity Mechanism

Federal supply side housing policies may exacerbate the spatial mismatch among the poor. The largest federal supply side housing program, the low Income Housing Tax Credit (LIHTC) program has had some success increasing the production of affordable housing in the suburbs, where jobs are plentiful (32). But Dawkins finds that despite prior evidence suggesting the LIHTC programs are spreading affordable housing into low-wage jobs rich suburbs (33), the housing is still systematically concentrated in high poverty neighborhoods and high poverty suburbs relative to housing stock overall (34). Importantly, these units may not be locating in areas where the need is highest (35). Dawkins and both Lang attribute this to the added subsidy given to units in "Qualified Census Tracts" (DDAs). These are low-income and high poverty areas which the Department of Housing and Urban Development (HUD) offers deeper subsidies for LHITC funded projects (36). Lang argues that because building in DDAs offers greater financial reward, developers choose to concentrate tax credit developments in those tracts—despite their high poverty rates (37). The QCT and DDA are the only spatially-oriented aspects of the LIHTC program that are set at the federal level.

Under the Obama administration, other federal housing supply side programs, such as Section 202, which provides housing for the elderly, and Section 811, which provides housing for the disabled, began prioritizing proximity to amenities and transit access (38). In its latest funding rounds, HUD offered projects applying for Section 202 funding the opportunity to earn up to 15 fifteen points (out of 102) for project accessibility; seven were for transit service and eight were for proximity to amenities (9). In contrast, Section 811 applicants could win ten out of 102 points on these criteria—five for transit service and five for amenities proximity (8). Additionally, HUD offered projects in both programs the opportunity to win 5 Policy Priority points, 4 of which could be won by implementing sustainability goals or demonstrating projects would be LEED certified or Green Building certified by the National Association of Home Builders, essentially double counting amenity access and transit service scores as these appear both directly in HUD scoring and are embedded in LEED (9, 39). Advocates for senior affordable housing anticipate there will be a significant need for additional senior housing near transit in the future—as well as need to preserve the affordability of a large segment of the senior stock in transit rich communities (40). Smaller and more specified HUD housing programs, such as the Housing Opportunities for Persons With AIDS (HOPWA) program, do not include such criteria (41).

The research on the efficacy of voucher dispersion as a means of addressing spatial mismatch is mixed. On the one hand, findings suggest that when residents are given the opportunity to select their own housing, they generally find housing closer to their work, closer to public transit and in lower-poverty neighborhoods when compared to residents in project-based housing (42, 43). However, there is also evidence that public transit access plays a minimal role in the locational decision of voucher recipients (35). Generally, the Section 8 program and other demand side housing voucher programs are credited with enabling residents to move into communities that supply-side, subsidized housing production could not penetrate (44). However, it's fairly clear that voucher recipients are still not fully integrated into high-opportunity, low poverty and jobs-rich communities (45).

HUD is now experimenting with the geographic scale at which the maximum amount a voucher pays out is calculated. These Fair Market Rents (FMRs) are currently calculated over large "HUD Market Areas" which generally align with county or metropolitan statistical area boundaries. HUD is experimenting with "Small Area FMRs" estimated at the ZIP code scale (46). Preliminary evidence out of Dallas, where ZIP code FMRs were first implemented in response to a lawsuit, suggests adjusting FMR scales may significantly affect the residential geographic mobility of voucher recipients (47).

Demand side policies, like vouchers, have been shown to put an upward pressure on rents (48). In the short run, this may present problems for maintaining housing affordability in transit and jobs rich neighborhoods, where there is the potential for increased section 8 demand, which results upwards bidding of rents. In the long run, however, this could prove beneficial. Increases in the rents may encourage developers to produce more units in those neighborhoods and spur existing landlords to rehabilitate existing substandard housing units (49). And it must be noted that repeated analysis find that demand side responses such housing vouchers are significantly more cost effective than supply-side subsidies for new housing construction (50, 51).

State and Regional Policies and the Proximity Mechanism

States direct affordable housing policy through their Qualified Allocation Plans (QAPs). The annual QAPs, approved by the federal Department of Housing and Urban Development (HUD), establish policy for the disbursement of Low Income Housing Tax Credits. The QAPs include scoring criteria for competitive tax credits; points can be awarded for cost efficiency, local government subsidy, and location. Johnson finds that from 2000 to 2010, the percent of states awarding points to projects for proximity to multimodal transportation facilities rose from 3% to 31% (52). Proximity to other amenities such as parks, libraries, social services, banks, schools, grocery stores and medical services increased from 16% of QAPs to 56% during the same period (53).

Most affordable housing policy is motivated primarily by poverty de-concentration. Johnson finds QAP policy does result in significantly more LIHTC projects in lower poverty communities (52). HUD's own research also concludes that the awarding of tax credits to projects outside areas of concentrated poverty and near more amenities in QAPs assists in poverty de-concentration and increases access to amenities (54). Given these results, we can speculate that the locational criteria used in scoring for competitive tax credit funded projects contributes to reducing residents' proximity to jobs and amenities (and by extension reduces VMT), but support research is not currently present in the literature.

Beyond the QAPs, states can also utilize land use policy to reduce the separation between affordable housing and suitable employment. Several states have land use laws designed to constrain local jurisdictions' exclusionary zoning practices. Exclusionary zoning is a process by which cities ensure that poor or low income families cannot afford to live in certain neighborhoods. Most communities create this effect by establishing minimum lot sizes, or only zoning for single-family detached units. The link between exclusionary zoning in the suburbs and spatial mismatch between low wage workers' and availability of low-wage work is well established in the literature (55). There is some evidence linking exclusionary zoning to spatial mismatch, but the strength of the association between exclusionary zoning in explaining spatial mismatch relative to other causes is unclear (56). However, since spatial mismatch is linked to excess commuting among the poor (57), policies aimed at overriding exclusionary zoning have the potential to also reduce excess commuting and thus, VMT among low income households.

In one of the most extensive reviews of anti-exclusionary zoning policies to date Bratt and Vladeck (2014) argue that these policies are important for ensuring that affordable housing construction is dispersed across regions and states. Interestingly, they find that cities that succeed in meeting these state mandated affordable housing benchmarks tend to be less white, of lower incomes and have less total housing construction relative cities less successful under identical state laws. Successful communities under anti-exclusionary laws are also likely to be cities with serious jobs-housing imbalance (58). There is limited to no research that examines how anti-exclusionary zoning policies affect the cost of constructing new housing. But the relationship a relationship exclusionary practices and higher housing prices exists (59).

One last state level proximity mechanism is density bonuses. States can offer density bonuses for the inclusion of affordable housing as part of a larger development project. Density bonuses have been found to increase housing production in already dense, centralized communities (citation). This strategy holds promise for producing housing in low-VMT communities, but at the cost of concentrating new affordable housing in areas with higher than average poverty rates (60).

Local Government Policies and the Proximity Mechanism

Local government housing policies that can reduce VMT via the proximity mechanism are significant in that they can enable those jurisdictions with severe jobs-housing imbalances or shortages of affordable housing to directly specify where more affordable housing can be built. This sub-section reviews these policies and their benefits for VMT reduction.

Local government inclusionary housing mandates—a requirement that some percentage of a new residential development contain affordable housing or the developer must pay an in-lieu fee—are the most direct means of ensuring housing at all income levels is produced in every community. Scholars have traditionally had trouble evaluating these programs; requirements can vary by city and the option for developments to pay into an affordable housing fund in-lieu of including affordable units is also allowed in some cities (61, 62). Despite the difficulty in evaluating these programs, there are some points of interests that have emerged from the research. First, inclusionary housing policies may also serve to shore up affordable housing production in cities that have historically had more trouble producing housing and have state housing mandates (63).

In theory, if most cities have robust inclusionary housing laws, then inclusionary-based affordable unit production should at least parallel market rate production with respect to the intra-regional spatial distribution of new units. The theoretical cost of having these programs is that by reducing developer profits through forcing a subsidy—the inclusionary units—the policy ends up hamper overall housing production, although very little evidence of this has yet to be found (Rosen, 2004). Later research found that evidence of price increases from inclusionary housing is spuriously driven by the fact that cities with fast rising prices are those which implement these policies (e.g., the research may suffer from selection bias) (64). Coordination of inclusionary zoning policies across localities in the same region holds greater promise of evenly distributing inclusionary-zoning developed affordable sites (65). The importance of regional coordination of such policies seems obvious; developers respond to intra-regional variation in inclusionary-zoning requirements by concentrating construction in communities where the requirements are least expensive.

Cities and counties also control land use and zoning, providing the opportunity for additional affordable housing through a milieu of land use and zoning changes that increase density in jobs and amenity-rich neighborhoods. Zoning to enable backyard or "granny flat" units behind single family homes can boost the range of naturally affordable housing (66), especially in transit-oriented neighborhoods (67). Affordability by design—the legalization of micro-units or flats with shared common areas—offers great potential in providing naturally affordable housing in dense, expensive areas with close proximities to amenities and jobs (68). However, this frequently requires significant overhaul of existing zoning and regulatory barriers (69).

Cities can also enable the reallocation of commercial structures to residential development, placing new housing in central business districts with immediate proximity to employment and services (70). Zoning and regulatory changes occurring at the local do not come with direct subsidizing of new developments. However, there is no systematic, quantitative evidence suggesting this array of policies produces affordable housing in communities that would otherwise not be built.

Several jurisdictions in California also charge non-residential developments with affordable housing linkage fees, which charge new employment sites on a per-square foot basis to fund affordable housing programs; these policies are primarily designed to address jobs-housing imbalances (71, 72). The processes for estimating linkage fees is relatively uniform, drawing from Nollan v. California Coastal Commission and Dolan v. City of Tigard (73, 74). But there is little evidence that the policy reduces the production of commercial development (75). In the long term, linkage fees may slow commercial development in urban cores; the fees can consume developer profits during downturns (76).

There are also a significant array of zoning practices, including relaxing or expanding height restrictions, limits on mixed-use development, setback requirements, lot coverage maximums, and/or lot size minimums and maximums (77). These practices can lower the cost of housing production for infill development for both affordable and market rate units, increasing the number of units proximate to jobs and amenities as well as reducing their costs. . Or put another way, cities implementing pro-infill zoning policies can assist in reducing spatial-mismatch by undoing the zoning mechanisms which produced exclusionary zoning. No studies directly link the cost of affordable housing production and the density, height and other zoning limits, but economies of scale in housing development and simulation analysis demonstrate these policies increase both the cost of housing development and the cost of commuting limiting projects' and cities' compactness (78, 79).

Infrastructure Mechanism

Housing policies that can impact VMT through infrastructure mechanisms do so by directly linking the financing of affordable housing development to transit or active mode infrastructure. A large body of research demonstrates the VMT reductions of transit oriented development (12, 80–82). There is less research directly quantifying the impact of placing affordable housing in transit-oriented developments (TODs) on residents VMT, noting that low income residents VMT is more sensitive to being in a TOD (83). Infrastructure mechanisms function by inducing mode shift, when residents shift from auto to transit, walking and bicycling facilities

Federal Policies and the Infrastructure Mechanism

The Choice Neighborhoods Initiative (CNI) is the most significant advancement of federal affordable housing redevelopment policy in the last decade. The predecessor program of CNI, HOPE VI, redeveloped dilapidated public housing projects, creating better designed mixed-income communities, but this came at the cost: tens of thousands for former public housing residents were displaced (84). The new CNI program provides additional financial support to again rebuild communities' infrastructure and provide enhanced social services for economic revitalization (6). Choice Neighborhood projects can spend up to 15% of their budgets on Critical Community Improvements (CCIs). Several projects currently underway include improved bicycle and pedestrian facilities, and improved transit service (85–87). Despite requiring considerable federal investment, the interventions are considered significantly less expensive than inaction or minor rehabilitation (88).

Researchers on redevelopment have identified quantifiable metrics by which CNI could be deemed a success; only one of the metrics is associated with transportation: increased transit service (7). Given some of the major accessibility and infrastructure changes soon to be underway in CNI communities, these projects also warrant further study as they represent natural experiments that can advance our understanding of how new infrastructure influences travel behavior.

State and Regional Policies and the Infrastructure Mechanism

California has experience producing affordable housing proximate to major transit infrastructure, and linking housing construction with investments in transit and bicycle and pedestrian facility upgrades. Advocates with Housing California have documented that the state's Infill Infrastructure Grant (IIG) and Transit Oriented Development (TOD) Grant have helped produce over 12,000 affordable and market rate units at roughly $36,000 per units in subsidy (89). This analysis does not consider the extent to which such subsidies were necessary to ensure housing production, or if units funded through this program merely functioned to crowd out units the market would have already provided for—as some have suggested the LIHTC program does (90).

There is, however, reason to believe that the subsidies provided by the IIG and TOD grants are necessary to at least ensure the provision of affordable units in TOD sites, particularly those built along fixed route rail systems fixed route transit systems increase land and property values. A large body of literature suggests that adjacency to fixed route transit can command land and housing price increases anywhere from a 1% to 15% (91–93).   While this literature is mostly concerned with adjacency to transit systems as opposed to TOD developments, we would expect the effect of transit on property values to be stronger in TODs as they are designed and built to capitalize on transit access and also include walkability and bike ability in their designs (94–96). Even the process of planning for potential transit investments and rail expansions can trigger property value increases (97). The transit premium as only increased since the Great Recession (91, 98).

Taken holistically, the research to date suggests that subsidizing low income housing in transit oriented developments should thus be roughly 1% to 15% more expensive than subsidizing low income housing elsewhere, all things being equal. It's not clear if the additional subsidies provided by the TOD and IIG programs cover or exceed this cost. If these programs failed to meet the additional costs (associated with increased property values), then developers may cut costs elsewhere, bargain down zoning or parking requirements with cities, or sought out additional subsidies. If the subsidy exceeded the additional need, then projects taking advantage of these programs may have simply drawn less subsidy from other sources they would have won otherwise or experienced cost inflation.

California has also introduced its own program for affordable housing production and rehabilitation that mimic's the Choice Neighborhood Initiative. The new program, the Affordable Housing and Sustainable Communities (AHSC) program, links new housing with improved green infrastructure. The proposed scoring criteria for AHSC projects, and subsequent pushback from various stakeholders, highlights the challenges facing policy makers hoping to simultaneously address social equity and environmental sustainability issues . As of this writing, 2016 draft scoring criteria place only 30 out of 100 points on emissions reductions and cost-effectiveness, while rewarding just 10 points to projects for depth of housing affordability (e.g. units at 30% of area median income versus units at 80% of area median income) (20).

The AHSC is a good program for evaluation because it relies on a specific, uniform and replicable tool to estimate the emissions reductions of affordable housing projects based on their locations and attributes: CalEEMod, a development emissions estimation model. CalEEMod is not a VMT estimator, but it includes estimation of VMT produced by sites. It links project costs and estimated emissions reductions, and can be applied uniformly to projects funded through any sources, not just the AHSC. However, CalEEMod isn't really set up to address affordable housing and some advocates have noted studies suggest the software may be under-estimating the emissions reductions from affordable housing commitments in projects (99).

Finally, a few ambitious metropolitan planning organizations (MPO), which are responsible for disbursing transportation dollars at the regional scale, have created financial incentives to induce development of affordable housing alongside transit and transit infrastructure improvement programs. The San Francisco Bay Area's Metropolitan Transportation Commission's Housing Incentive Program (HIP), for example, provided over $7.3 million dollars to provide set per-bedroom grants to housing projects, assisting in the financing of nearly 5,000 units all within a third of a mile of a fixed route transit stop with service intervals of 15 minutes or less during peak commute times (100).

Local Policies and the Infrastructure Mechanism

The strongest affordable housing production tool available to local jurisdictions is the abolition of minimum parking requirements for housing construction. Evidence from New York suggests developers generally only build the minimum required amount of parking, and that parking minimums correlate negatively with distance to transit (101). In Los Angeles, the relaxing of parking requirements has played a critical role in enabling developers to construct more housing (102). Shoup has long argued that parking requirements artificially raise the cost of housing, penalizing car-free households with higher housing costs (103). There is clear evidence that parking availability increases auto use (104), Activist organizations are now working with developers and cities to enable new infill developments to be built without arduous minimum parking requirements in exchange for developers purchasing lifetime transit passes for new units and prioritizing bicycle parking, among other things (105). However, this approach may face some of the most significant road blocks, as transportation and parking related complaints are some of the most common to fuel NIMBY (not-in-my-backyard) backlash against affordable housing project (106). This obstacle is strong enough that California had to pass a state law requiring cities to allow senior and special needs affordable housing projects meet lower minimum parking requirements (107).

Conclusions

Nearly all policies increasing housing in TODs are supply side. Given the weight of the evidence that demand side programs are more cost effective and can induce a supply side response, policy makers should explore offering demand side policies to help lower income households afford TODs. Policy makers should also consider adjust existing demand side policies to account the higher cost of living in more accessible communities.

Policies which increase housing proximity to destinations, particularly those embedded in point systems for various funding programs, are not sensitive to how local exclusionary zoning may be constricting the number of projects in each locality that can successfully compete for funding. Policy makers should examine how this dynamic may be impacting land prices of those occasional sites that possess the right mix of proper local zoning and an optimal location for winning tax credits or other subsidies. The state's Regional Housing Needs Allocation (RHNA) has a proven record of success, it should form the basis around which more aggressive regional housing policies can be established. For example, the state or an MPO could be given the right to override local planning decisions on sites provided in adequate site inventories. In a case where such a site is infeasible for a project because of height limits or other rules the developer could apply directly to the state to override local rules.

New Research Directions

New research needs to examine if the locational scoring criteria of QAP impacts the physical and social mobility of site residents and if so, to what extent. This research should also compare residents' sites to the proximity of their previous homes to the same set of amenities to examine which programs are reducing VMT by assisting residential transitions into more location efficient areas. Scholars should explore how policy variation over space and time in LIHTC project scoring criteria contributes to different transport outcomes among project residents—and what costs, both financial costs and the loss of the ability to utilize housing policy to meet other social goals.

The impact of the RHNA and similar programs on both the supply of affordable housing and the cost of land need further analysis. The individual and cumulative impacts of various aspects of local zoning, from height limits to aesthetic requirements to sustainability requirements on the cost of building housing are still unaccounted for. How these costs are unevenly forced onto affordable housing development across our regions and the resulting incentive surface they create has also not been fully charted.

On the demand size, scholars should explore the role of policy scale in predetermining voucher eligibility, particularly the scale at which Fair Market Rents for Section 8 vouchers. More importantly, there is a lack of understanding of how the many spatially oriented housing policies and program scoring criteria at multiple levels of government synergistically drive affordable housing development into some areas and not others.

Chapter 2: The Ability of Supply Side Programs to Penetrate High Opportunity, Jobs and Transit Rich Neighborhoods

Constructing affordable housing in low-poverty, jobs-rich communities has been a priority of state and federal housing policy for decades. Scholars generally credit the Low Income Housing Tax Credit program with significantly improving the locational quality of new affordable housing compared to the mega-projects built in the 1950s and 1960s (33). Very little research compares the locational outcomes of affordable housing units based on the different types of programs which funded them. We compare the locational outcomes of units funded by three distinct types of programs against each other and against market rate units: inclusionary housing units, redevelopment supported units and tax credit financed units. We compare how these programs vary in locational outcomes across three distinct metropolitan areas: the San Francisco Bay Area, Greater Sacramento, and San Diego County. Data is drawn from the authors' own examination of multiple different planning and housing financing sources and spans the years from 2000 to 2010.

With respect to neighborhood job access, we find units funded through all three types of programs underperform against market rate units overall. We find they perform evenly against market rate units in the Bay Area and actually perform better than market rate units in the Greater Sacramento area. With respect to neighborhood poverty rates, all three types of programs perform worse than market rate development. With respect to transit, grocery and medical access, tax credit funded projects outperform other units built by programs and market rate units only with respect to transit and grocery access, suggesting the emphasis on location in California's scoring criteria for tax credits are effective, but not uniformly so (19).

These results are exploratory, we believe they offer a high level view of what is happening in our affordable housing programs with respect to location. What these results do not do is offer comprehensive judgement on the efficacy of these programs, as the benefits of affordable housing extend beyond improving access to high opportunity neighborhoods. Sometimes, providing someone with a safe, clean habitable and affordable home can improve their physical health and educational and employment outcomes regardless of location (*108*).

The Probability of Affordable Housing Reaching High Opportunity Areas

The affordable housing tax credit program is the largest supply-side affordable housing construction program. Meant as a replacement to large project-style affordable housing built directly by the federal government, tax credit financed housing is developed by private and non-profit organizations who compete for tax credits that they can sell to banks to raise funding for subsidized housing. While the tax credit program may out-perform the older housing projects (32), it is still concentrated in higher poverty communities due to bonuses in the tax credits the federal government awards to projects located in specific neighborhoods (34). In a quest to maximize returns, developers appear to be systematically locating in these communities despite their higher than average poverty rates (37). Those states who utilize their tax credit allocation plans to prioritize building in low poverty neighborhoods, however, appear to have some success in placing sites in "high opportunity" neighborhoods (53). However, California's Tax Credit Allocation Committee (TCAC) does not reward projects for locating in low-poverty neighborhoods, making it unlikely tax credit funded projects in our sample will outperform market rate units with respect to neighborhood poverty rates (19). With respect to transit access, however, tax credit projects may outperform market rate units, as TCAC awards points to competitive project applications for those projects located within a half mile of transit service, a locational incentive found to be effective in other states (19, 54). This should hold particularly true for senior housing, which is also subject to specific criteria about access and proximity to medical facilities in California's tax credit allocation plan (19).

Inclusionary housing can be expected to at least match market rate development with respect to locational outcomes by policy design. Cities implement mandates on new developments in which anywhere from 10% to 30% of new units in any development must be affordable, and these units are referred to as inclusionary units (62). However, some cities do allow developers to pay in-lieu fees (*109*). Under policy regimes in which inclusionary housing policies are mandatory for all jurisdictions, inclusionary units are found to be evenly spaced across regions (65). Given that inclusionary housing is widespread in use in our case study regions (*110*), we should expect inclusionary housing to perform well compared to market rate development.

California's redevelopment program is almost completely unstudied with respect to the locational outcomes of sites. The modern scheme of redevelopment in California commenced with Proposition 18, which enabled local redevelopment agencies to receive funding through tax-increment financing (*111*). Subsequent policy changes in the state, especially Proposition 13, created conditions wherein cities increasingly expanded their definitions of redevelopment "project areas" to increase funding availability (*111*). Because these programs were primarily concentrated in urban areas, however, we may hypothesize that they should outperform market rate production with respect to job and transit access, particularly in fast growing regions where many suburban communities may still be too new to require their own redevelopment programs. In contrast, the areas targeted for redevelopment may be communities which have previously faced systematic underinvestment (hence they are targeted for redevelopment), and thus these projects may underperform. It is worth reiterating that locational benefits are just one of the many kinds of benefits of affordable housing like improved health and educational outcomes (*108*). In cases where the housing is part of community revitalization, the lack of positive locational outcomes should not be counted against these programs—they may be a component in a bigger effort to improve an existing location, instead of relocating people elsewhere.

Gathering The Data

The data on affordable housing production was gathered following a five step process outlined by Palm and Niemeier (*112*). This process is summarized in Figure 1. As jurisdictions report affordable housing to their respective metropolitan planning organizations (MPOs), the process involved searching through state and local planning records identifying sites and units until the dataset matched what the jurisdictions reportedly produced. This process was necessary because California did not maintain a comprehensive dataset on affordable housing production from all programs statewide during this study period, 2000 to 2010 (*113*). Data on market rate production was pulled from the United States Census Bureau. It is worth noting that many projects included some component of multiple programs: some inclusionary funding and tax credits, or redevelopment and tax credit support. These were allowed to count in the distributions of each source they were funded by.

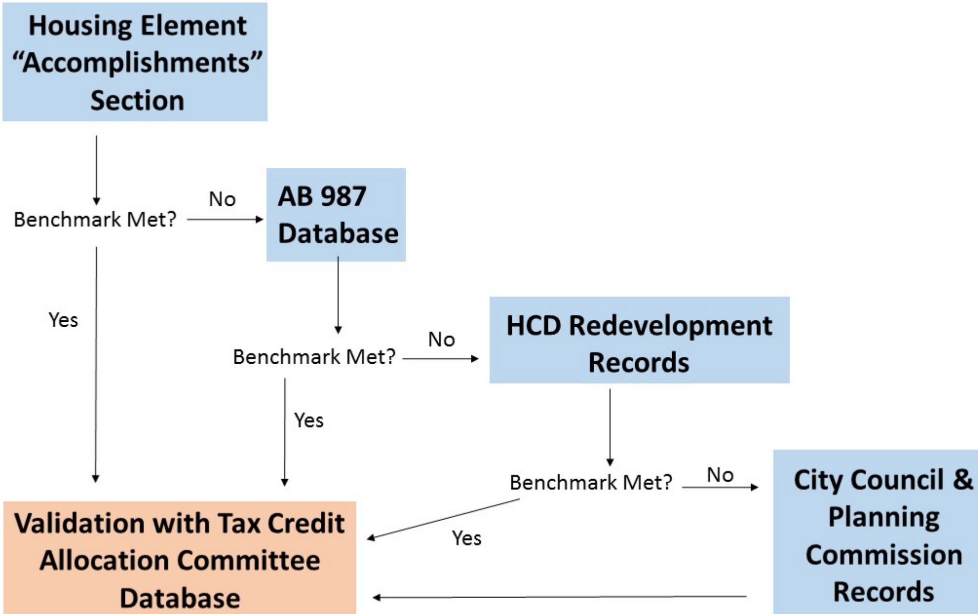

Figure 1: Housing Production Documentation Process

Outcome variables for units are summarized in Table 1. As described in the previous chapter, our analysis includes multiple measures of jobs-housing balance that have been found to be significant predictors of 'excess commuting' and commute times (2, 16, 26). As also discussed previously, we include the more low-wage worker sensitive measure of jobs-housing fit (1). Based on their importance in TCAC regulations, we include access to medical facilities and grocery stores (19, 54). We also include poverty level, as poverty concentration in projects' sites has long been a challenge supply side programs have been trying to address (33, 34). As scholars have evaluated the effectiveness of the location of affordable housing with respect to need, we include the measure used by those researchers to define need: the percent of households rent burdened (35). Lastly, we include exploratory results on air quality and school quality. All measures at the Census Tract Scale.

Table 1: Summary Statistics of Outcome Measures for Units

	Minimum	Median	Mean	Maximum
Jobs Housing Balance (2.5 Mile Buffer)	0.002	0.760	1.136	9.964
Jobs Housing Balance (5 Mile Buffer)	0.088	0.877	1.061	14.540
Jobs Within 45 Minute Auto Commute	0.000	134369.364	186646.840	916589.448
Low Wage Jobs to Affordable Housing Fit	0.000	3.570	5.310	31.230
Jobs Within 45 Minute Transit Commute	0.000	657.261	5235.145	115939.862
Number of Medical facilities Per 1000 people (5 Mile Buffer)	0.000	1.280	1.490	7.680
PM 2.5 Concentration	4.140	9.780	9.819	12.500
Percent of Tract Residents Within .5 Mile of Grocery Store	0.000	35.090	44.253	100.000
Percent of Households Below 200% of Poverty Level	0.000	22.420	26.556	96.660
Change in Nearest Elementary School Academic Performance Index Score (2000-2014)	-0.045	0.143	0.185	0.880
Academic Performance Index Score, Nearest Elementary School (2002-14	427.000	847.000	843.847	998.000
Percent of Households Rent Burdened (2010-14 American Community Survey)	15.380	48.910	49.481	85.190

Results

Results across all three regions with respect to job access are presented in Figure 2. All figures in this section plot the distribution of units with respect to the locational outcome labeled above each set of distributions. Red lines denote the 75th percentile for each distribution. The higher the red bar is, the greater the number of units funded by that program at the upper end of the outcome variable's distribution. The mean for each distribution is in black and median in blue. The distributions represent the distribution of units funded by each program (or not, as in the case of market rate units). This is distinct from the distribution of projects, which can contain between one and four hundred plus units.

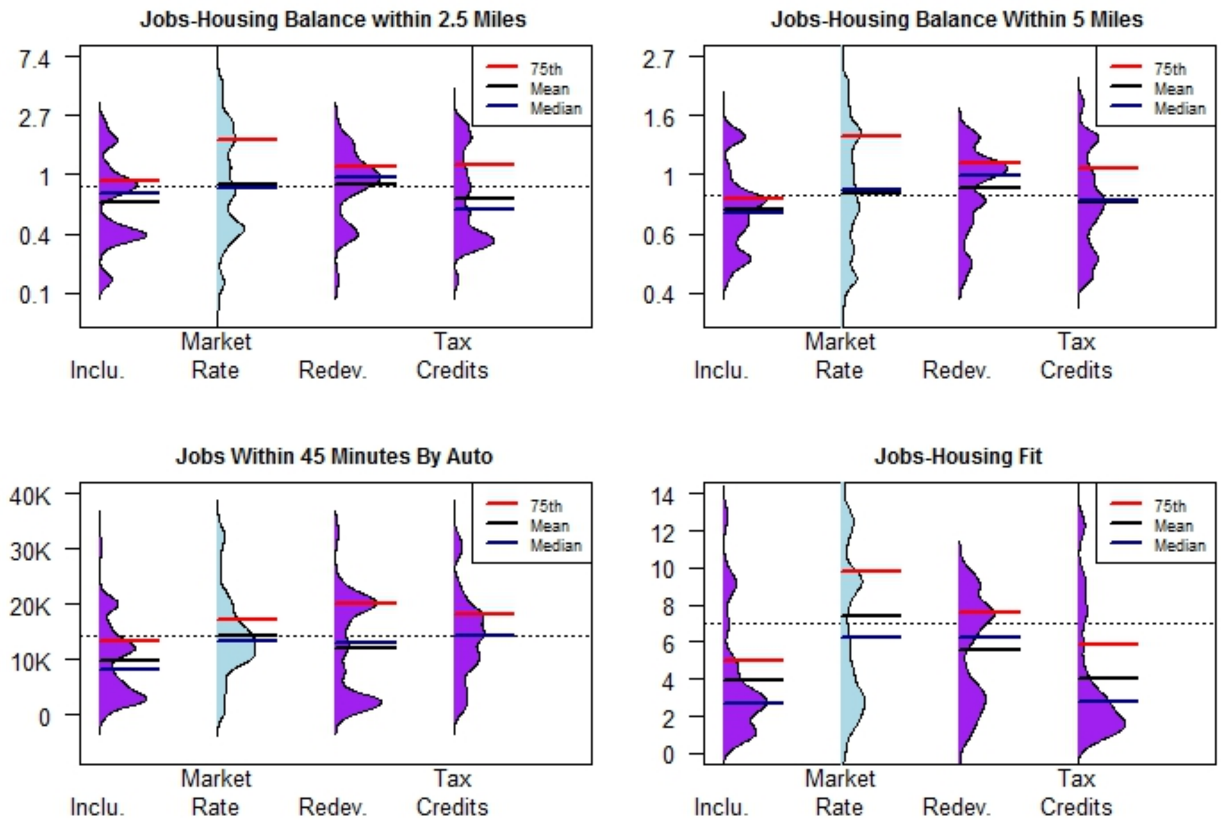

Figure 2: Differences in Job Access Outcomes By Funding Source

On jobs housing balance, redevelopment funded units outperform market rate units in terms of mean and median, unlike tax credit and inclusionary units. However, the top quarter of market rate units (with respect to jobs-housing balance) is in neighborhood with systematically better jobs housing balance than the top quarter of redevelopment units as defined by the same outcome variable. With respect to job access by auto commute, market rate units perform about the same against all three programs, except that redevelopment and tax credit funded units have a top-heavy distribution with respect to this measure (see red bars). On low wage jobs to affordable housing balance, or jobs-housing fit, market rate units outperform the three programs dramatically (bottom right chart). Among the three affordable housing program types, redevelopment performs best on this metric, followed by tax credits with inclusionary housing performing the worst. Figure 3 presents strikingly different results on job access by transit, and access to other facilities.

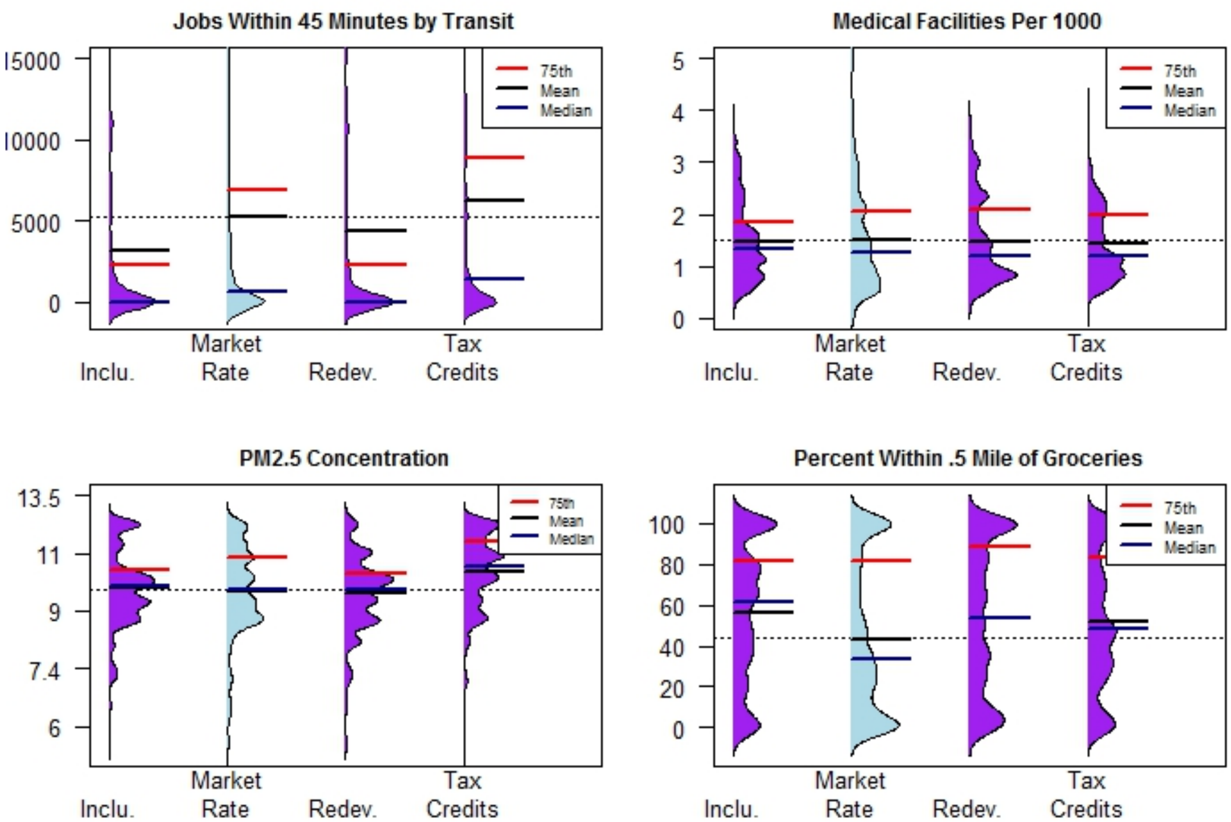

Figure 3: Differences in Transit Access and Quality Of Life Outcomes By Funding Source

Recalling that California's Tax Credit Allocation Committee prioritizes projects proximate to transit, medical facilities and grocery stores, Figure 3 shows the program is having mixed effects. Tax credit funded units dramatically outperform market rate, inclusionary and redevelopment units with respect to jobs accessible by transit. In contrast, there is no major difference between the three programs and market rate units with respect to access to medical services. For access to groceries, redevelopment and inclusionary units perform best, followed by tax credit funded projects. Units created through all three programs perform better than market rate units on this outcome.

In terms of exposure to poor air quality (bottom left chart), tax credit units have the greatest exposure, followed by market rate units. Similarly concerning results for tax credit funded units are presented in Figure 4.

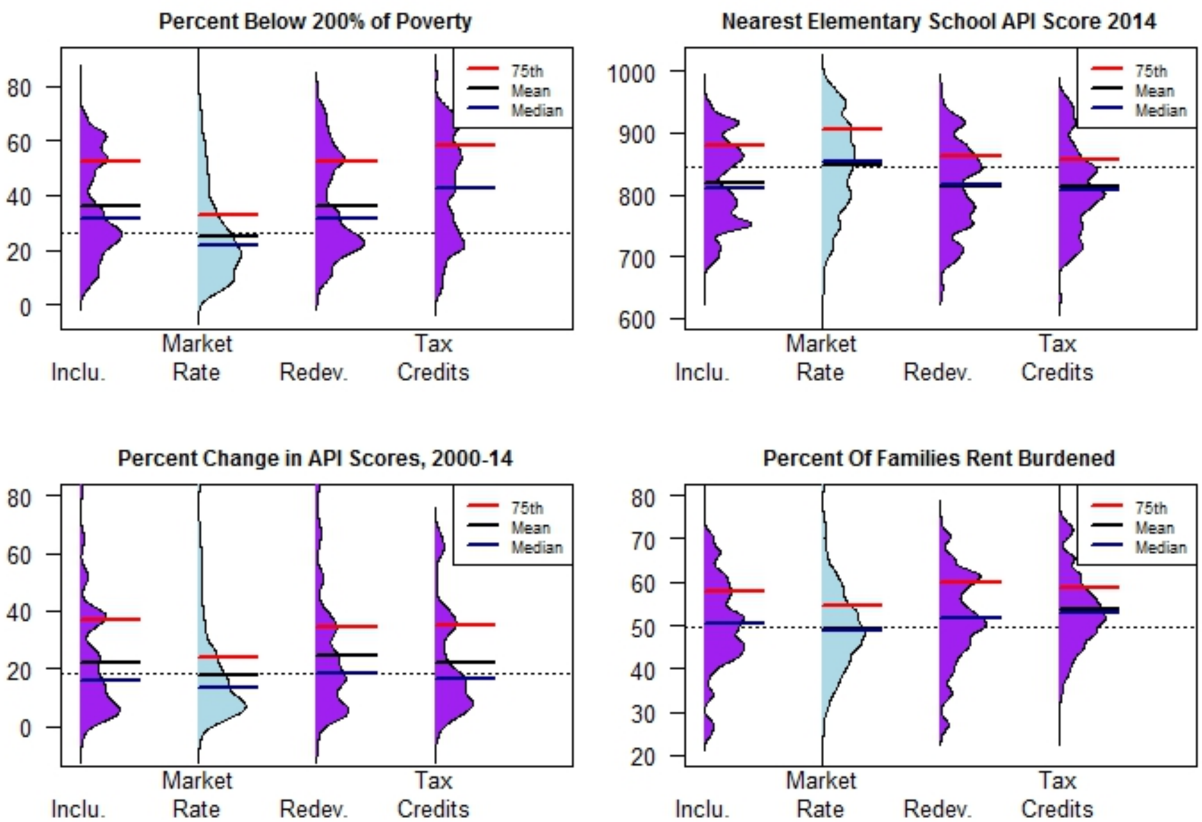

Figure 4: Differences in Education, Rent and Poverty Outcomes By Funding Source

With respect to poverty rates, market rate units dramatically outperform units funded by all three kinds of programs. Tax credit funded units are disproportionately located in neighborhoods with higher poverty rates relative to inclusionary and redevelopment units (top left chart). The educational results are more mixed. While the average Academic Performance Index (API) score of the nearest elementary school was highest for market rate units (top right chart), the average change in the API from 2000-2014 was lowest for market rate units (bottom left chart). This means that while market rate units were more likely to be located in areas with higher elementary school API scores, the affordable units funded by all three programs are locating in areas where the schools have at least been improving over the last fifteen years. Lastly, the affordable units are systematically located in areas with higher rent burdens than market rate units (bottom right). This is a good thing, as it means affordable units are locating in areas where the need for affordable housing is higher (which may explain the higher poverty rate results, too).

Multi-Region Results: Senior Versus Non-Senior Housing

Because senior housing sites are sometimes subject to different locational criteria, we present the spatial outcomes of senior projects relative to both market rate and other affordable new construction in this section.

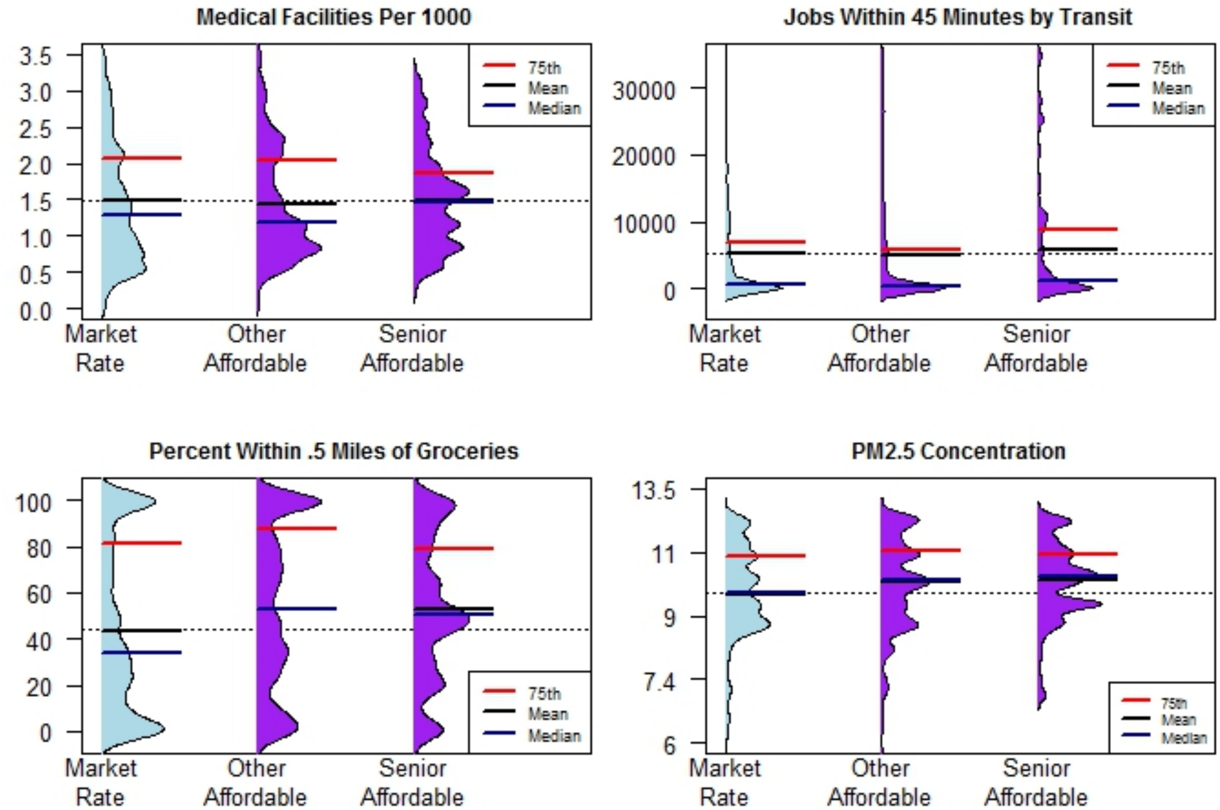

Figure 5: Differences in Senior-Specific Outcome Measures

Requirements and incentives for senior affordable housing to locate near medical facilities appear to have no effect (top left chart of Figure 5). In contrast, incentives that places these projects near transit appear to have a significant impact (top right chart). Senior affordable housing out performs market rate production with respect to grocery access (bottom left chart), but under performs compared to other affordable projects. As with other affordable housing projects, senior housing has slightly higher PM 2.5 concentrations than market rate production, on average.

Results By Region: San Francisco Bay Area

Job accessibility results for the Bay Area are presented in Figure 6.

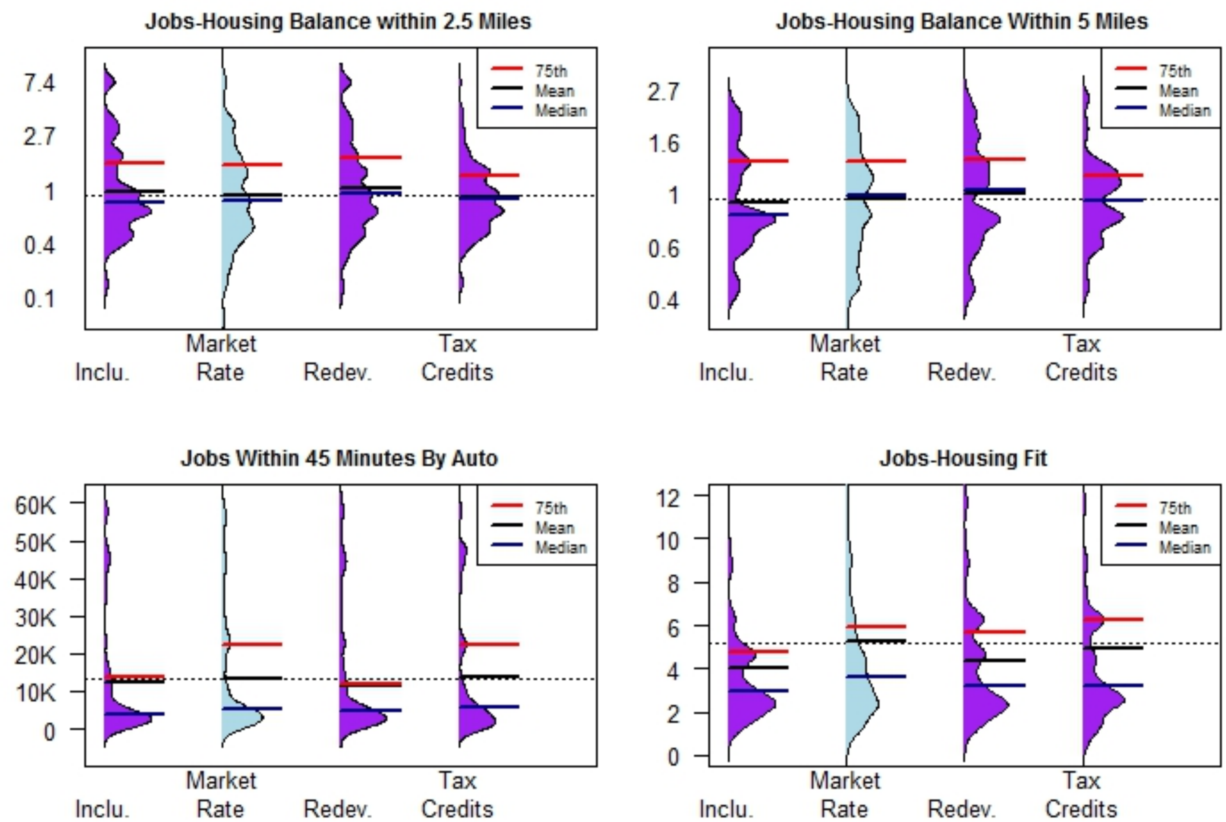

Figure 6: Differences in Job Access Outcomes By Funding Source, Bay Area

In the Bay Area, affordable housing units across all three funding sources perform similarly against market rate units with respect to jobs housing balance. With respect to job access by automobile, distribution means do not vary by program type, although the upper end of the distributions for market rate and tax credit units are similarly higher than those of inclusionary and redevelopment supported units. With respect to jobs housing fit, market rate, redevelopment and tax credit funded units all perform similarly, and are trailed slightly by inclusionary units. These results contrast with job access by transit, presented in Figure 7.

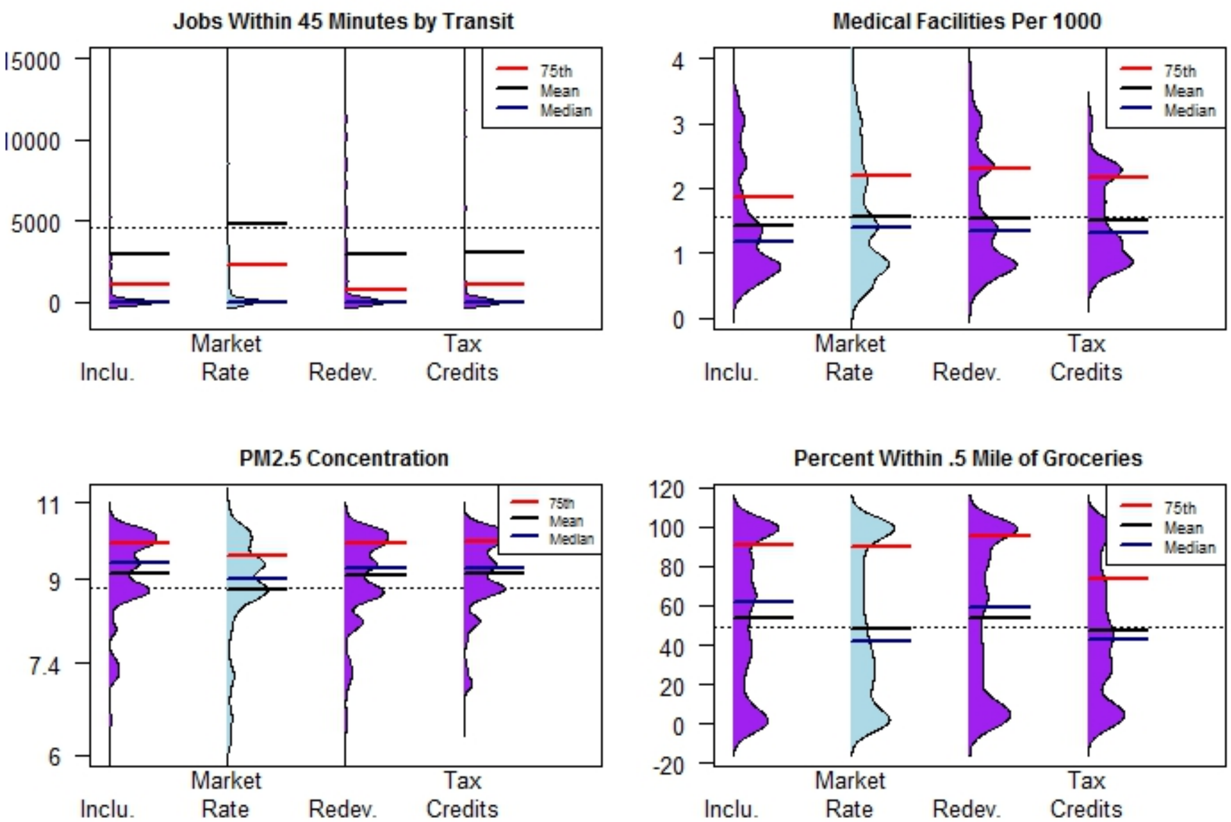

Figure 7: Differences in Transit Access and Quality Of Life Outcomes By Funding Source, Bay Area

Market rate units out perform all three programs with respect to jobs within a 45 minute transit commute. In contrast, there is little difference across all four distributions with respect to medical access and PM 2.5 concentrations. Only in terms of grocery access (bottom right), do affordable units outperform market rate production, and this is limited to inclusionary and redevelopment funded units. Socio-economic factors are presented in Figure 8.

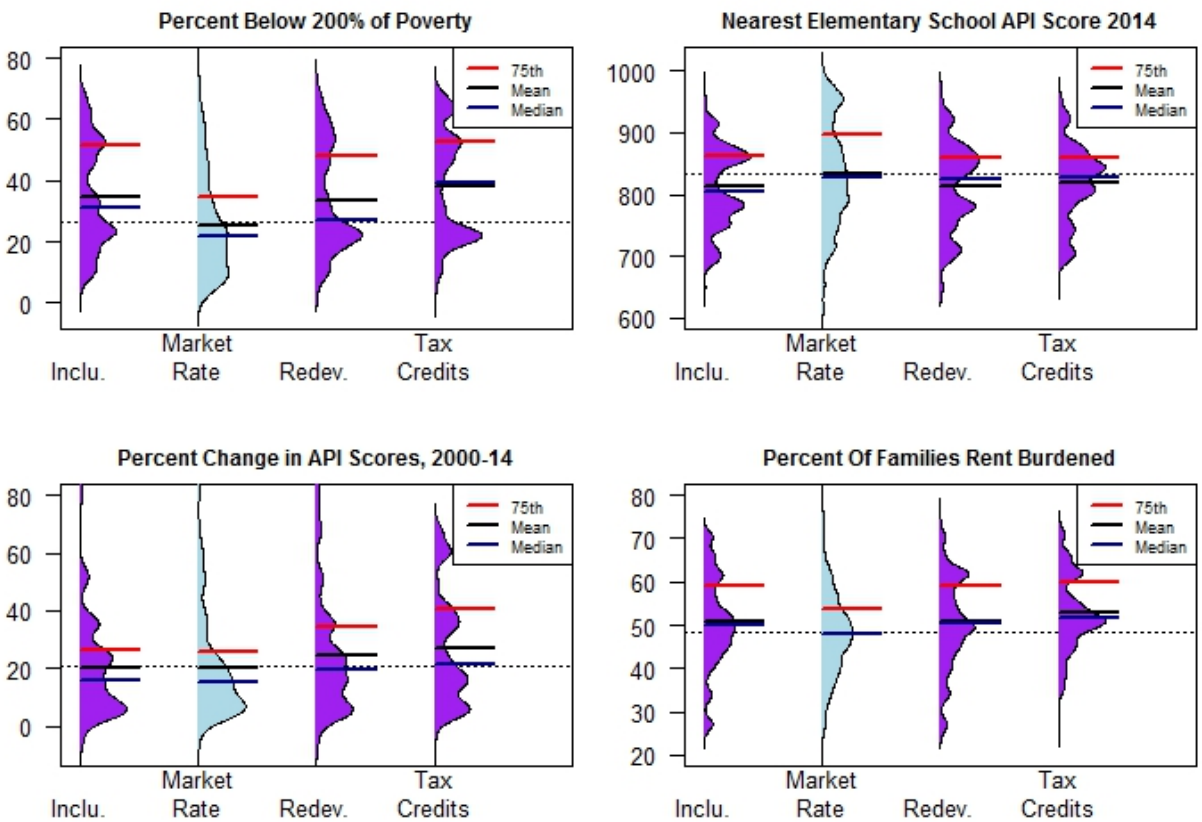

Figure 8: Differences in Education, Rent and Poverty Outcomes By Funding Source, Bay Area

As with the overall patterns, in the Bay Area market rate units are in lower poverty communities compared to affordable units (top left chart). Similarly, market rate units are in areas where the elementary schools have higher API scores (top right chart). Unlike the overall patterns, in the Bay Area only redevelopment and tax credit funded units outperform market rate units with respect to being near schools that have been improving over the past 15 years (bottom left chart).

Results By Region: San Diego

Job access results for San Diego are presented in Figure 9.

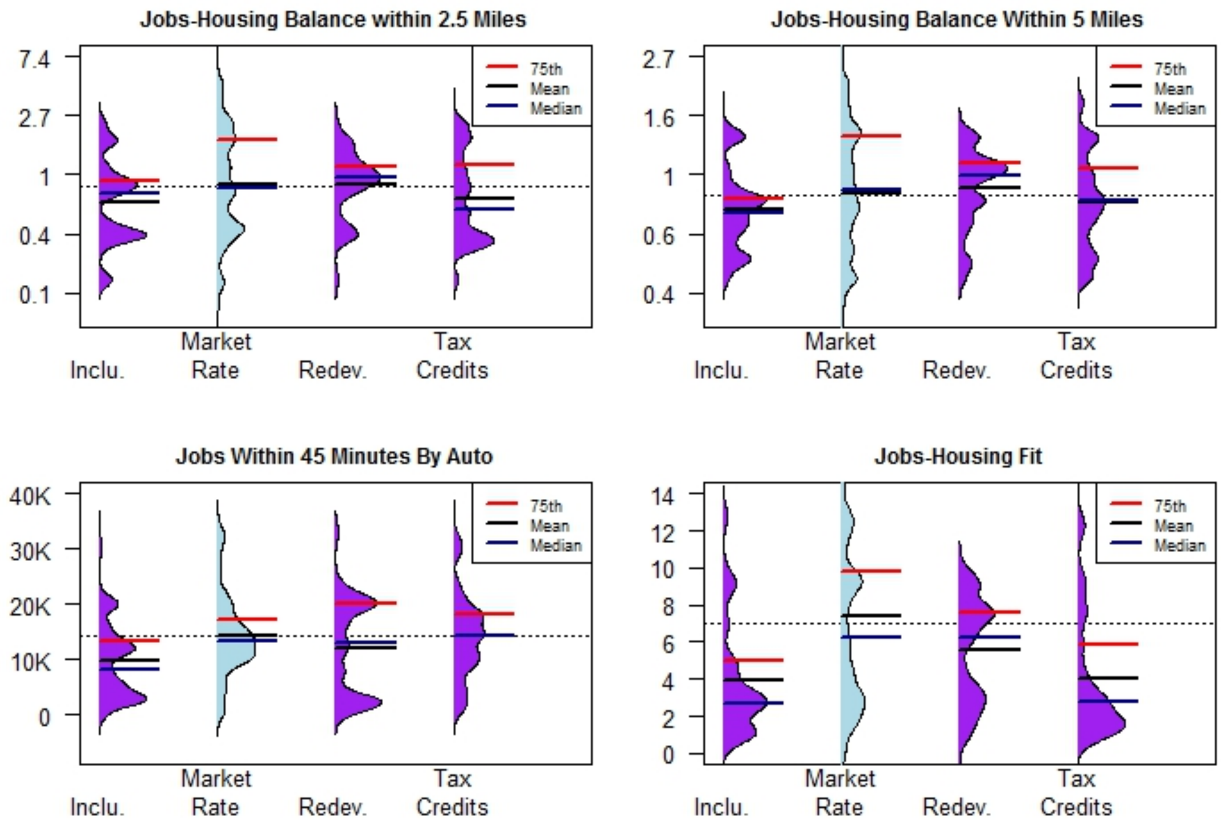

Figure 9: Differences in Job Access Outcomes By Funding Source, Bay Area, San Diego

In San Diego, market rate units dramatically outperform affordable units with respect to jobs housing balance and jobs-housing fit. Inclusionary and tax credit units in particularly perform much worse on jobs-housing fit than market rate units (bottom right). Yet when it comes to jobs accessible by automobile commute, differences are much smaller: there is a large tail among redevelopment supported units at the upper and lower ends of the distribution, and inclusionary units perform slightly worse that market rate units. The job access by transit results in Figure 10, however, paint a much different picture.

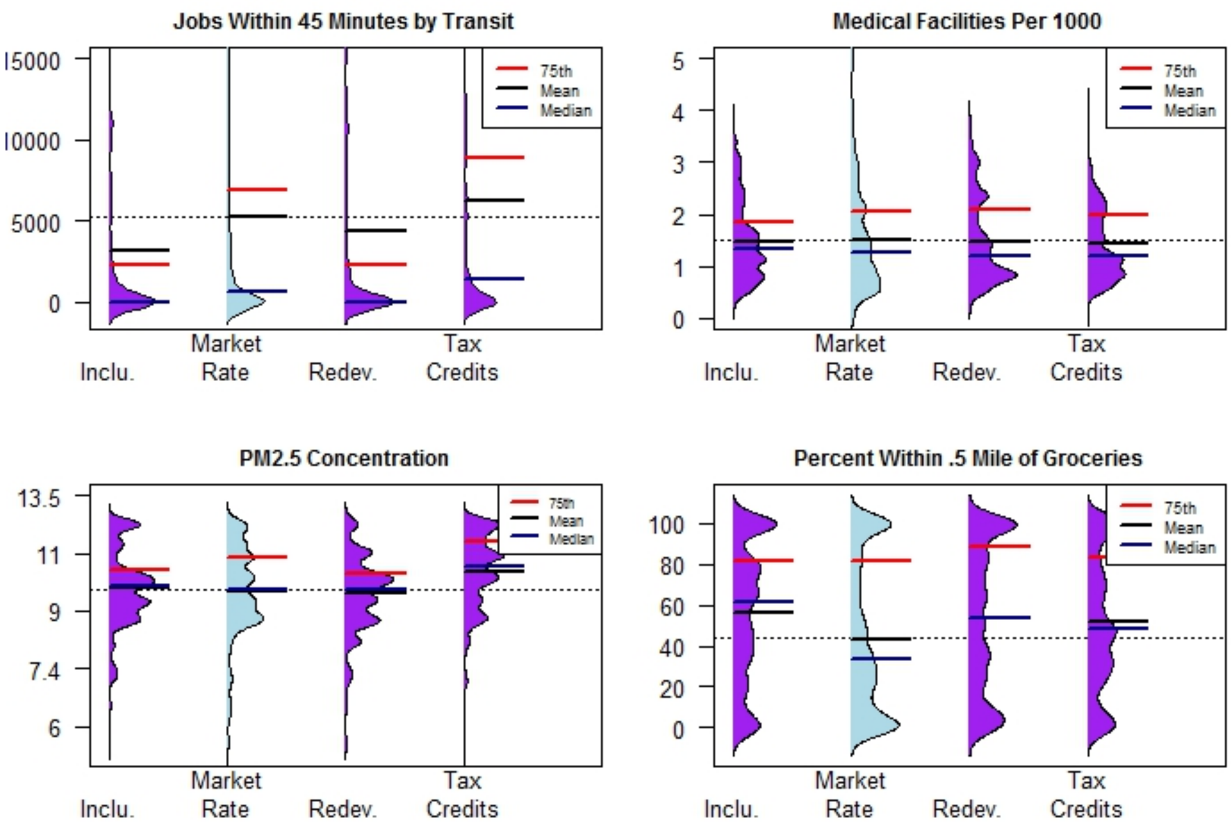

Figure 10: Differences in Transit Access and Quality Of Life Outcomes By Funding Source, San Diego

Tax credit units significantly outperform market rate units with respect to jobs accessible by transit in San Diego (top left chart). With respect to medical facility access and PM 2.5 concentration, there are no major discernable differences. Affordable units across all three programs outperform market rate units with respect to grocery access. Despite policy efforts incentivizing tax credit projects near grocery stories, units funded by this program are not in systematically better locations with respect to grocery access than redevelopment and inclusionary units. Educational and poverty outcomes are presented for San Diego in Figure 11.

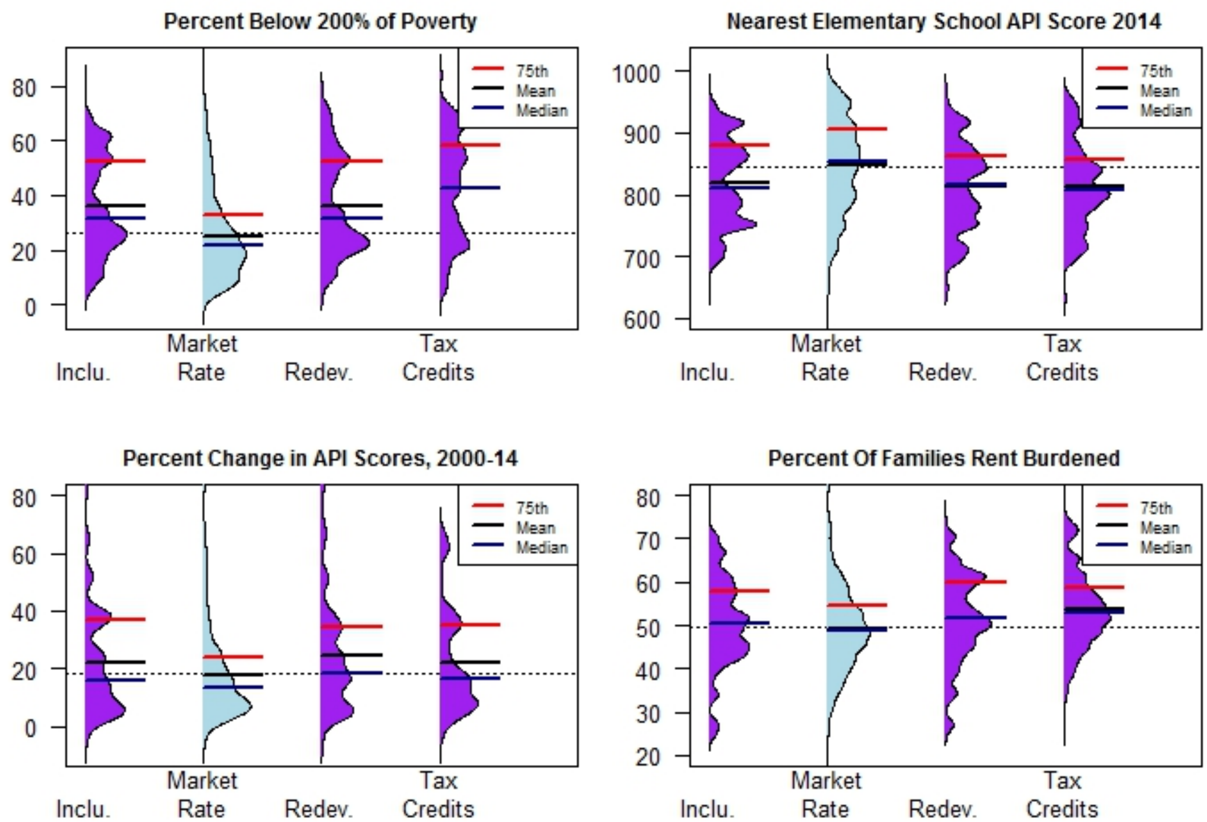

Figure 11: Differences in Education, Rent and Poverty Outcomes By Funding Source, San Diego

As with the Bay Area, market rate units in San Diego are in neighborhoods with systematically lower poverty rates compared to affordable units. Among affordable units, the distribution of poverty rates is generally similar except that tax credit units are in areas with systematically higher poverty rates compared to the other two groups of affordable units. School quality patterns match those in the Bay Area: affordable units are located in areas where elementary school API scores are lower than for market rate units, but these are schools which have shown more dramatic improvements over the last 15 years. Affordable units are also more likely to end up in more severely rent burdened neighborhoods in San Diego, but the gap with respect to market rate units is smaller for this region than for the Bay Area.

Results By Region: Sacramento

Sacramento job accessibility results are presented in Figure 12.

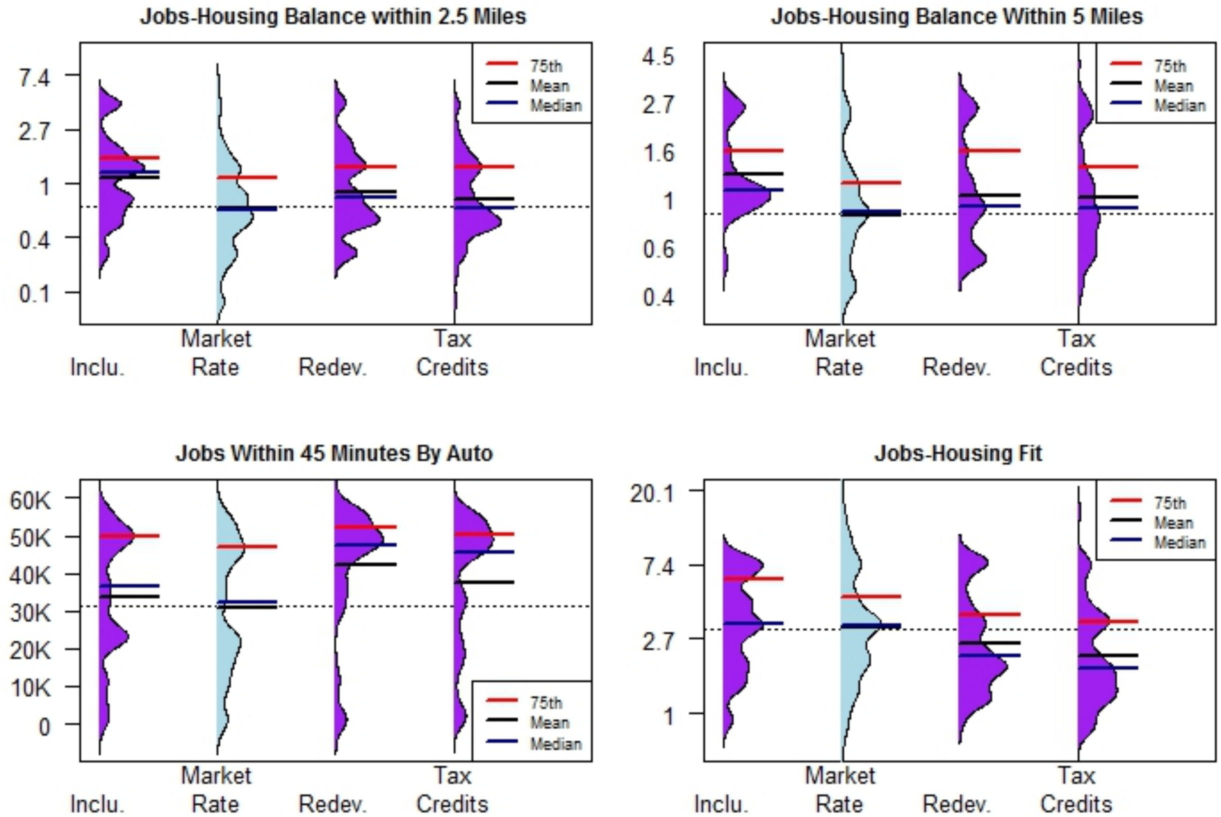

Figure 12: Differences in Job Access Outcomes By Funding Source, Sacramento

Sacramento breaks with the previously reported patterns of market rate units outperforming affordable units with respect to job access. On jobs housing balance by a 2.5 or 5 mile threshold, affordable units in all three programs outperform market rate units, with inclusionary units more significantly outperforming market rate units. For jobs-housing fit, inclusionary units perform best, followed by market rate units, then redevelopment units, then tax credit units. Lastly, with respect to job access by car, all three affordable programs outperform market rate units, with redevelopment funded units outperforming market rate most dramatically. These results also hold up for job access by transit, which is presented in Figure 13.

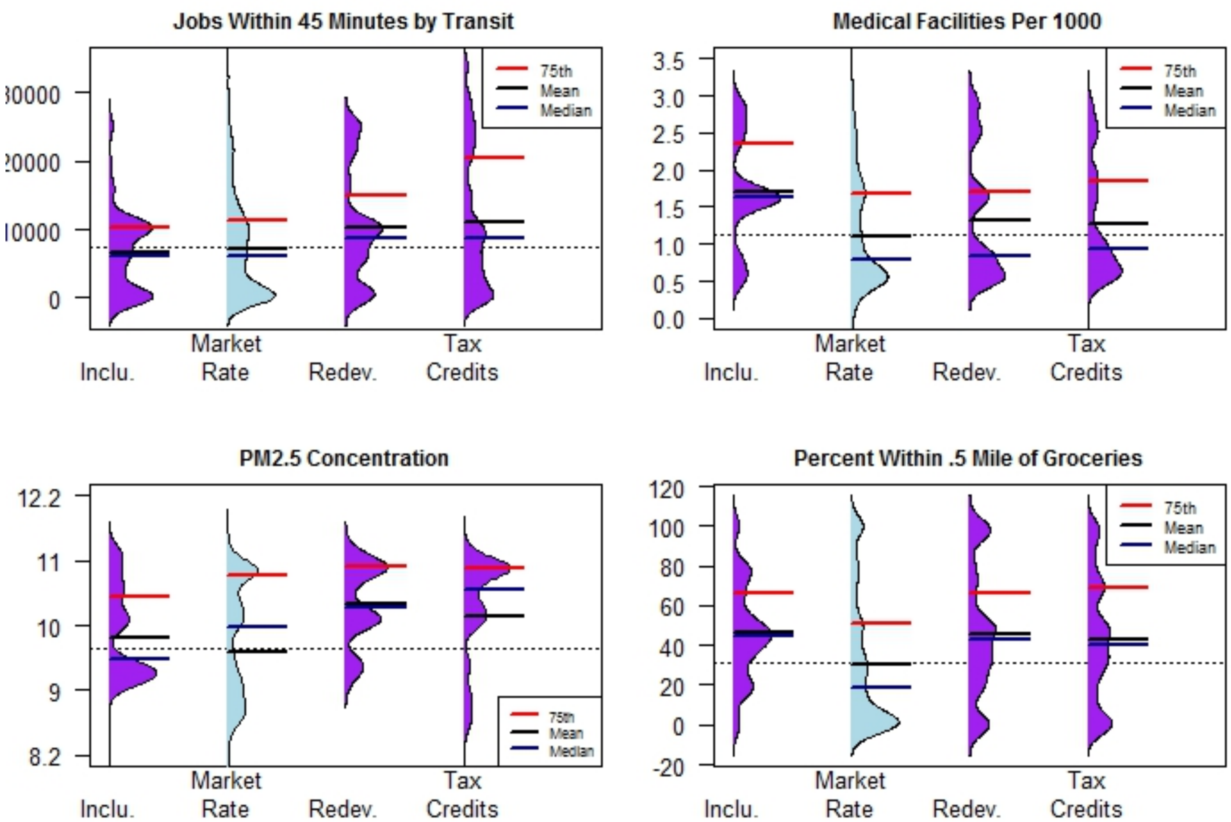

Figure 13: Differences in Transit Access and Quality Of Life Outcomes By Funding Source, Sacramento

For job access by transit, tax credit funded units perform best, followed by redevelopment units and then inclusionary units, which are only marginally different on this measure from market rate production. On medical access, inclusionary units dramatically outperform the other three groups of units and are also clustered in communities with significantly lower PM 2.5 concentrations. On PM 2.5 levels, redevelopment and tax credit units perform worse than market rate production, as was also shown to be the case in the Bay Area. Educational and poverty outcomes for the Sacramento area are presented in Figure 14.

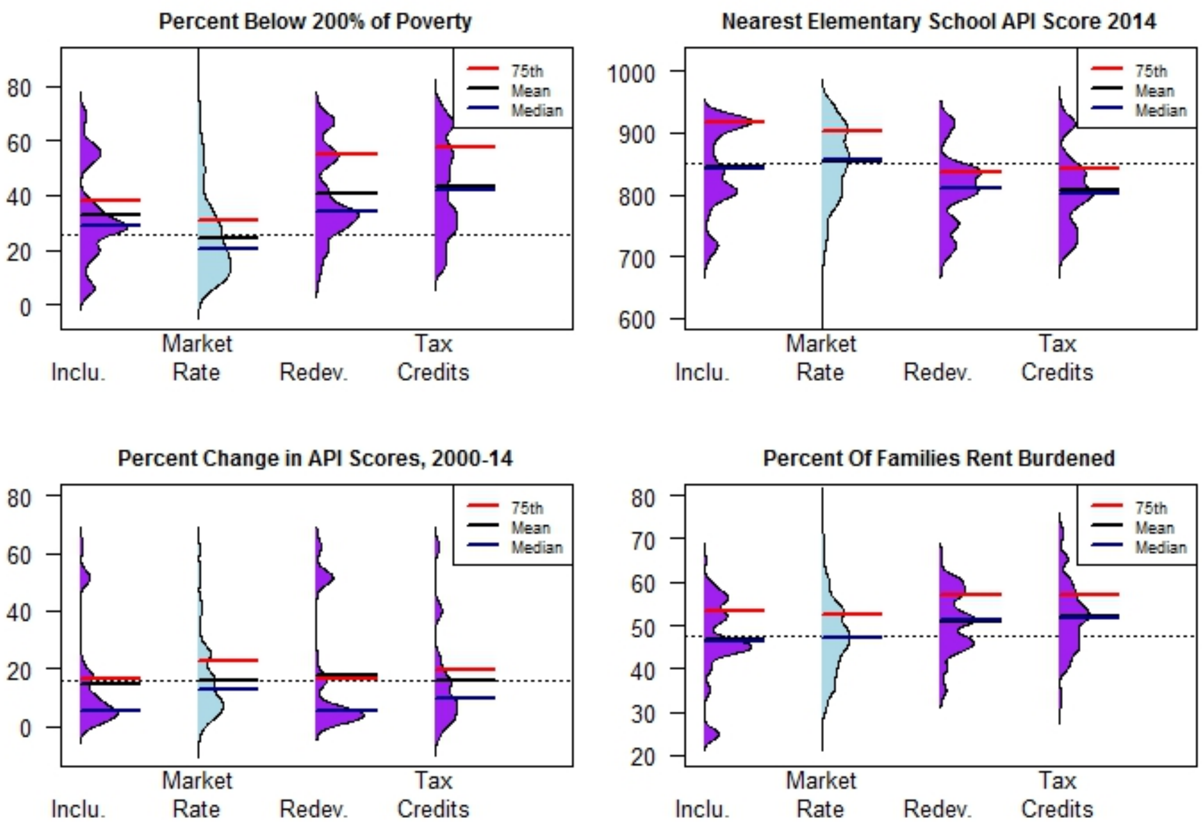

Figure 14: Differences in Education, Rent and Poverty Outcomes By Funding Source, Sacramento

As with prior regions, Market Rate units perform better with respect to poverty rates and elementary school API scores versus affordable production. There is one exception: inclusionary units in the Sacramento area outperform market rate and other affordable units with respect to elementary school API scores. Unlike with the previous regions, however, market rate units also outperform affordable units with respect to being located near schools which have been improving over the last decade. Lastly, only redevelopment and tax credit supported units ended up in areas with higher rent burdens relative to market rate production.

Conclusions

The efforts of California's Tax Credit Allocation Committee (TCAC) to improve transit access and grocery access for tax credit funded sites are working. Among senior projects in particular these results are the most pronounced. However, these results appear to come at the cost of these projects locating in areas with higher poverty rates (relative to market rate production).

That said, we find that based on McClure's approach to defining need as neighborhood rent burdens (35), all three types of programs are placing units in tracts with greater need compared to market rate units. This begs the question: if the greatest need is in high opportunity areas, should we be focusing our efforts on building housing elsewhere? The systematic concentration of affordable units in tracts with higher PM 2.5 concentration relative to new market rate production, however, is another concern born out of these findings.

Lastly, inclusionary units do not appear to mimic the spatial distribution of market rate production. This may be due to the 'in-lieu fee' option of many inclusionary programs that enable developers to pay fees in-lieu of developing housing on site. Future research should dissect if in-lieu fee supported units are in systematically better or worse locations, as measured by these and other metrics, compared to on-site inclusionary. The results could hold serious implications for how cities should structure the trade-off they present developers when allowing an in-lieu fee alternative.

TCAC might consider exploring alternative approaches to concentrating development near opportunity, like Illinois' approach of blending all the metrics into a general index of "high opportunity" and "low opportunity" areas instead of offering separate sets of points for specific amenities. How these different approaches impact locational outcomes and associated costs should be explored further in the literature.

Chapter 3: The Impact of Scale Changes of Fair Market Rents on Transit and Jobs Access of Section 8 Eligible Units in Three of California's Largest MPOs

The Department of Housing and Urban Development (HUD) is currently experimenting with new ways of defining subsidy caps for Section 8 housing vouchers. This change, called the "Small Area Fair Market Rent" (SAFMR), shrinks the geographic scale at which voucher maximums are calculated from the region level, known as the HUD Market Area, to the ZIP code level; this change has major implications for the spatial dispersion of voucher holders in cities. The results of a pilot program in Texas suggests that this policy scale change is exhibiting significant impact on voucher holders' residential location decisions (47). The potential for the policy change to impact voucher holder access into California's transit and jobs rich neighborhoods could also be significant but has not been studied. In this study, we model how rescaling voucher maximums from the regional level to the ZIP code level alters the voucher accessibility of affordable rental units. We model this change using a database of for-rent listings spanning three of California's metropolitan planning organizations (MPOs): the San Francisco Bay Area (MTC-ABAG), Sacramento (SACOG) and San Diego (SANDAG). We spatially contrast our rental listings with data on neighborhood transit richness and jobs access in order to examine how the FMR policy shift may compliment or complicate regional efforts to increase housing affordability in these "low VMT" communities. We calculate voucher maximums at three alternative scales, the county, the public use micro sample area (PUMA) and the ZIP code. We contrast how these smaller-scaled FMRs alter voucher holders' access to neighborhoods compared to the current FMRs scaled over multi-county "Market Areas" that generally encompass large numbers (e.g., millions in some locations) of residents.

Our results show that under existing HUD (FMR) policy, voucher recipients are systematically priced out of rental listings in jobs and transit rich communities and moreover, that voucher accessible units are concentrated in high poverty neighborhoods. We find that shrinking the geographic scale at which voucher maximums are calculated significantly improves the voucher accessibility of rental units in jobs rich communities, but any improvements in voucher access to transit rich rental units is limited to the City of San Francisco. We find that this increased access also brings with it the added benefit of significantly increasing voucher access to rental units in low poverty neighborhoods, a critical HUD metric. Within the scholarly literature, our approach is unique in that we are modeling, by neighborhood, the percentage of actual rental listings that voucher holders could consider given HUD voucher maximums (the FMRs).

The next section provides background on housing voucher programs and the demand for affordability in California. We provide a review of relevant literature as well. We then describe our dataset and our approach to modeling alternative FMRs, with a presentation of our results following. Since the distribution of actual voucher accessible market rental listings under existing policies has never been explored, we begin our discussion of the results by examining voucher access to jobs rich, transit rich and low poverty communities under existing policies. We then show how re-scaling FMRs alters this landscape. The large body of results are summarized in the conclusion section with recommendations for housing policy makers federally, statewide across these three specific MPOs.

Housing Vouchers In the California Context

Section 8 vouchers are a federal, demand-side rental subsidy program introduced in the 1970s as part of a shift in federal housing policy away from substandard housing clearance and towards the goal of reducing household rent burdens (*114*). Housing vouchers enable residents to move to any unit on the market with rents below the HUD determined Fair Market Rent (FMR) maximum. These FMRs are based on the 40th percentile rent for a two bedroom unit in the voucher recipients' HUD Market Areas.[1] Tenants pay one-third of their income towards rent, with the rest paid directly to the landlord by the voucher administering agency. Local Public Housing Authorities (PHAs) serve as administering agencies for vouchers across California and the United States. Landlords agreeing to accept vouchers are required to meet a number of obligations, including regular inspections of units, which frequently deter landlords from accepting voucher holders (*115*).

With the demolition of public housing, HUD expanded voucher use to provide displaced residents with "Housing Choice Vouchers." Scholars argued that providing residents the opportunity to move out of high poverty neighborhoods could break a cycle of poverty re-enforced by the spatial mismatch between the location of low income households and the availability of low wage employment within urban areas (29). HUD enabled researchers to explicitly test this hypothesis by designing a policy experiment in which some residents of dilapidated public housing projects received housing vouchers they could only spend in low-poverty neighborhoods: the Moving to Opportunity (MTO) program, the results of which are discussed in the next section.

Together, the nation's housing voucher programs currently serve over five million people in two million households (*116*). Within California, the program faces major demand pressure, with waitlists for vouchers in the San Francisco Bay Area exceeding capacity by tens of thousands and requiring local administering agencies to close waitlists (*117*). Even in areas of the state considered more affordable, e.g., Fresno, waitlists are three to four times greater than the program's capacity (*118*). The effect of a policy shift like the re-scaling of voucher maximum payouts could significantly impact the ability of this program to meet these demand pressures by altering the cost of vouchers. This study represents the first to explore how altering the policy structure of the voucher program could affect voucher holders access to low-VMT neighborhoods.

Section 8 and Low VMT Neighborhoods

Most of the voucher literature centers on the results of the MTO experiment regarding participants' health and employment outcomes, the latter of which should theoretically correlate with job access. Recipients of the MTO experimental vouchers initially received only minor benefits from participation (*119–121*). However, follow up studies of participants 10 to 15 years after treatment found significant improvements in subjects' physical and mental health (*119*). Children whose families took vouchers into lower-poverty neighborhoods

[1] HUD Market Areas do not always overlap with other regional delineations. For example, the San Francisco Metropolitan Statistical Area is split into two HUD Market Areas: one which includes San Francisco, Marin and San Mateo counties versus another which includes Alameda and Contra Costa counties.

experienced higher college attendance rates, higher earnings, and were less likely to end up as single parents (*122*). Overall, however, the literature suggests the benefits of MTO were much weaker than the 'neighborhood effects' hypothesis may suggest (*123*). But if we look at the Gautreaux program, a court ordered initiative which provided vouchers to former public housing residents relocated into Chicago's high opportunity suburbs, dramatic, rather than marginally, improved outcomes for recipients were observed (*124*, *125*). How do we reconcile the striking differences between the Gautreaux and MTO outcomes? Some have argued the real failure of MTO may be that it failed failed to enable beneficiaries to break out of the spatial structure of segregated cities (*126*). This evaluation might imply the treatment was simply too weak or failed to tackle a major component of the problem, racial segregation and discrimination.

Because improving accessibility and mobility were not the primary motivators for the MTO experiment, the major MTO studies generally operationalize job accessibility as simply tract level unemployment rates, i.e., without consideration of geographical proximity to employment centers. The role of transportation options is usually mentioned only in passing (*121*). In fact, many studies looking at the effects of changes in employment outcomes do not measure job accessibility of recipients' new neighborhoods at all, focusing only on tract level poverty rates (e.g. Kling, Liebman, & Katz, 2007; Ludwig, Duncan, & Pinkston, 2005) or more simplistically: walking distance to some form of public transit (e.g. Sanbonmatsu et al., 2003).

There have been a few studies of the residential relocation choices of voucher recipients with respect to transit and job accessibility, with both measures more rigorously defined as in the transportation and planning literatures. There is moderately strong evidence that having an automobile improves employment outcomes (Bania, Coulton, & Leete, 2003; Blumenberg & Pierce, 2014), and that increased transit accessibility does not seem to alter pre/post move employment status (*129*). That is, improvements in transit service did not help previously unemployed residents find employment. While these results are striking, the Blumenberg, Pierce analysis did not contextualize their results within Sampson's (2008) critique of the treatment itself: how significant were the improvements in job and transit accessibility experienced by program participants whose neighborhood relocation outcomes were upwardly mobile? Could voucher holders even afford to access neighborhoods with significantly richer transit connectivity and job access?

In contrast to previous studies, our work fills an important research gap by examining the extent to which voucher recipients can afford to live in transit and jobs rich neighborhoods given FMR constraints. Specifically, we explore how access to housing in higher neighborhoods changes under various FMR spatial contexts using actual rental market data in three of the nation's most expensive rental markets: MTC, SACOG, and SANDAG. There are five HUD Market Areas within these three MPOs: San Jose (Santa Clara County), the East Bay (Alameda and Contra Costa counties), San Francisco (San Francisco, Marin and San Mateo counties), Sacramento (Sacramento, Placer and El Dorado counties) and San Diego (San Diego County). Our data also allows us to model how proposed changes to voucher rent thresholds may affect the ability of voucher recipients to access low-VMT communities.

Scale and the FMR

Since HUDs FMRs are calculated with metropolitan statistical area medians and percentiles, they are insensitive to the much finer scale at which our urban areas are segregated along lines of income and race (*130*). New policy innovations by HUD, like the Small Area Fair Market Rents (SAFMRs), might help convert Section 8 vouchers into the kind of high opportunity neighborhood mobility treatment that policy makers intended for MTO vouchers. The first SAFMR program was implemented in Dallas, Texas in 2012, and was in response to a court order declaring the existing FMR formulas reinforced residential segregation and thus were illegal under federal civil rights laws (*131*). Under the SAFMR policy, voucher maximums are calculated at the ZIP code scale in lieu of established regionally based formulas. Within three years of implementation, Dallas participants had moved into neighborhoods with significantly lower poverty and crime rates (47), while at the same time, the cost of financing the vouchers actually declined (*132*). The Dallas study, while intriguing, is constrained in its generalizability by two issues. First, the study results were achieved in one of the nation's most affordable rental markets: Dallas (*133*). And second, consistent with the previous literature on vouchers, the Dallas studies, to date, have not examined voucher recipients' neighborhood outcomes with respect to job access and transportation.

Methods and Data

We offer two major advances to the literature on vouchers: first, we examine the capability of voucher holders to access job accessible and "low VMT" communities. Second, we explore how changing the FMR subsidy boundaries affects the ability of voucher holders to access for-rent listings in lower poverty neighborhoods. To accomplish these two objectives, we take advantage of advanced data acquisition tools now available and utilize a dataset of for-rent unit listings in our three study areas. This unique database allows us to determine the extent to which voucher maximums themselves, as opposed to, for example, landlord discrimination against voucher holders, prevent voucher recipients from accessing jobs-rich communities.

Defining Low VMT Neighborhoods

The transportation and planning literatures has explored a wide array of outcome measures with respect to job accessibility and transit accessibility. We have taken from this literature and prioritized outcome measures that could be gathered consistently across all three MPOs (Table 1). We adopted a transit accessibility measure from the Environmental Protection Agency's Smart Location Database. Transit accessibility is correlated with voucher holders' ability to maintain employment after moving (*129*) as well as correlated with reduced VMT (*4*, *80*, *134*). We selected two measures for jobs accessibility: jobs-housing balance and jobs-housing fit, or the ratio between low wage jobs and housing units affordable to low wage workers. Jobs-housing imbalances across regions are associated with higher VMT and excess commuting (3, 16, 26). Spatial disparities in jobs-housing fit is associated with commute distances among low income workers, and has been shown to be a helpful measure of the job accessibility of low income households (*1*, *17*, *135*). However, as we are interested in seeing this policy enable voucher holders to live in those jobs-rich areas, we must counter-intuitively define "low VMT" communities as those with high jobs-housing fit, high jobs-housing balance, and a high number of jobs accessible by transit within a 45 minute commute. A household added to a community a high imbalance (more jobs than housing) is contributing to correcting the imbalance.

Table 2: Measures of Neighborhood VMT Potential

Variable	Description	Source
Transit Access to Employment	Number of jobs a resident can reach within 45 minutes by transit, time-decay weighted	Environmental Protection Agency's Smart Location Database (SLD)
Jobs-Housing Balance	The ratio of jobs to households within a distance of a tract or block, usually 2.5 or 5 miles	Census Longitudinal Employer-Household Dynamics (LEHD)
Jobs-Housing Fit	The ratio of low wage jobs to housing units affordable to low wage households	UC Davis Center for Regional Change Regional Opportunity Index (ROI)

As HUD's long-standing concern in voucher policy has been to increase recipients' access to low poverty neighborhoods (*119*), we also examine changes in the poverty rate. As the official poverty rate has come under criticism for not factoring in regional cost of living in expensive states like California (*136*), we opt to use a similar but more encompassing variable: the percent of residents in a tract living at or below 200% of the poverty level.

Rental Listings Data

We use a rental database prepared by Rent Jungle, which gathers for-rent listings from internet sources such as Craigslist, as well as the web-listings provided by newspapers and community web pages on a weekly basis. The data scan is completed each week using a uniform collection of listings cross-referenced over hundreds of sources in each metropolitan area. In total, our for-rent database has over 150,000 listings across the five HUD Market Areas for 2012 and 2013.

The data contain multiple listings when units have been advertised as available over multiple weeks or in some cases, when there are multiple units available at a single site. Our interest in the rental market is relatively straightforward: we want the inventory of available rentals in any given year. To create the inventory, we assigned a unique observation id for every unit with a unique combination of the following: an address, number of bedrooms and year of listing (2012 versus 2013). If the same unit was listed twice in the database with a minimum six month span in between, it was noted as being available twice during that year. In those cases where a unit was listed in both 2012 and 2013 with its availability remaining and moving from 2012 into 2013, it was allowed to count in both years if the total span of its availability was greater than six months (e.g. if it was available from September 2012 through April 2013. These heuristics reduced the total sample from 150,000 to 95,868 units. With 400 ZIP codes in our five market areas, this provides us with an average of 240 observations per ZIP code, far higher than the number of new renters that provided by the American Community Survey[2], and an average of 44 observations per census tract. The only limitation of this approach is that we cannot gauge the vacancy rates for listings on large multifamily sites, and future research should examine how to incorporate vacancy rates into use of this kind of highly detailed, disaggregate data.

Producing Alternative FMRs

We recalculate fair market rents at scales smaller or equal to the HUD Market Area: the county, the Public Use Micro Sample Area (PUMA) level and the Zip Code Tabulation Area (henceforth referred to as ZIP code). We included the PUMA scale because it is the smallest geography at which Census micro data is available for producing hypothetical alternative FMRs.

When calculating alternative or hypothetical FMRs, we attempted to align the process at each scale with the process constraints HUD faces when defining FMRs at the Market Area scale. This ensures that when we compare how differently scaled FMRs alter voucher access to our rental listings dataset, we are measuring the role of scale in pre-determining voucher access and not some other aspect of the FMR formula process. For example, HUD must work with ACS data produced on a time lag—the 2012 FMRs were estimated using the 2005-2009 ACS, and the 2013 FMRs were estimated using the 2006-2010 ACS. HUD offers insight on the Small Area FMR Demonstration Documentation webpage for how sub-FMR thresholds might be determined using calculations for hypothetical ZIP code FMRs (*137*). First, HUD calculates Market Area FMRs under established formulas. Then, HUD produces a rental ratio or 'weight' for each ZIP code which is multiplied by the Market Area FMR to get each ZIP code's FMR. The ratio is derived by dividing ZIP code median rents from the ACS over Core-Based Statistical Area median rents, as illustrated below:

$$\frac{\text{ZIP2} - \text{Bedroom Median Rent}}{\text{CBSA 2} - \text{Bedroom Median Rent}} * \text{HUD Market Area FMRs} = \text{ZIP FMRs}$$

ZIP codes with median rents higher than their CBSA thus have FMRs adjusted proportionally upwards. HUD caps these adjustment factors at 1.5, so that a ZIP code's FMRs are never more than 150% of the established Market Area FMRs. HUD does not, however, set a threshold for zip codes below the median. This approach side-steps the problem that at very fine geographic scales, the number of "recent movers" in the ACS may be too small to provide a reliable estimate of new rents, as the median rent statistic draws on the entire sample of renters. The CBSAs are not necessarily the same as the HUD Market Areas. For example, The San Jose, San Francisco and East Bay HUD Market Areas are all part of one CBSA. It is worth noting that HUD staff believe that ZIP code estimates would better represent small-scale differences if they were normalized over the broadest possible area, in this case, the CBSA (Correspondence with HUD Staff Dec. 3 2015).

[2] While the ACS does not publish sample sizes for small scales, using state-level sample sizes (*154*) we can deduce that the 2014-2010 ACS contains roughly 390 responses per ZIP code in California to represent the total housing stock. As roughly half of Californian households rent, the ACS thus probably averages 195 rental units surveyed per ZIP Code. As roughly 12% of renters' move annually (*155*), then we can estimate the ACS contains around 24 new-movers per ZIP code in California, compared to our sample of nearly 240 listings per ZIP code.

In line with HUD's proposed SAFMRs, we capped the ratios used to generate alternate FMRs so that they could be no higher than 1.5 times the Market Area FMR. In the case of the PUMA FMRs, we limited the microdata sample used to produce the median rent statistic to reflect the types of households HUD includes in Market Area FMR calculation: renter-occupied, non-institutional quarters with a kitchen and full plumbing.

Results

San Francisco and Oakland HUD Market Areas

As mapped in Figure 15 below, shifting to ZIP code FMRs dramatically reduces voucher access in pockets of formerly high voucher-access, but increases voucher access less dramatically across larger geographic spans. This amounts to a 'leveling out' of voucher accessibility across space. In the San Francisco HUD Market Area, this means voucher accessibility declines in previously high voucher access areas like the south eastern quadrant of San Francisco and the North Bay suburb of San Rafael. Previously voucher-inaccessible peninsula suburbs like San Mateo, Redwood City and Pacifica become more voucher accessible, as does most of San Francisco proper. This 'leveling out' pattern is also visible in suburbs with access to the Bay Area Rapid Transit (BART), including Millbrae and San Bruno. The western half of San Francisco proper also sees gains in voucher accessibility of between 3% and 50% of all rental units depending on the neighborhood.

In the Oakland HUD Market Area voucher accessibility is redistributed more dramatically as a result of an FMR shift. Areas which previously held high concentrations voucher eligible units in Richmond, West Oakland and central Oakland see precipitous drops in voucher accessibility. Meanwhile, voucher accessibility increases among rental units in the southern suburbs of Union City and Fremont as well as the eastern suburbs of Dublin, Pleasanton, Brentwood and Livermore.

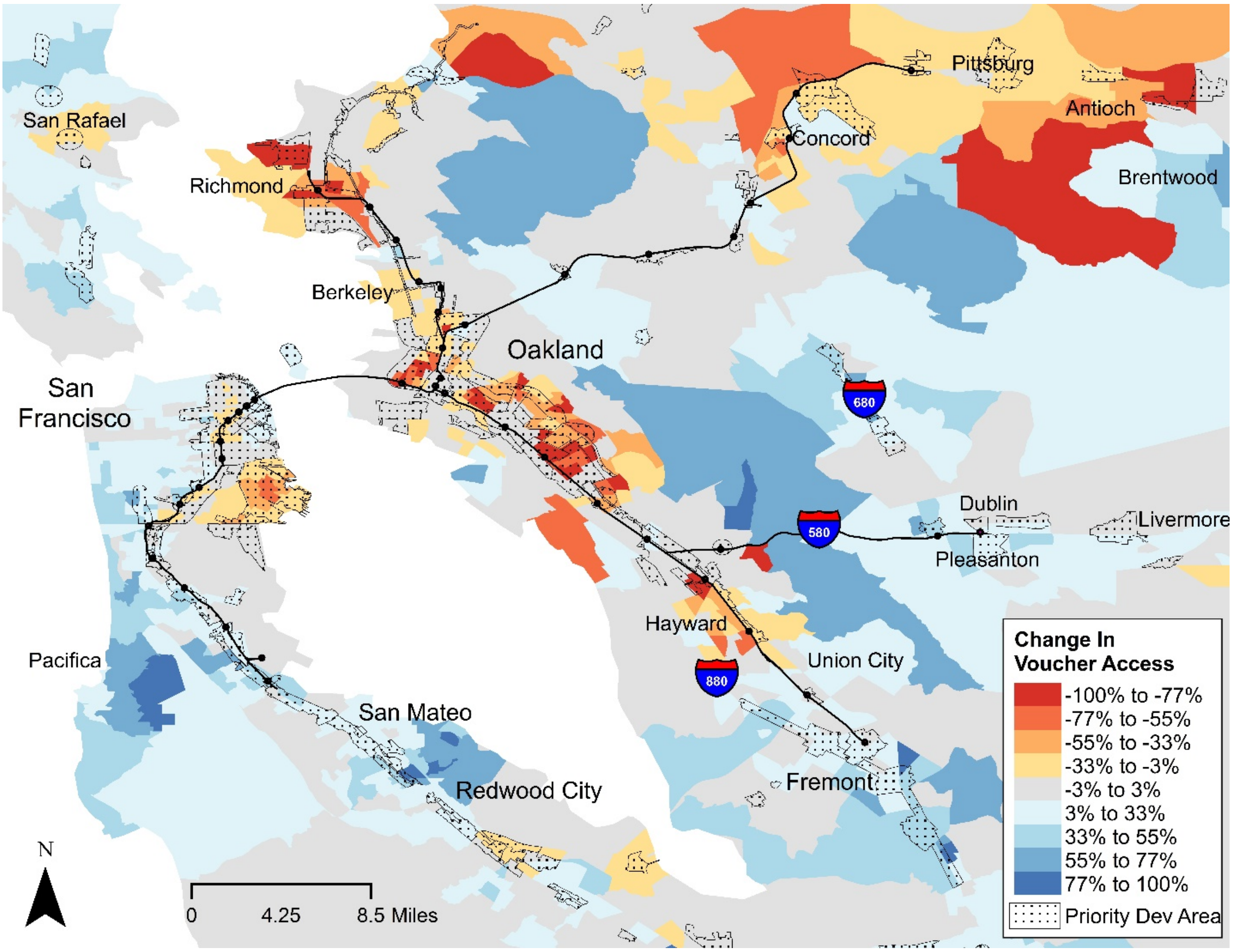

Figure 15 Percentage Point Changes in Voucher Accessibility When Shifting from a Market Area FMR to a ZIP Code FMR in San Francisco and the East Bay

In the San Francisco HUD Market Area, the overall percentage of rental listings in the rental database that voucher holders would be able to access rises from 15.7% to 28.2% when shifting from a ZIP code FMR. In the East Bay, the total percentage of rental listings accessible to voucher holders actually declines in a shift to ZIP code FMRs, from 34% accessible to 32.9%. This small loss appears to come with the benefit of increasing voucher accessibility in the Market Area's suburbs. However, the shift triggers a dramatic loss in voucher access in Oakland proper, with the percent of rental listings within city limits accessible to voucher holders declining from 38.6% to 24.7%, a loss of nearly 50%.

The significant increase in voucher accessible units in the San Francisco HUD Market Area does not significantly increase the job accessibility of the voucher-accessible stock relative to the voucher inaccessible rental listings, as illustrated in Figure 16. The violin plots in Figure 16 show the distributions of the voucher accessible listings and voucher inaccessible housing listings and how those distributions change as the FMRs are defined at different scales. The black bars represent the averages for the respective distributions. As the scale at which FMRs are defined declines, the voucher accessible stock shifts slightly towards neighborhoods with greater jobs-housing fit, as seen in the top left chart of Figure 16. This means voucher accessibility shifts towards neighborhoods where there are many more low wage jobs than there is housing affordable to low wage workers.

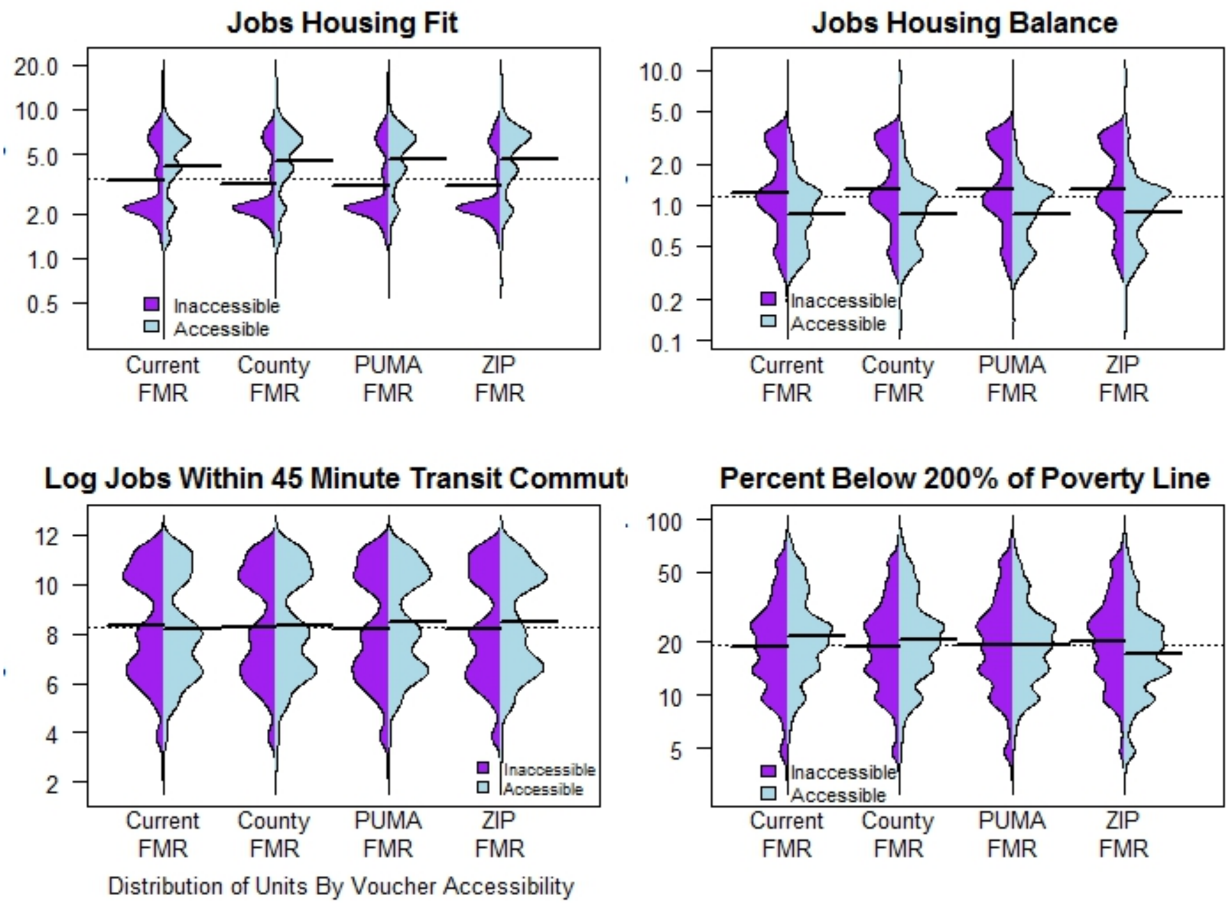

Figure 16 Shifts In Distribution of Outcome Variables By Voucher Accessibility and FMR Scale in the San Francisco HUD Market Area

With respect to overall jobs housing balance within 2.5 miles of a neighborhood, and the number of jobs within a 45 minute transit commute, the shift to smaller FMRs does not significantly improve outcomes with respect to voucher accessible units. Lastly, shrinking the scale at which FMRs are defined shifts the voucher-accessible pool of units to lower poverty communities as evidenced in the bottom right chart of Figure 16.

The Oakland HUD Market Area also shows similar patterns with no movement in the average jobs-housing balance of rental listings accessible to voucher holders. However, as the scale at which FMRs are defined shrinks, the disparity in jobs-housing fit between voucher accessible and inaccessible units nearly vanishes.

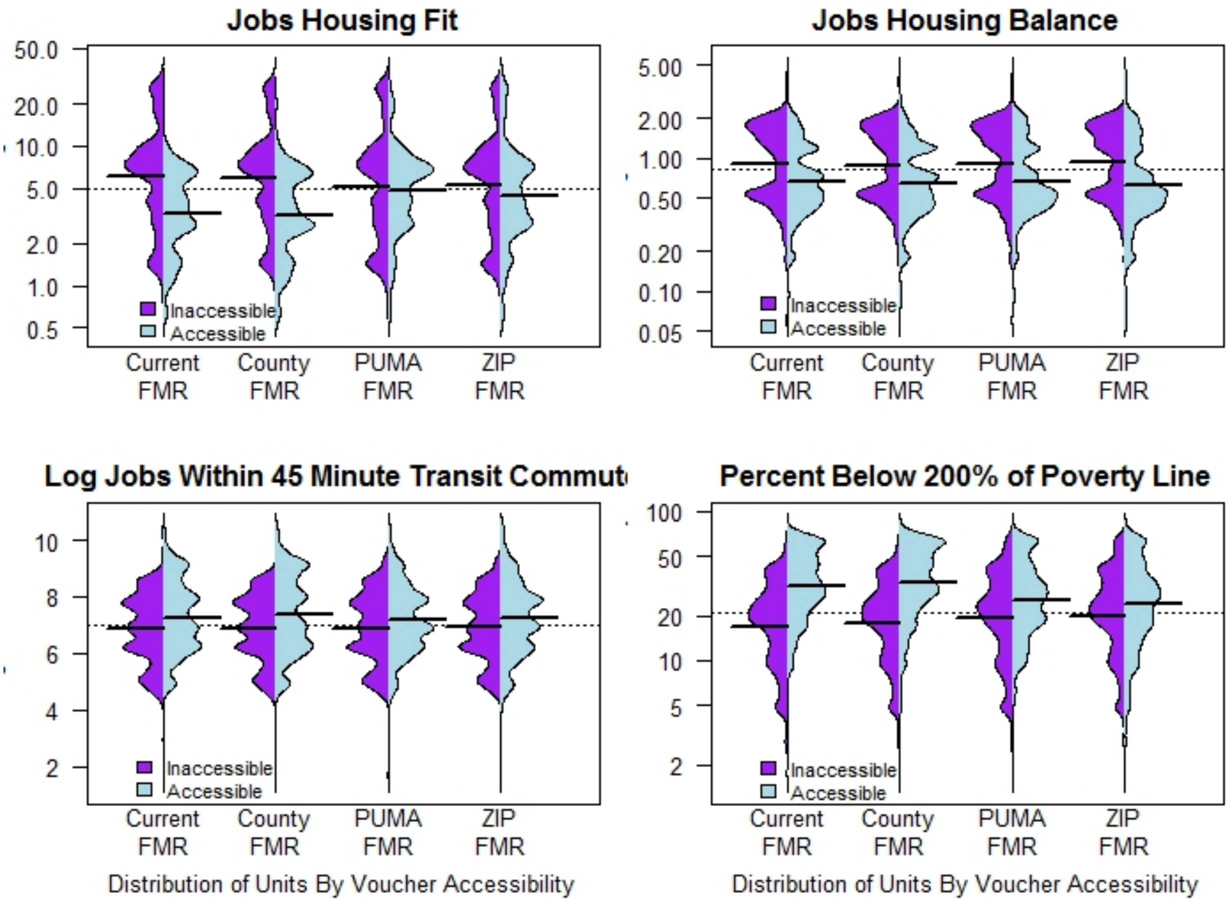

Figure 17 Shifts In Distribution of Outcome Variables By Voucher Accessibility and FMR Scale in the Oakland HUD Market Area

Under the current FMRs, voucher accessible units in the Oakland HUD Market Area are concentrated in areas with significantly higher poverty rates as illustrated in the bottom right chart of Figure 17. This disparity declines significantly when FMRs are defined at the ZIP code scale.

Santa Clara-San Jose HUD Market Area

In The Santa Clara-San Jose HUD Market Area, the shift to ZIP code FMRs reduces voucher access in the eastern neighborhoods of the City of San Jose, but modestly increases voucher access in the suburbs of Saratoga, Los Gatos, Cupertino and Milpitas. This change is mapped in Figure 18 below. Losses in voucher eligibility are dramatic in eastern San Jose, as well as the southern suburb of Gilroy (see inset).

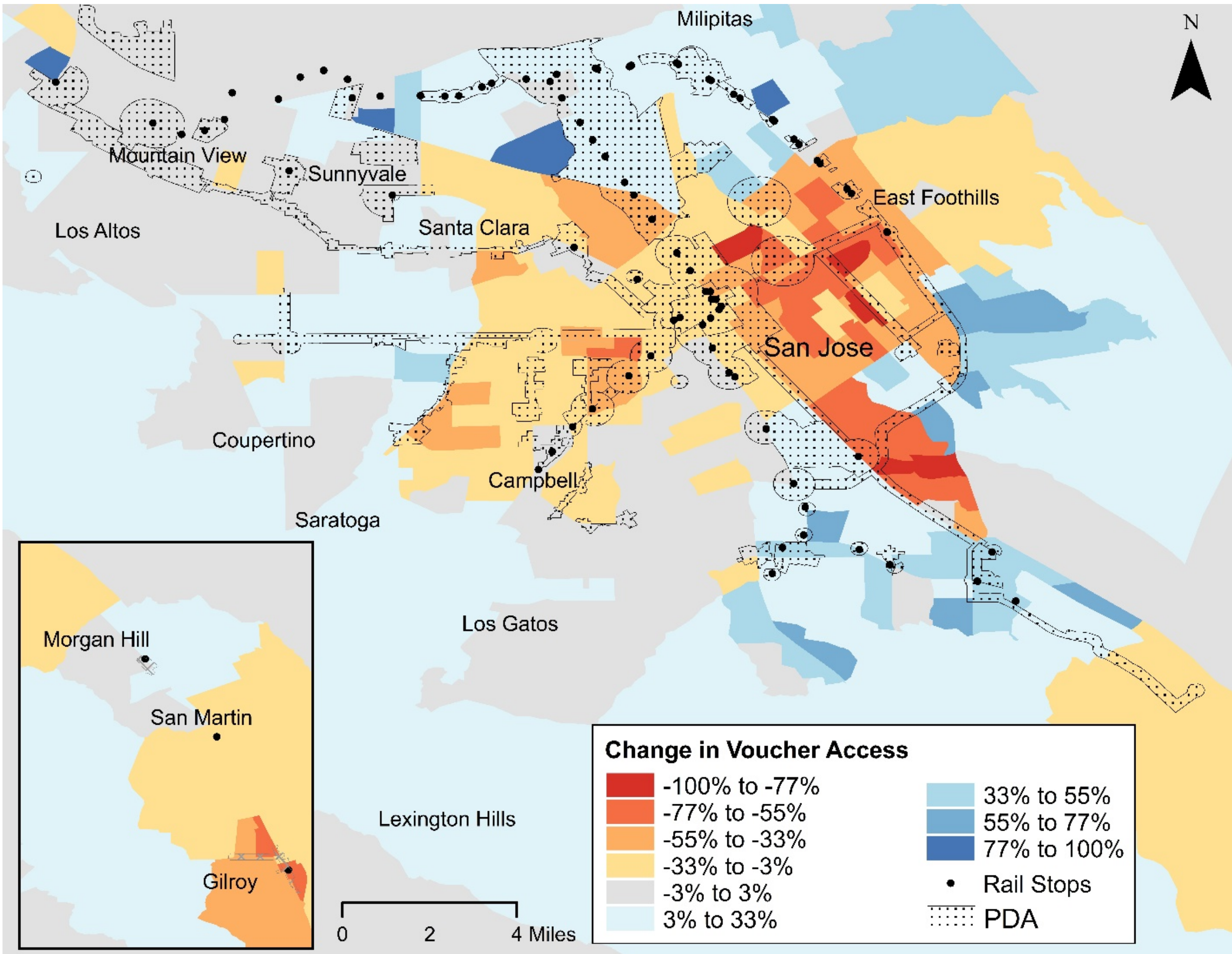

Figure 18 Percentage Point Changes in Voucher Accessibility When Shifting from a Market Area FMR to a ZIP Code FMR in the Santa Clara-San Jose HUD Market Area

Despite the large loss of voucher accessibility in east San Jose and the more modest voucher access gains in the suburbs, the overall share of rental listings in this market accessible to voucher holders declines by two percentage points, from 27.7% to 25.7%.

This slight loss in overall voucher accessibility comes with two major benefits illustrated in Figure 19. First, the disparity in jobs-housing fit between voucher accessible and inaccessible stock virtually vanishes as FMR scale declines (top left chart). Second, the over-representation of voucher accessible units in high poverty communities also nearly vanishes (bottom left chart).

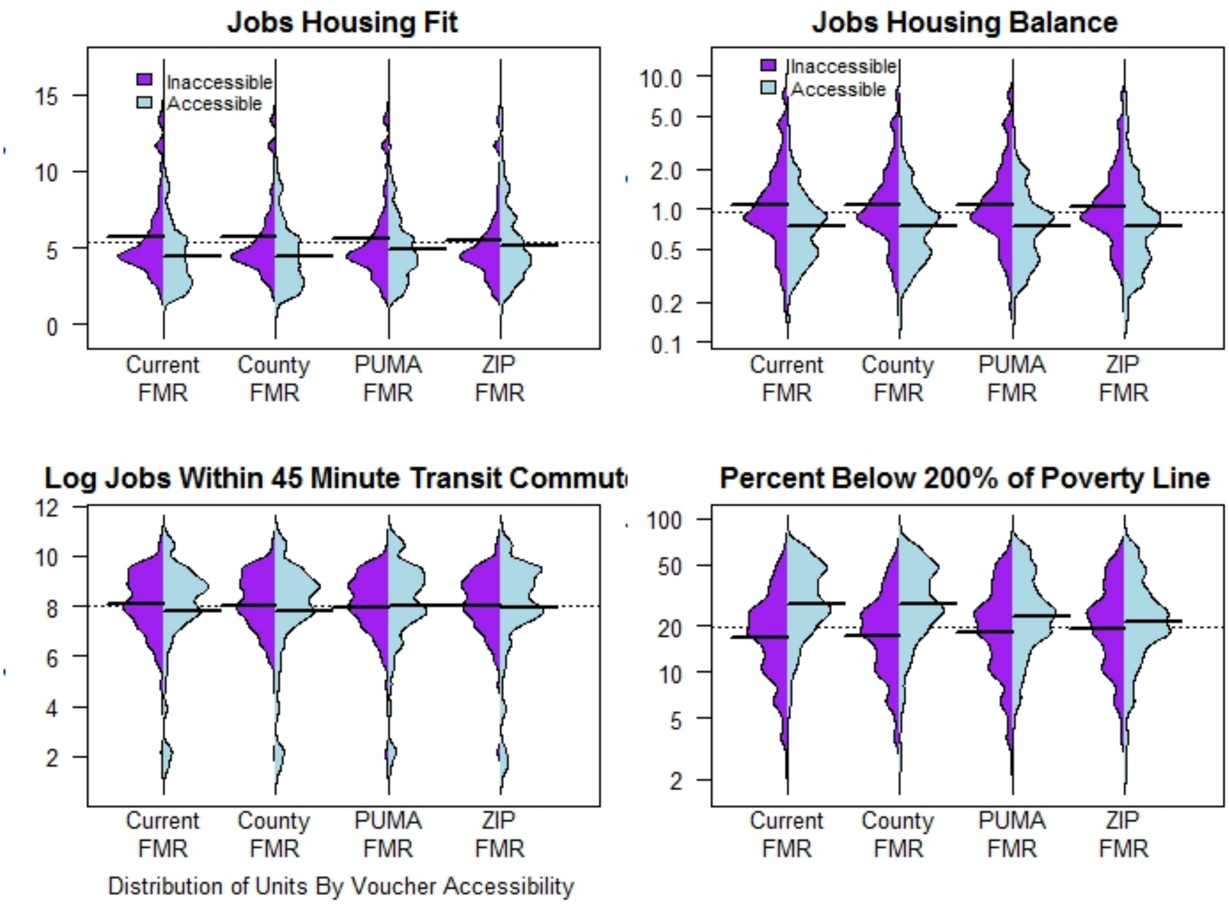

Figure 19 Shifts In Distribution of Outcome Variables By Voucher Accessibility and FMR Scale in the Santa Clara-San Jose HUD Market Area

As with the San Francisco and Oakland HUD Market Areas, however, this region's voucher accessible stock does not significantly shift into transit rich and high jobs-housing balance neighborhoods as FMR scale declines.

San Diego HUD Market Area

The San Diego HUD Market Area provides the most compelling evidence of the benefits of shifting to a ZIP code FMR, as mapped in Figure 20. Voucher accessibility declines dramatically in high poverty neighborhoods south of Interstate 8 and east of the San Diego Bay. The loss is matched by equally dramatic increases in voucher accessibility in San Diego neighborhoods north of Interstate 8. In the northern suburbs, voucher accessibility shifts towards the coast: declining in the inland suburbs of Vista and Escondido while increasing in the coastal suburbs of Oceanside, Encinitas and Carlsbad.

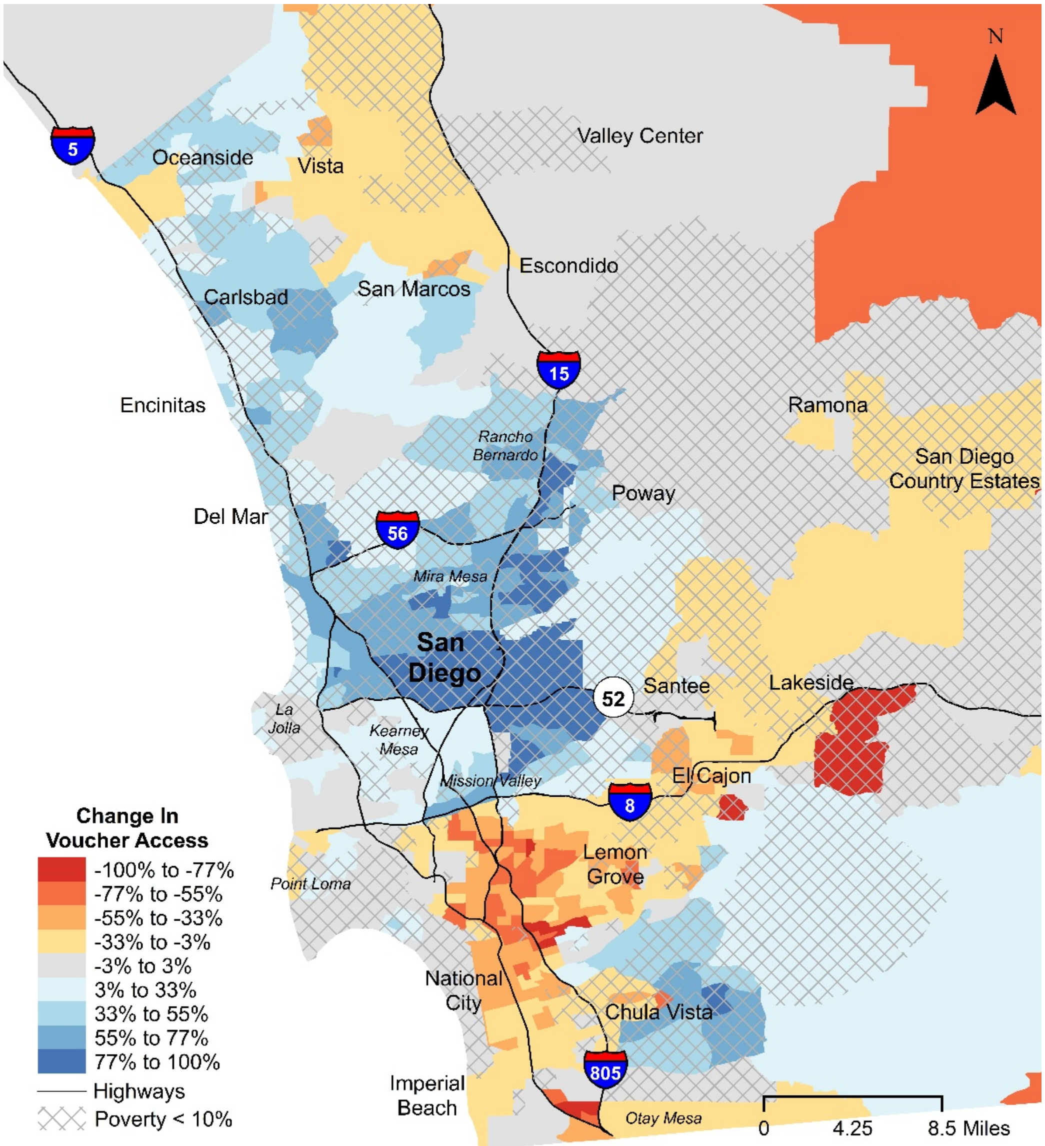

Figure 20 Percentage Point Changes in Voucher Accessibility When Shifting from a Market Area FMR to a ZIP Code FMR in San Diego

On the southern end of San Diego County, voucher access declines National City and San Diego neighborhood Otay Mesa but increases in equal measure in eastern half Chula Vista. Overall, 57.9% of rental listings in this Market Area are accessible to voucher holders under ZIP code FMRs, compared to just 49% under current FMRs—an 8.8 percentage point increase.
San Diego also sees the most dramatic improvements in our outcome measures for voucher accessible units, as illustrated in Figure 20.

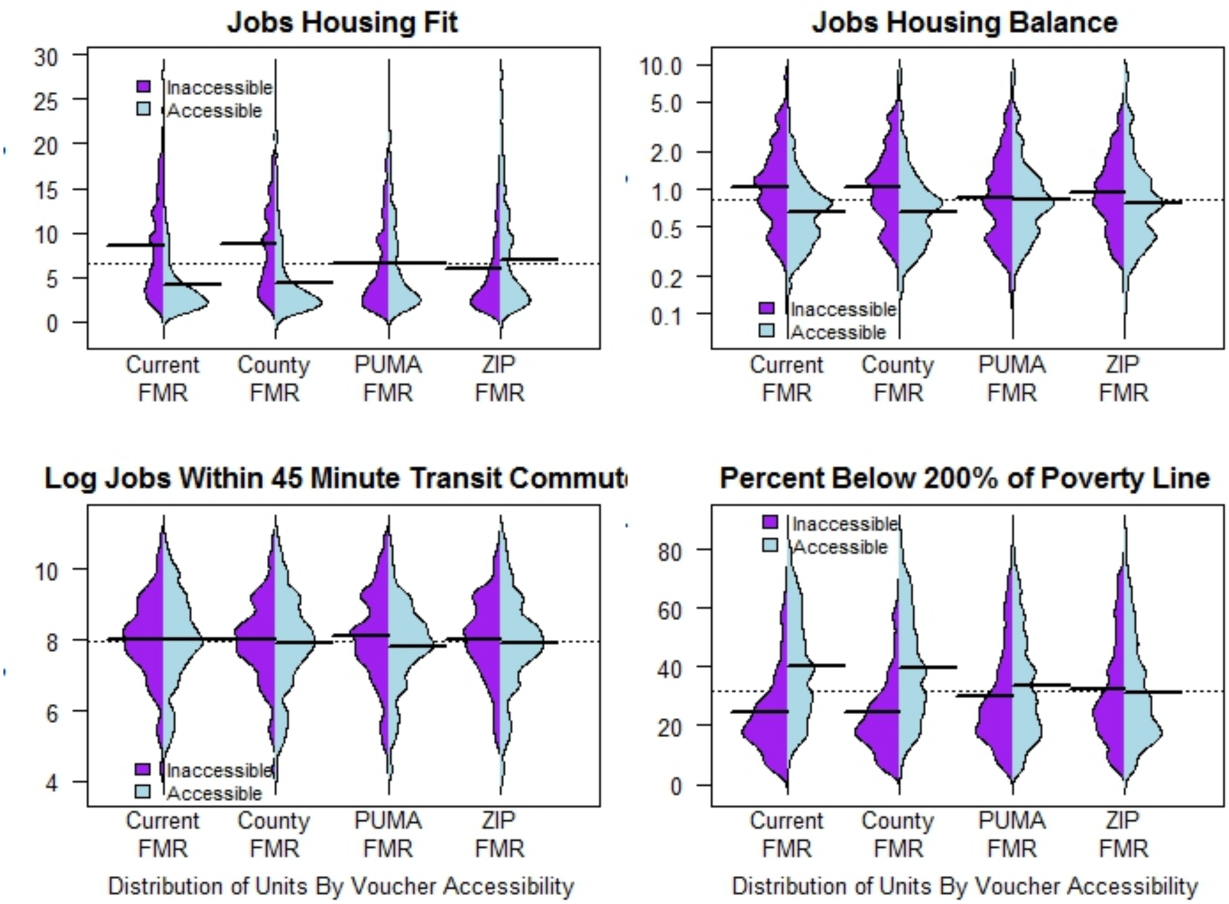

Figure 21 Shifts In Distribution of Outcome Variables By Voucher Accessibility and FMR Scale in the San Diego HUD Market Area

The disparity in jobs-housing fit between voucher accessible and inaccessible units reverses in San Diego under a shift to ZIP code FMRs, while the disparity in overall jobs-housing balance is nearly eliminated. The concentration of voucher accessible units in high poverty neighborhoods also vanishes as more rental listings in low-poverty neighborhoods become voucher accessible (bottom left right).

Sacramento HUD Market Area

In Sacramento, the shift to ZIP code FMRs decreases voucher access in the core of Sacramento proper while increasing voucher access in northern and eastern suburbs, as illustrated in Figure 22. The suburbs which see the largest increases in voucher accessibility are Granite Bay, Folsom, El Dorado Hills, Rocklin, Lincoln, Loomis and Roseville.

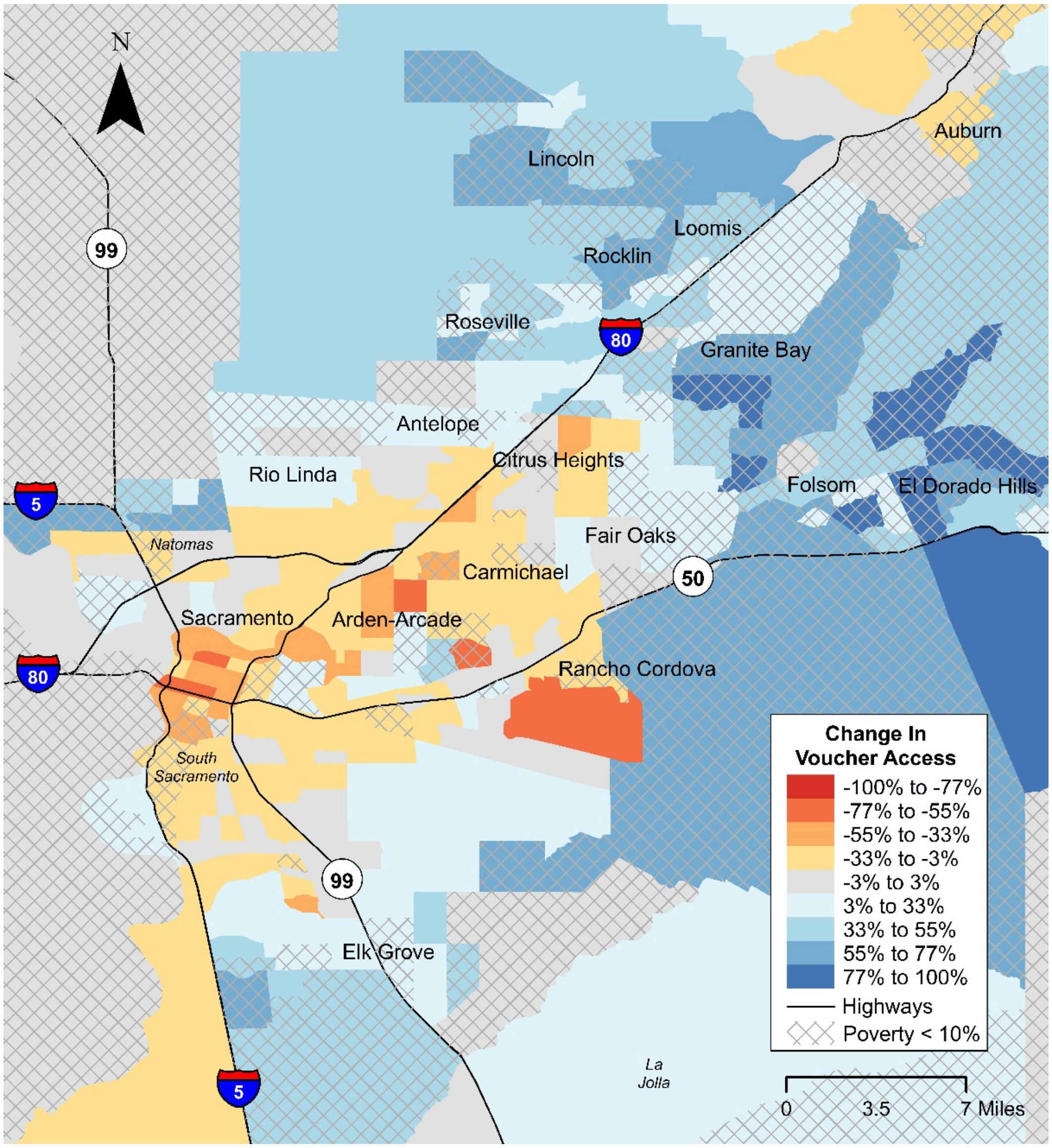

Figure 22 Percentage Point Changes in Voucher Accessibility When Shifting from a Market Area FMR to a ZIP Code FMR in Sacramento

Suburbs closers to the City of Sacramento, like Rio Linda and Antelope, see modest increases in voucher access, as does the southern suburb of Elk Grove. The overall voucher accessibility of rental listings in the Sacramento HUD Market Area rise from 66.5% to 72.9% as a direct result of the shift to ZIP code FMRs. Voucher eligibility is highest in Sacramento among our five case study HUD market areas because Sacramento's FMRs were calculated using census median rents, as opposed to 40th percentile rents, during the years covered by this analysis. HUD has since returned Sacramento to FMRs based on 40th percentile census rents.

Figure 23 presents changes in the distribution of our outcome variables for voucher accessible and inaccessible units under different FMR scales. Sacramento follows a similar pattern to Bay Area HUD Market Areas, with voucher accessible units shifting to lower poverty communities (bottom left chart) and communities with improved jobs-housing fit (top right chart). Unlike with previously reviewed regions, voucher accessible units actually shift to areas with lower jobs-housing balances as FMR scale declines (top right chart). This may be explained by the significant loss of voucher accessible units in and around downtown Sacramento—home of the state Capitol and large concentration of State government jobs. As with previous Market Areas, rescaling FMRs does not appear to 'move the needle' on jobs accessible by transit for voucher accessible units.

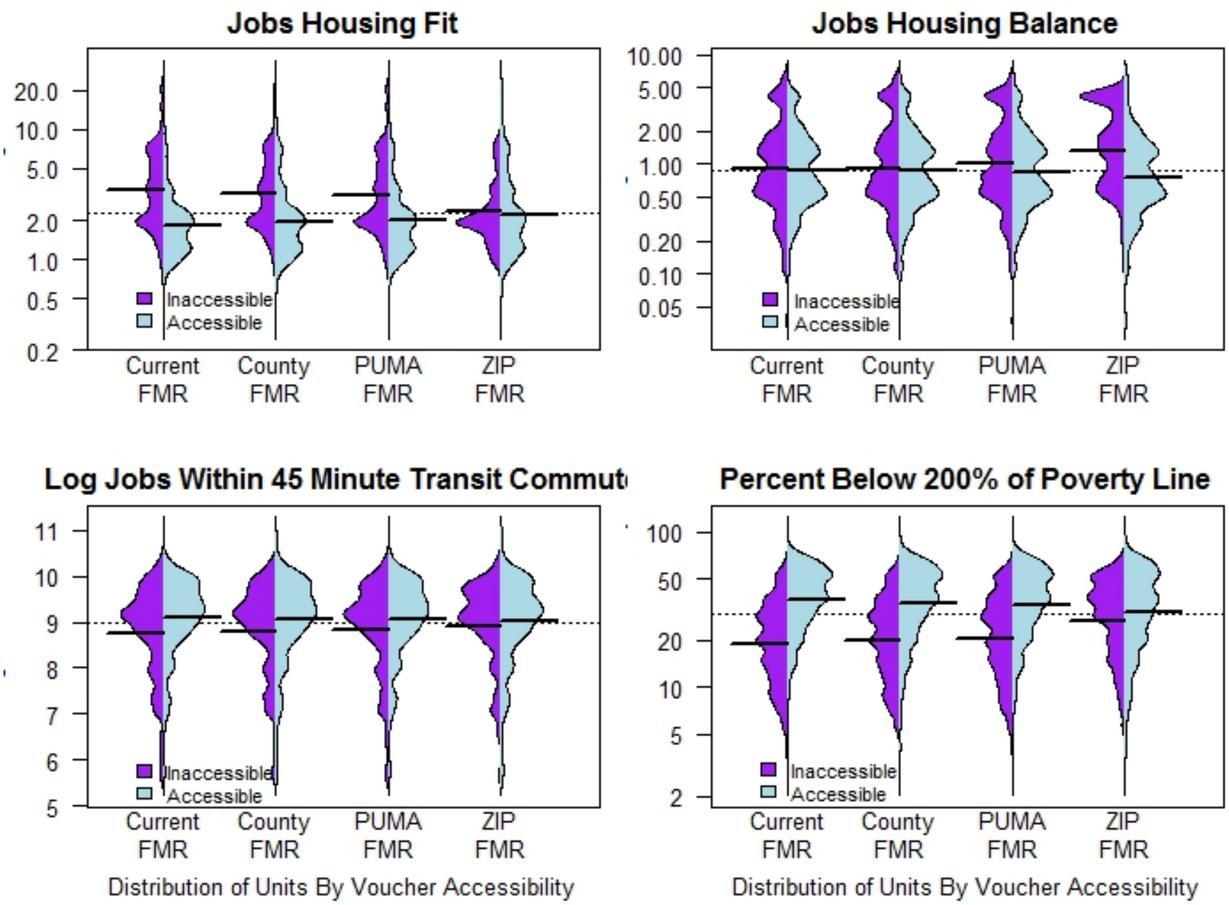

Figure 23 Shifts In Distribution of Outcome Variables By Voucher Accessibility and FMR Scale in the Sacramento HUD Market Area

Conclusions

Across all five case study "HUD Market Areas," shifting HUD FMR policy to finer geographic scales increases voucher holders' access to listed rental units in low poverty and jobs rich neighborhoods. Only in the San Francisco market area does this policy shift increase voucher holder access to units in transit-rich neighborhoods, and then only slightly. In the Sacramento, San Francisco and San Diego markets, FMR re-scaling de-concentrates or "levels out" rental unit availability for voucher holders more evenly across space. Local governments and public housing authorities in these regions should consider working with HUD to transition their voucher programs to Small Area Fair Market Rents.

In contrast, re-scaling FMRs appears to merely shift the un-even concentration of voucher accessible units in the East Bay away from Oakland and Richmond and towards suburbs further south and east, with voucher eligibility in Oakland proper declining by 50%. The particularly dramatic loss of voucher accessible units in rapidly gentrifying east Oakland under this policy framework in particular should be of concern. Further research should flesh out if the unreliability of rental estimates at smaller geographic scales explains why these rapidly gentrifying neighborhoods are so sensitive to policy scale shifts. Policy makers and housing agencies in the San Jose market should also be worried about how a shift to small scale FMRs appears to dramatically reduce voucher accessibility in large segments of eastern San Jose and the City of Gilroy.

The concerning results for the East Bay and San Jose highlight the potential need for HUD to establish FMR floors when shifting to small scaled FMRs in a fashion similar to HUD's current ceiling. For example, HUD might consider ensuring that ZIP code FMRs cannot be less than 70% of the Market Area FMRs that would otherwise be instituted. Future research can determine where this threshold may need to be.

Lastly, it is important to highlight that the tremendous gains in access to rental units in jobs rich and low-wage jobs rich neighborhoods brought about by smaller scaled FMRs does not come at the expensive of HUD's efforts to get voucher holders out of high poverty neighborhoods. In contrast, small scale FMRs significantly increase the number of for-rent listings in low-poverty neighborhoods that would be accessible to voucher holders.

Chapter 4: Is Prioritizing Affordable Housing in California's Rail Accessible and Jobs-Rich Neighborhoods Increasing Development Costs?

California tax payers have supported bonds in excess of a billion dollars to fund housing construction in infill parcels and rail accessible neighborhoods under the state's Infill Infrastructure Grant (IIG) and Transit Oriented Development (TOD) housing subsidy programs (89). Little analysis has explicitly examined how prioritizing affordable housing development in transit and jobs rich neighborhoods in this way impacts the cost of developing affordable housing generally, or with respect to light rail access specifically. This is unfortunate, as potential costs increases translate into a reduction in the total number of affordable units that can be produced given the limited housing resources states possess. In fact, the high cost of constructing affordable housing in California recently led the state's Legislative Analyst's Office to conclude that solving the state's housing crisis by subsidizing new affordable housing construction would be prohibitively expensive (*138*). In this research, we ask how much of the cost of affordable housing in California is due to the emphasis that the state housing policy places on rail access. The existing literature (e.g., see the recent synthesis of Zuk et al 2015) suggests that affordable housing costs should be affected by proximity to rail.

Nationally, one of the most important resources for creating affordable housing is the Department of Housing and Urban Development's (HUDs) Low Income Housing Tax Credit (LIHTC). This program provides the budget authority for state and local LIHTC-allocating agencies to issue tax credits for the acquisition, rehabilitation, or new construction of rental housing targeted to lower-income households (*139*). In California, a budget authority in excess of $90,000,000 for LIHTC is administered through the California Tax Credit Allocation Committee (TCAC). We use data gathered from the LITHC applications prepared by affordable housing developers to create a dataset of affordable housing project budgets for the years 2008 to 2016. Using ordinary least squares and spatially lagged regression, we develop cost models for affordable housing projects to predict the effects of rail transit and job access on projects' total development costs (per unit). We use spatially weighted regression to then examine how the effects of key determinants vary across space. The study data are projects located in the state's four largest metropolitan areas: the San Francisco Bay Area, Sacramento, Los Angeles and San Diego.

In both our ordinary and spatially lagged multivariate regressions, our modeling suggests that proximity to rail stations has only a very weak (non-significant) effect (on a cost per unit basis) for affordable housing development. With respect to job access, we found that job access within a 45 minutes transit or automobile commute has only a weak effect on cost; however, we do find significant positive effects for the jobs-housing balance in and around housing projects' neighborhoods. That is, the greater the jobs relative to housing around a given project, the higher the total development cost per unit.

Theoretical Rational: Why Affordable Housing Near Rail Should Be More Expensive

The literature offers an almost unanimous perspective on the impacts of transit infrastructure and jobs access on rents and home values: as consumers recognize the commute cost savings of living near jobs and transit, they bid up land and property values in transit and jobs rich neighborhoods (*140–142*). In fact, the literature is clear that close proximity to fixed route transit can increase land or property values from between 1% to 15% (91–93, 96). The evidence of this effect is stronger in TODs, developments intentionally designed to maximize resident and employee use of adjacent transit (*94*, *95*, *97*, *143*). Panel studies suggest transit-proximity has played a larger role influencing land and property markets since the Great Recession (91, 98). Therefore, we would expect that affordable housing in close proximity to major rail infrastructure should also be significantly more expensive than affordable housing built elsewhere. Affordable housing developers have voiced this as a critical concern, since they cannot include land values in the calculation of their tax credit subsidies (19).

There are also a small number of studies that have inconclusive or negative results, suggesting that transit may not always have a meaningful impact on property values. One study of fourteen cities found that transit raised property values in only three: Chicago, Boston and Washington D.C. (Kahn, 2007). Gatzlaff & Smith (1993) failed to find a significant effect of rail construction on property values in single family homes along a new rail line in Miami. These results, which stand in contradiction to the bulk of the literature, raise the possibility that – at least in some cities – there are factors through which transit may affect property values: it is not enough that a transit station is built, that station must also measurably improve residents' access to jobs and amenities to induce residents to bid up rents. Studies on the San Francisco Bay Area have found the price per square foot of housing is significantly influenced by the number of jobs within a 45 commute shed (*59*, *146*). This suggests that any analysis of transit proximity should include measures of job accessibility that may affect affordable housing development costs.

Other Rail Access Related Factors Contributing to Cost Escalation

Affordable housing adjacent to major rail transit may appear more expensive not just because of increased land values, but also because these projects tend to be infill projects that face additional expenses such as roads and sewage upgrades (77, 89). Additionally, projects in these neighborhoods may be more expensive because structures may be significantly taller, requiring more expensive inputs and the inclusion of expensive attributes like elevators (21). Theoretically, many non-rail accessible infill projects also face these added costs, but much of the costs can be recouped through market value sales. Practically speaking, when the available land near transit is zoned high density or requires significant infrastructure upgrades—these are the costs the state bears when it promotes affordable development near rail.

What Determines the Cost of Affordable Housing?

Labor, land and material are the basic drivers of housing production costs, including affordable housing costs (*147*). These factors are both space and time variant, requiring empirical modeling of affordable cost trends to account for labor market trends over time and the spatial segmentation of labor and land markets. Most of the other variables reviewed in the literature affect affordable housing costs through a project's land values or the demand for labor or material inputs. We can thus expect housing and labor markets themselves to be significant predictors of affordable housing costs. We also expect that any regulatory mandates that require increased wages for construction workers or higher quality materials to increase the cost of affordable housing projects, as prevailing wage laws have been found to increase affordable housing development costs between 8% and 12% in multiple site-specific analysis (*148*). Economies of scale do exist in affordable housing production, with per unit development costs declining as the number of units in a project increases (21). More units on smaller parcels of land, or higher densities, can help offset land costs (ibid). Zoning standards and regulations can also affect costs. Minimum parking requirements have been targeted as prime culprits of higher development costs in housing, including affordable housing projects (22, 102, 103).

Many attributes of an affordable housing infill project are pre-determined not by local zoning regulations or labor market conditions, but by the populations served by the projects. In California, state law and tax credit regulations offer a varied set of standards like parking requirements and unit sizes, which depend on the population a project serves (19). Legislation recently passed in California prevents a project serving seniors, for example, from requiring anything more than .5 parking space per senior unit and .3 spaces per special needs unit (*149*). Single-Resident Occupancy (SRO) projects require much fewer square footage than projects aimed at large families. Thus, the type of project and population served can be a significant predictor of project costs.

Finally, the income of levels of residents expected to dwell in affordable housing projects also indirectly affects project costs because rents are determined by incomes. Practitioners refer to this as the "depth of affordability." Rents on a tax credit funded site are generally no more than one third of a household's income, so the lower the average income of residents on site, the lower the rents and the greater the "depth of affordability," and thus, the amount of subsidy needed. In the last decade, some evidence suggests that developers may be locating in sites that minimize the amount of subsidy families are receiving by locating in areas where rents are already lower or the projects can win special spatially defined "bonus" subsidies from tax credit allocating agencies (37).

Empirical Setting

We compiled the applications for Low Income Housing Tax Credits (LIHTC) that were submitted to the California Tax Credit Allocation Committee (TCAC) from 2008 through 2016. We used R to extract and compile our dataset. The competition for funding is stiff and because many projects can end up applying for tax credits multiple times, we identified and removed duplicate projects, keeping only the very latest application for each project. Limiting the dataset to the latest applications of new construction projects resulted in a total sample size of 949. We also eliminated observations located in regions with little to no rail infrastructure. The analysis was constrained to the state's four largest metropolitan planning organizations, all of which contain major transit systems: San Francisco Bay Area, Greater Sacramento Area, Greater Los Angeles Area and Inland Empire, and San Diego County. Finally, projects often did not contain complete information, and these were also eliminated. The final complete dataset used for this analysis contained 496 observations (Table 1).

Table 4: Data Preparation and Remaining Sample Size

Data Cleaning Step	**Remaining Sample Size**
Initial Tax Credit Project Applications, 2008 to 2016	2012
Remove non-New Construction projects	1340
Remove repeat applications, keep latest and final application	864
Remove projects outside major MPOs with rail	651
After removing projects with missing or incomplete records	496

The information contained in the TCAC applications included 12 variables of interest to us; these variables were found to be significant in previous studies of affordable housing costs (21, 22). Our analysis dataset includes a wide distribution of development cost per unit, including several projects with costs below $200,000 per unit (Table 5). The distribution of total units per project tracks the distribution of the number of parking spaces, as would be expected given their pairwise correlation of .71. As evidenced in Table 2 the vast majority of projects were developed for large families (60%), followed by seniors (22%). A fifth (N=104) of the projects are within half mile of rail stop, and 12.5% are within a quarter mile. County indicator variables are included as proxies for differences in the land and labor markets across the state.

Table 5: Summary Statistics

	Minimum	Median	Mean	Maximum
Total Cost Per Unit	$119,992	$350,253	$362,998	$785,184
Physical Attributes				
Total Units	6	62	73	438
Residential Square Feet Per Unit (100s)	3.36	8.67	8.53	18.49
Common Area Square Feet (1000s)	0	5.15	10.07	101.9
Commercial Square Feet (1000s)	0	0	1.104	71.9
Project Has Elevator	0	0	0.409	1
Year Funded	2008	2010	2012	2016
Number of Parking Spaces	5	73	95.34	557
Has Underground Parking	0	0	0.3	1
Demographic Attributes				
Average Affordability	25%	48.72%	48.77%	100%
Non-Targeted (baseline for following:)	0	0	0.058	1
At-Risk	0	0	0.002	1
Large Family	0	1	0.6	1
Seniors	0	0	0.22	1
Special Needs	0	0	0.11	1
SRO	0	0	0.01	1
Transit And Job Access				
Within A 1/3 Mile of FRT Stop	0	0	0.157	1
Within Half Mile of FRT Stop	0	0	0.21	1
Within 1/4 Mile of FRT Stop	0	0	0.125	1
Jobs-Housing Fit	0.17	2.7	5.01	172.15
Jobs Within 45 Minutes By Transit	0	1067	8195	71764
Jobs Within 45 Minutes By Car	155.1	190238.7	253738.9	839819.3
Jobs Housing Balance (2.5 Miles)	0.103	0.922	1.26	6.77
Jobs Housing Balance (5 Miles)	0.226	1.048	1.129	2.609
TOD Program	0	0	0.06	1
County Indicator Variables				

When we compare the differences in the distribution of total development costs per unit (TDCPU) by distance to rail stops, Figure 24, we find no obvious trend between proximity to stops and total development costs. The average TDCPU does not begin to decline significantly until projects are greater than one mile from rail stops. It is worth noting that all but one of the projects with total development costs above $700,000 per unit were located within a mile of these rail stops.

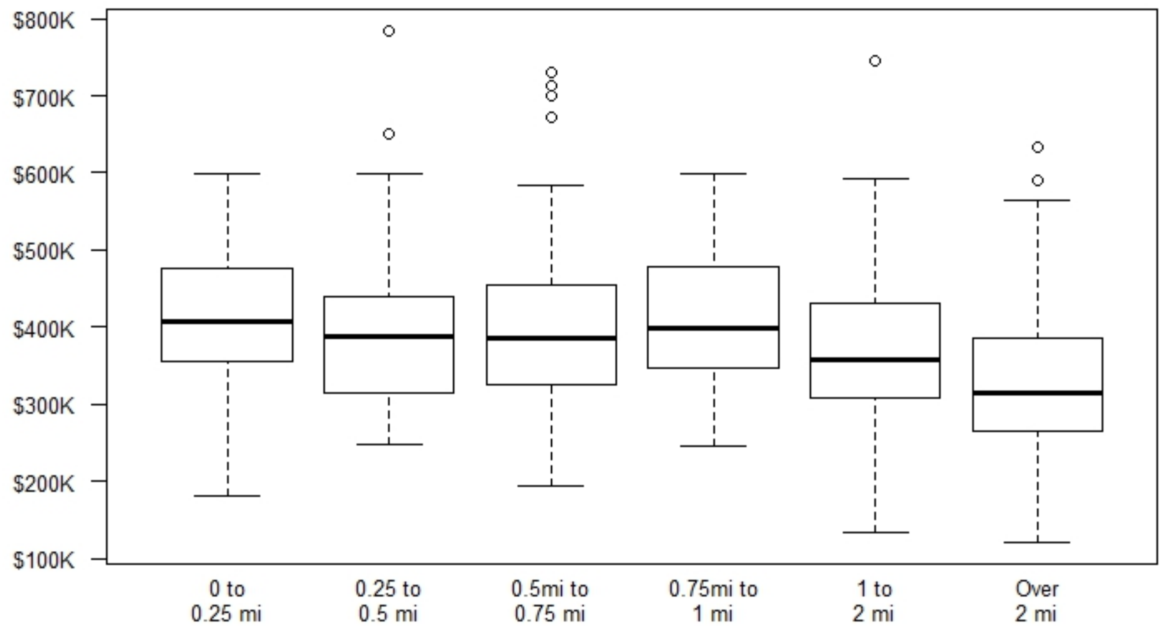

Figure 24: Distributions of Total Cost Per Unit by Distance to Rail, LRT or Trolley Stops

For our modeling, we established indicator variables for projects that are within a quarter mile, one-third mile or one-half mile of a rail transit stop. Our distances are based on studies identifying these thresholds as relevant in determining the effect of TODs on travel behavior (82). We limited our calculations to passenger rail, light rail and trolley stops, with buses excluded. This is consistent with the California's Transit Oriented Development (TOD) Program, which in practice has only funded projects in close proximity to these types of transit systems (89). This program uses Proposition 1 bond money and is executed through the Department of Housing and Community Development (HCD). We include a separate indicator variable designating if the project received funds from the TOD program.

To capture job accessibility, we constructed a variable identifying jobs within a 45 minute transit or automobile commute (*146*). We also included two metrics of jobs-housing balance: 1) total jobs-housing balance within 2.5 miles of a housing site's census tract and 2) total jobs-housing balance within 5 miles of a site's census tract. The placement of more affordable housing in communities with large imbalances may contribute to a reduction in excess commuting created by such imbalances (2, 16). Lastly, since these are affordable housing projects, we also test for *jobs-housing fit*, which is the ratio between low wage workers and housing units affordable to low wage workers within 2.5 miles of a census tract. This measure has been found to strongly predict the commute times and distances of the low wage workers who may be eligible for affordable housing, making its relationship to affordable housing costs critically important for our analysis (1, 17).

Results

The literature on modeling affordable housing is mixed in its approach. Some work suggests geographically weighted regression performs best in predicting rents and property values (*150*), while others maintain that traditional OLS with spatial indicator variables provides the most robust results (*151*). Thus, we took two approaches. We modeled the housing costs as a function of spatial indicators using OLS. We also specified models utilizing a spatial lag approach which, as we will discuss, corrected for spatial autocorrelation in the Bay Area and Greater Sacramento regions. As part of our results, we also present detailed mapping of how the effects on costs of key independent variables vary across space.

OLS Results

Our OLS model specification results are presented in Table 6. For visual simplicity, the County Indicator variables for each of the models are presented separately in Table 7. Consistent with the literature, we find evidence of economies of scale: the total number of units correlates negatively and significantly with total development costs. The relationship is inelastic: a one percent increase in the total number of units produces a 0.17% to 0.18% decrease in total development costs per unit.

Residential square feet per unit, our proxy for unit size, correlates positively with total development costs as expected, as does commercial square footage. Common area square footage is positively but insignificantly associated with total development costs. The presence of an elevator is very weakly but positively associated with project costs. Perhaps due to the collinearity issue discussed in the previous section, we do not find the number of parking units correlating significantly with total development costs. However, we do find the presence of underground parking is significant, and may increase the total development cost by between 5.7% and 7% per unit.

The average affordability level of a project's affordable units correlates negatively with total development cost; we expect this based on the literature. Put another way: a one percent increase in the HUD-defined income levels of residents (requiring shallower subsidies) decreases total development cost by 0.7%. Relative to the baseline of projects that serve at-risk populations, only projects targeted at seniors are significantly different, having TDCPUs between 9% and 9.5% lower. Projects facing the prevailing wage requirement are between 15% and 16% more expensive than those that are not required to pay prevailing wages.

Model 1 (M1) presents the results for transit proximity within a third of a mile, while Model 2 (M2) and Model 3 (M3) cover transit proximity within a half mile and quarter of mile respectively. Model 4 (M4) presents results for low wage jobs to affordable housing *fit*. Model 5 (M-5) presents results for jobs within a 45 minute transit commute and Model 6 (M6) presents results for jobs within a 45 minute auto commute. Models 7 and 8 present jobs housing balance results within 2.5 mile and 5 mile buffer respectively, and Model 9 presents results for participation in the state's TOD affordable housing program.

Table 6: OLS Regressions On (Dependent Variable is Log of Total Development Costs Per Unit)

	Baseline	M1	M2	M3	M4	M5	M6	M7	M8	M9
Intercept	-53.331***	-51.923***	-52.274***	-52.809***	-52.601***	-53.037***	-53.519***	-54.158***	-52.306***	-54.054***
Prevailing Wage Required	0.158***	0.156***	0.156***	0.158***	0.16***	0.159***	0.159***	0.156***	0.156***	0.16***
Total Units	-0.168***	-0.171***	-0.174***	-0.17***	-0.168***	-0.167***	-0.168***	-0.181***	-0.176***	-0.168***
Residential Sqft.	0.016**	0.016**	0.016**	0.017**	0.016**	0.016**	0.016**	0.017**	0.017**	0.016**
Common Area Sqft.	0.001^	0.001	0.001^	0.001	0.001	0.001^	0.001^	0.001	0.001	0.001^
Commercial Sqft.	0.013***	0.012***	0.012***	0.012***	0.013***	0.013***	0.013***	0.012***	0.013***	0.013***
Project Has Elevator	0.038^	0.035^	0.036^	0.036^	0.036^	0.038^	0.038^	0.042*	0.042*	0.038^
Year Funded	0.033***	0.033***	0.033***	0.033***	0.033***	0.033***	0.033***	0.034***	0.033***	0.034***
Number of Parking Spaces	0.006	0.008	0.01	0.007	0.008	0.006	0.006	0.017	0.011	0.006
Has Underground Parking	0.058**	0.054**	0.054**	0.056**	0.057**	0.058**	0.059**	0.046*	0.047*	0.059**
Average Affordability	-0.005***	-0.005***	-0.005***	-0.005***	-0.005***	-0.005***	-0.005***	-0.005***	-0.005***	-0.005***
At-Risk	-0.095	-0.095	-0.121	-0.095	-0.103	-0.1	-0.097	-0.053	-0.102	-0.095
Large Family	0.059	0.057	0.057	0.057	0.059	0.059	0.059	0.073^	0.063	0.06
Seniors	-0.103*	-0.102*	-0.101*	-0.103*	-0.104*	-0.104*	-0.103*	-0.076^	-0.094*	-0.102*
Special Needs	-0.018	-0.018	-0.019	-0.018	-0.02	-0.018	-0.018	0.002	-0.013	-0.019
SRO	0.098	0.093	0.099	0.093	0.096	0.097	0.096	0.119	0.092	0.102
In 1/3 Mile of Rail Stop		0.032								
In Half Mile of Rail Stop			0.029							
In 1/4 Mile of Rail Stop				0.025						
Jobs-Housing Fit					-0.001					
Jobs 45 Minutes By Transit						0				
Jobs 45 Minutes By Car							0			
Jobs Housing Bal. 2.5 Mi.								0.028**		
Jobs Housing Bal. 5 Mi.									0.046*	
In TOD Program										-0.017
R-Squared	0.6554	0.6567	0.6567	0.6561	0.6567	0.6555	0.6555	0.6631	0.6595	0.6556
Adjusted R Squared	0.6276	0.6282	0.6282	0.6275	0.6281	0.6269	0.6269	0.6351	0.6312	0.6269
Moran's I P (North MPOs)	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.001***	0.001***
Moran's I P (South MPOs)	.968	.984	.936	.990	.965	.959	.948	.775	.763	.763

Significance Levels: *.001, **.01, *.05, ^.1**

Table 7: County Indicator Variables for OLS Models

County Indicators	**Baseline**	**M 1**	**M 2**	**M 3**	**M 4**	**M 5**	**M 6**	**M 7**	**M 8**	**M 9**
Contra Costa	-0.121*	-0.114*	-0.113*	-0.116*	-0.119*	-0.121*	-0.119*	-0.124*	-0.117*	-0.124*
El Dorado	-0.365**	-0.357**	-0.356**	-0.361**	-0.368**	-0.365**	-0.362**	-0.374**	-0.356**	-0.368**
Imperial	-0.574***	-0.567***	-0.567***	-0.569***	-0.579***	-0.573***	-0.571***	-0.576***	-0.577***	-0.575***
Los Angeles	-0.149***	-0.142***	-0.143***	-0.145***	-0.15***	-0.145***	-0.142***	-0.158***	-0.161***	-0.15***
Marin	-0.021	-0.012	-0.013	-0.016	-0.021	-0.02	-0.02	-0.027	-0.025	-0.025
Napa	-0.22*	-0.214*	-0.213*	-0.216*	-0.222*	-0.22*	-0.22*	-0.229**	-0.225**	-0.222*
Nevada	-0.88***	-0.874***	-0.874***	-0.876***	-0.881***	-0.874***	-0.876***	-0.926***	-0.909***	-0.881***
Orange	-0.167***	-0.159***	-0.159***	-0.162***	-0.156***	-0.166***	-0.165***	-0.175***	-0.18***	-0.17***
Placer	-0.296**	-0.287**	-0.287**	-0.291**	-0.3**	-0.295**	-0.293**	-0.308**	-0.298**	-0.298**
Riverside	-0.326***	-0.319***	-0.319***	-0.322***	-0.328***	-0.324***	-0.324***	-0.324***	-0.32***	-0.328***
Sacramento	-0.401***	-0.399***	-0.398***	-0.4***	-0.404***	-0.398***	-0.395***	-0.425***	-0.423***	-0.404***
San Diego	-0.132**	-0.129**	-0.132**	-0.13**	-0.133**	-0.131**	-0.13**	-0.132**	-0.133**	-0.134**
San Francisco	0.302***	0.302***	0.299***	0.301***	0.3***	0.302***	0.301***	0.301***	0.278***	0.298***
San Mateo	0.024	0.024	0.024	0.022	0.025	0.029	0.027	0.032	0.024	0.02
Santa Clara	-0.046	-0.043	-0.048	-0.043	-0.046	-0.045	-0.045	-0.061	-0.057	-0.048
Solano	-0.445***	-0.437***	-0.437***	-0.441***	-0.445***	-0.445***	-0.443***	-0.438***	-0.436***	-0.447***
Sonoma	-0.207***	-0.199***	-0.199***	-0.202***	-0.208***	-0.203***	-0.199**	-0.211***	-0.208***	-0.209***
Sutter	-0.518***	-0.511***	-0.51***	-0.514***	-0.521***	-0.517***	-0.516***	-0.522***	-0.508***	-0.52***
Ventura	-0.133*	-0.124*	-0.124*	-0.127*	-0.133*	-0.133*	-0.131*	-0.13*	-0.132*	-0.135*
Yolo	-0.32***	-0.31***	-0.309***	-0.314***	-0.323***	-0.32***	-0.32***	-0.374***	-0.347***	-0.323***
Yuba	-0.518***	-0.511***	-0.51***	-0.515***	-0.521***	-0.517***	-0.512***	-0.511***	-0.511***	-0.52***

None of the rail transit indicator variables included in the regressions of are significant at or beyond the .05 level. Moreover, none of the coefficients register effects are greater than 3%. The jobs-housing fit, or the jobs-housing balance experienced by low wage workers, is uncorrelated with total development cost per unit.

Relative to Alameda, San Francisco is the most expensive county in our sample (Table 3), followed by Ventura, San Mateo and Santa Clara. The inclusion of our spatially sensitive rail and jobs access variables do not appear to significantly alter County indicator variables.

Model 5 (M5) presents results for jobs within a 45 minute transit commute and Model 6 presents results for jobs within a 45 minute auto commute. Neither are significant. In contrast, Total jobs-housing balance within both a 2.5 mile radius and five mile radius, are significantly and positively associated with per unit development costs as demonstrated in Models M7 and M8. Model 9 presents results for the effects of participation in the state TOD program, which have no significant effect on costs.

The model specifications account for 66% of the variance in the dependent variable, which is lower than the 80% attained by a previous study of affordable housing development costs in California (21). However, that study had a much smaller sample (284 projects versus our 496), which may partially explain the difference. Additionally, the previous analysis included a variable on construction material quality that we were unable to replicate.

We ran separate Moran's I tests of spatial autocorrelation in the model residuals for the North versus South MPOs, and found highly significant spatial autocorrelation in the Bay Area and Sacramento, but none in Los Angeles and San Diego. To ensure the spatial autocorrelation would not bias our results, we duplicated our OLS regressions with a specified spatial lag, the results of which are presented in the next subsection.

Spatially Lagged Regressions

The first half of the spatially lagged regressions are presented in Table 8. As in the previous subsection, County indicator variables are presented in separate table for ease of reading,Table 9. In these models, total unit count and residential square feet per unit retain their significant effects. Commercial square footage retains it positive and significant impact on costs, with 1,000 square feet of commercial space increasing costs by roughly 5% per unit. Underground parking and year funded also maintain positive and significant coefficients.

Among demographic variables, average affordability and senior projects retain their statistical influence on cost, with projects for seniors registering per unit total development costs at 11-12% lower than the baseline group, projects for At-Risk populations.

Table 8: Spatial Lag Model Results

	Baseline	Model 1	Model 2	Model 3	Model 4	Model 5	Model 7	Model 8	Model 9
Intercept	-44.396***	-42.647***	-43.848***	-43.668***	-43.456***	-44.396***	-47.01***	-43.973***	-44.862***
Prevailing Wage Required	0.153***	0.15***	0.15***	0.152***	0.154***	0.153***	0.152***	0.15***	-0.155***
Total Units	-0.177***	-0.182***	-0.183***	-0.18***	-0.176***	-0.177***	-0.19***	-0.184***	-0.155***
Residential Square Feet Per Unit	0.015**	0.015**	0.015**	0.015**	0.015**	0.015**	0.016**	0.016**	0.015**
Common Area Square Feet	0.002*	0.002*	0.002*	0.002*	0.002*	0.002*	0.001^	0.002*	0.001*
Commercial Square Feet	0.058**	0.059**	0.055**	0.059**	0.058**	0.058**	0.048*	0.053**	0.058**
Project Has Elevator	0.027	0.023	0.025	0.024	0.025	0.027	0.032^	0.032^	0.03^
Year Funded	0.027***	0.026***	0.027***	0.027***	0.027***	0.027***	0.028***	0.027***	0.028***
Number of Parking Spaces	0.017	0.02	0.021	0.019	0.018	0.017	0.028	0.022	0.003
Has Underground Parking	0.057**	0.051**	0.053**	0.053**	0.057**	0.057**	0.046*	0.046*	0.056**
Average Affordability	-0.005***	-0.005***	-0.005***	-0.005***	-0.005***	-0.005***	-0.005***	-0.005***	-0.006***
At-Risk	-0.149	-0.147	-0.177	-0.147	-0.155	-0.149	-0.102	-0.152	-0.134
Large Family	0.035	0.03	0.031	0.03	0.034	0.035	0.049	0.042	0.049
Seniors	-0.118**	-0.116**	-0.115**	-0.117**	-0.118**	-0.118**	-0.091*	-0.105*	-0.12**
Special Needs	-0.048	-0.047	-0.049	-0.048	-0.05	-0.048	-0.026	-0.038	-0.046
SRO	0.073	0.066	0.074	0.066	0.071	0.073	0.095	0.07	0.078
Within A 1/3 Mile of Rail Stop		0.047^							
Within Half Mile of Rail Stop			0.034						
Within 1/4 Mile of Rail Stop				0.039					
Jobs-Housing Fit					-0.001				
Jobs 45 Minutes By Transit						-0.084			
Jobs 45 Minutes By Car									
Jobs Housing Balance (2.5 Mi.)							0.029***		
Jobs Housing Balance (5 Mi.)								0.051**	
In TOD Program									0.029
Rho	0.22429	0.23589	0.23704	0.22929	0.20545	0.22429	0.25516^	0.21441	0.2275
LR Test p-value	0.143	0.1216	0.120	0.133	0.185	0.146	0.091	0.16	0.134
AIC	-246.85	-248.65	-247.14	-247.1	-246.04	-246.85	-256.58	-252.1	-258.09
AIC for Linear Model	-246.71	-248.25	-246.73	-246.85	-246.27	-246.71	-255.73	-252.12	-257.85

Significance Levels: *.001, **.01, *.05, ^.1**

Table 9: County Indicators For Spatial Lag Models

County Indicator Variables	Baseline	Model 1	Model 2	Model 3	Model 4	Model 5	Model 7	Model 8	Model 9
Contra Costa	-0.084	-0.075	-0.076	-0.077	-0.084	-0.318*	-0.087	-0.081	-0.076
El Dorado	-0.318*	-0.301*	-0.303*	-0.308*	-0.325*	-0.418**	-0.318*	-0.309*	-0.307*
Imperial	-0.418**	-0.399**	-0.4**	-0.407**	-0.435**	-0.111**	-0.398**	-0.428***	-0.403**
Los Angeles	-0.111**	-0.1*	-0.103*	-0.105*	-0.115**	-0.024	-0.117**	-0.127**	-0.111*
Marin	-0.024	-0.01	-0.014	-0.016	-0.025	-0.2*	-0.029	-0.028	-0.018
Napa	-0.2*	-0.187*	-0.189*	-0.192*	-0.205*	-0.78***	-0.202*	-0.206*	-0.184*
Nevada	-0.78***	-0.765***	-0.767***	-0.771***	-0.791***	-0.135**	-0.81***	-0.817***	-0.762***
Orange	-0.135**	-0.12*	-0.122*	-0.125*	-0.128*	-0.208^	-0.141**	-0.153**	-0.127*
Placer	-0.208^	-0.188	-0.191	-0.196	-0.221^	-0.252***	-0.204^	-0.215^	-0.197
Riverside	-0.252***	-0.235**	-0.237**	-0.242***	-0.261***	-0.299***	-0.236***	-0.248***	-0.249***
Sacramento	-0.299***	-0.29**	-0.288**	-0.294**	-0.31***	-0.098^	-0.305***	-0.327***	-0.284**
San Diego	-0.098^	-0.091^	-0.095^	-0.094^	-0.102^	0.281***	-0.091^	-0.101*	-0.086
San Francisco	0.281***	0.282***	0.278***	0.281***	0.281***	0.027	0.279***	0.255***	0.289***
San Mateo	0.027	0.026	0.026	0.023	0.029	-0.048	0.036	0.028	0.043
Santa Clara	-0.048	-0.043	-0.049	-0.044	-0.049	-0.372**	-0.058	-0.061	-0.042
Solano	-0.372**	-0.355**	-0.358**	-0.363**	-0.379**	-0.179**	-0.352**	-0.365**	-0.358**
Sonoma	-0.179**	-0.164*	-0.166*	-0.17**	-0.185**	-0.413**	-0.177**	-0.182**	-0.166*
Sutter	-0.413**	-0.396**	-0.397**	-0.404**	-0.425**	-0.121*	-0.4**	-0.406**	-0.397**
Ventura	-0.121*	-0.105^	-0.108^	-0.111*	-0.123*	-0.249*	-0.115*	-0.12*	-0.106^
Yolo	-0.249*	-0.229*	-0.227*	-0.238*	-0.261*	-0.408**	-0.281*	-0.281*	-0.24*
Yuba	-0.408**	-0.391**	-0.392**	-0.399**	-0.42**	-44.396***	-0.386**	-0.404**	-0.399**

Among our rail transit measures, the indicator for being within a third of a mile of a rail stop is weakly significant and shows an effect of raising project costs by an average of 4.7%. No other measures of transit proximity are significant. As with the OLS regressions, our jobs-housing balance metrics are highly significant and show a positive effect while jobs housing fit and participation in the TOD program show no significant effects.

The log-likelihood test p-values for all nine models plus the baseline model are insignificant, indicating that these model specifications have corrected the spatial autocorrelation. The Rho values, which indicate the impact of the spatial lag, range between .20 and .26, but the Rho is statistically significant in only one case (Model 7). Models 7 and 9 also perform best according to the Akaike Information Criteria (AIC), despite participation in the TOD Program (Model 9) being statistically insignificant.

Geographically Weighted Regression Results

Our next step was to include the variables specified in Models 7 and 8 in our geographically weighted regression (GWR) analysis. GWR is helpful for understanding how costs vary across space. When using OLS, we assume that the estimated coefficients remain the same across a region; GWR allows the estimated coefficients to vary within the region (*152*). While promising, we present these results cautiously—what is important here is how the reported coefficient either grows or shrinks across space, rather than what its absolute value is.

The variation in coefficient results for Model 7 and Model 8 are presented in Table 10. Due to the increased importance of space in calculating coefficients in GWR, models can be easily over-specified if too many spatially auto-correlated variables are included. The inclusion of sets of indicator variables representing different groups, like populations served, can also present problems for this approach. Thus, the models in this subsection only retain the variables from previously presented models that do not introduce these complications.

As coefficients vary across space in GWR, Table 10 presents summary statistics for each of the coefficients in the model. The "Global" column on the far right end of Table 10 is the overall coefficient for the variable for the region as a whole. The estimated coefficients for jobs-housing balance within a 2.5 mile radius of a project are positive when measured at 80% of the observations. Surprisingly, average affordability is also measured as having a positive effect at nearly a quarter of the observations. At over a quarter of the locations in the sample, commercial square footage registers a *negative* coefficient. The effect of the prevailing wage is uniformly positive, but the effect differs spatially, with the maximum effect over 100% greater than the minimum.

Table 10: Geographically Weighted Regression For Model 7, Job-Housing Balance (2.5 Mile Buffer)

	Minimum	1st Quantile	Median	3rd Quantile	Max	Global
		Model 7				
Intercept	-119.7	-103.6	-39.79	-28.8	-19.38	-58.924
Log Total Units	-0.293	-0.242	-0.217	-0.148	-0.068	-0.182
Has Prevailing Wage	0.109	0.153	0.179	0.217	0.263	0.204
Average Affordability	-0.014	-0.006	-0.002	0	0.002	-0.004
Residential Square Feet Per Unit	0.009	0.023	0.028	0.038	0.056	0.03
Common Area Square Feet	0	0.001	0.002	0.003	0.006	0.003
Commercial Square Feet	-0.109	-0.022	0.029	0.067	0.086	0.054
Year	0.016	0.021	0.026	0.058	0.066	0.036
Log Parking Spaces	-0.04	0.005	0.031	0.049	0.1	0.005
Underground Parking	-0.019	0.058	0.075	0.1	0.3	0.125
Jobs-Housing Balance (2.5 Miles)	-0.015	0.005	0.031	0.036	0.086	0.022
		Model 8				
Intercept	-65.09	-64.86	-33.57	-30.16	-29.71	-56.0425
Log Total Units	-0.252	-0.251	-0.235	-0.175	-0.174	-0.182
Paid Prevailing Wage	0.158	0.161	0.163	0.205	0.206	0.199
Average Affordability	-0.006	-0.006	-0.002	-0.002	-0.002	-0.005
Residential Square Feet Per Unit	0.02	0.021	0.023	0.032	0.032	0.031
Common Area Square Feet	0.002	0.002	0.003	0.003	0.003	0.003
Commercial Square Feet	0.028	0.03	0.031	0.062	0.063	0.056
Year	0.021	0.022	0.023	0.039	0.04	0.034
Parking Spaces	0.005	0.006	0.031	0.046	0.047	0.005
Underground Parking	0.081	0.082	0.081	0.13	0.132	0.116
Jobs-Housing Balance (5 Miles)	0.058	0.06	0.071	0.072	0.077	0.065

Model Diagnostics	*Model 7*	*Model 8*
AICc	-71.24	-158.71
AIC	-93.19	-238.29
Residual Sum of Squares	23.19	15.91
Quasi-Global R^2	0.4499	0.622

We can map the spatial variation the coefficients of these variables across space. This helps us to understand how the importance of the variables in impacting development costs varies cross space. The importance in these results is not necessarily the actual coefficients at different points in space, but their effects relative to other regions.

Figure 25 presents the spatial variation in the effect of Jobs-Housing Balance within 2.5 miles of sites' census tracts. The effect of jobs-housing balance on housing costs (at a 2.5 mile buffer) is highest in San Diego County and along the fringes of Riverside County in the south. In the north, the effect is higher in Santa Clara County and San Francisco City, but approaches zero in the northern suburbs of San Francisco, the East Bay in and around Oakland proper and much of the greater Sacramento Area. All things equal, jobs housing balance increases the cost of affordable housing production costs in San Diego, Santa Clara and San Francisco counties, while it does not appear to effect costs in Sacramento and the East Bay.

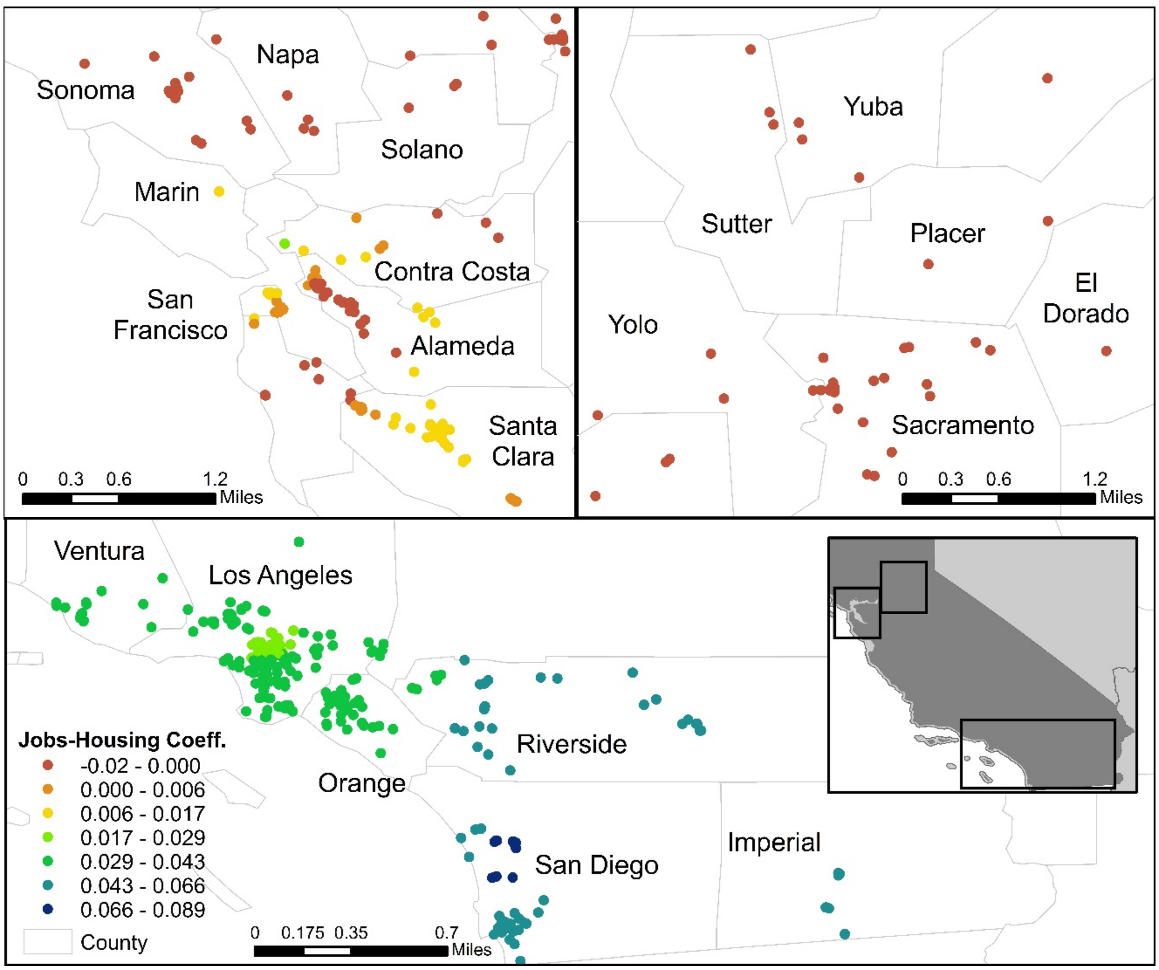

Figure 25: Spatial Variation in Jobs-Housing Balance (2.5 Mile Buffer) Coefficient in Geographically Weighted Regression

The effects of commercial square footage are presented in Figure 26. The inclusion of commercial space in projects appears to have a negative impact within the Los Angeles area, and registers the strongest positive effects in the San Francisco Bay Area and Sacramento. Commercial square feet registers a weak positive effect on housing costs in the counties south of Los Angeles: Orange, San Diego, Riverside and Imperial. The negative effect in and around downtown Los Angeles could mean that the inclusion of commercial space in some projects there enabled developers to secure better lending terms overall for their projects if demand for commercial space was high there.

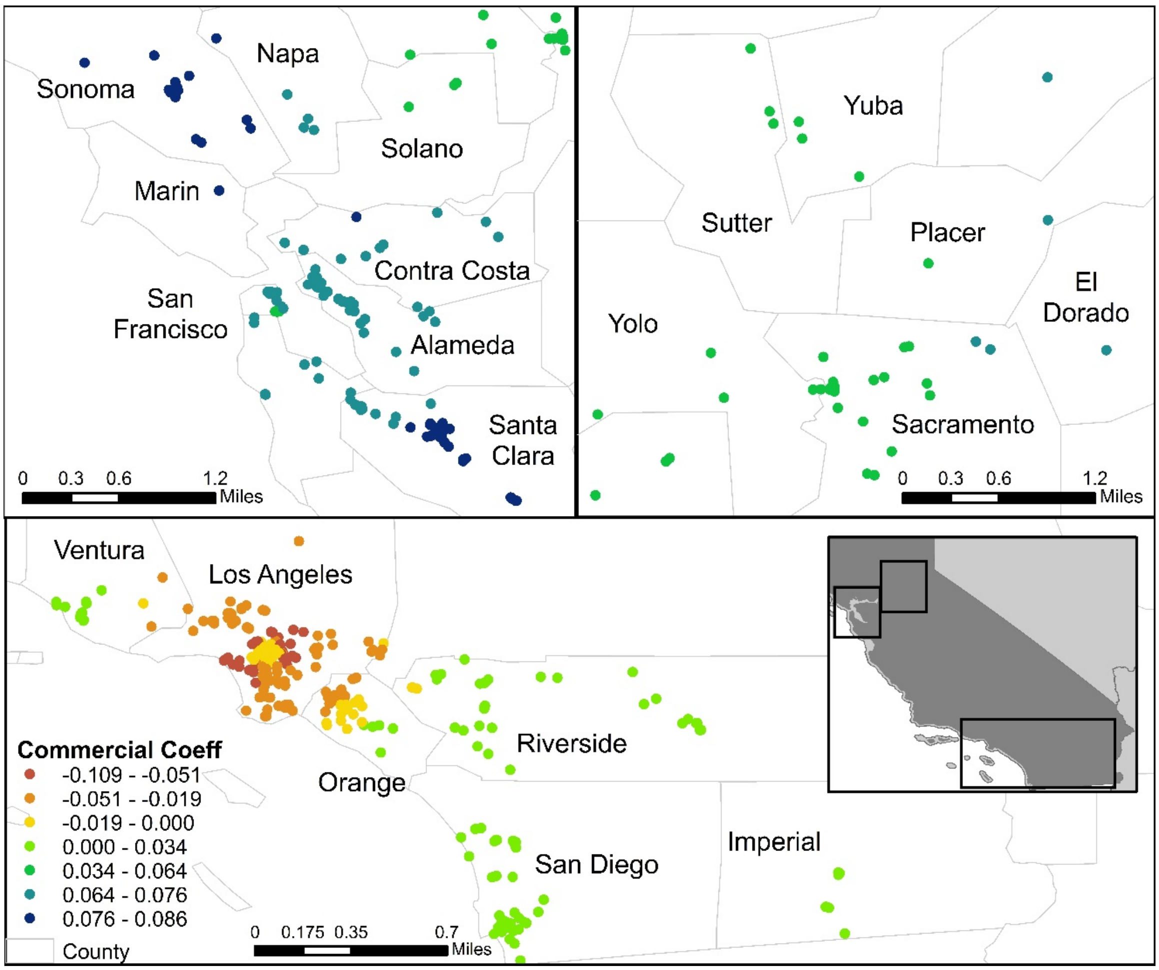

Figure 26: Spatial Variation in Commercial Square Footage Coefficient in Geographically Weighted Regression

The spatial pattern in the effect of average affordability is presented in Figure 27. Recall that the higher the average affordability, *the shallower the subsidy* that is required. Thus, in areas where the coefficient is negative, deeper subsidies are presumably increasing development costs while a positive coefficient suggests deep affordability there correlates with reduced project costs. While this seems counter-intuitive, a single SROs or senior project could exert this effect in an area.

Depth of affordability is raising costs most dramatically in Santa Clara County, home of Silicon Valley, and much of the Sacramento region. The effect of this variable is closer to zero or even slightly positive San Francisco, Alameda and Los Angeles counties, despite these how expensive comparable market rate units might be in these areas. Deeply affordable SROs and senior projects may be skewing the GWR in these areas. Overall, these results suggest that providing affordable housing for the poorest residents has significant and strongly positive effect on project costs in Sacramento and Silicon Valley.

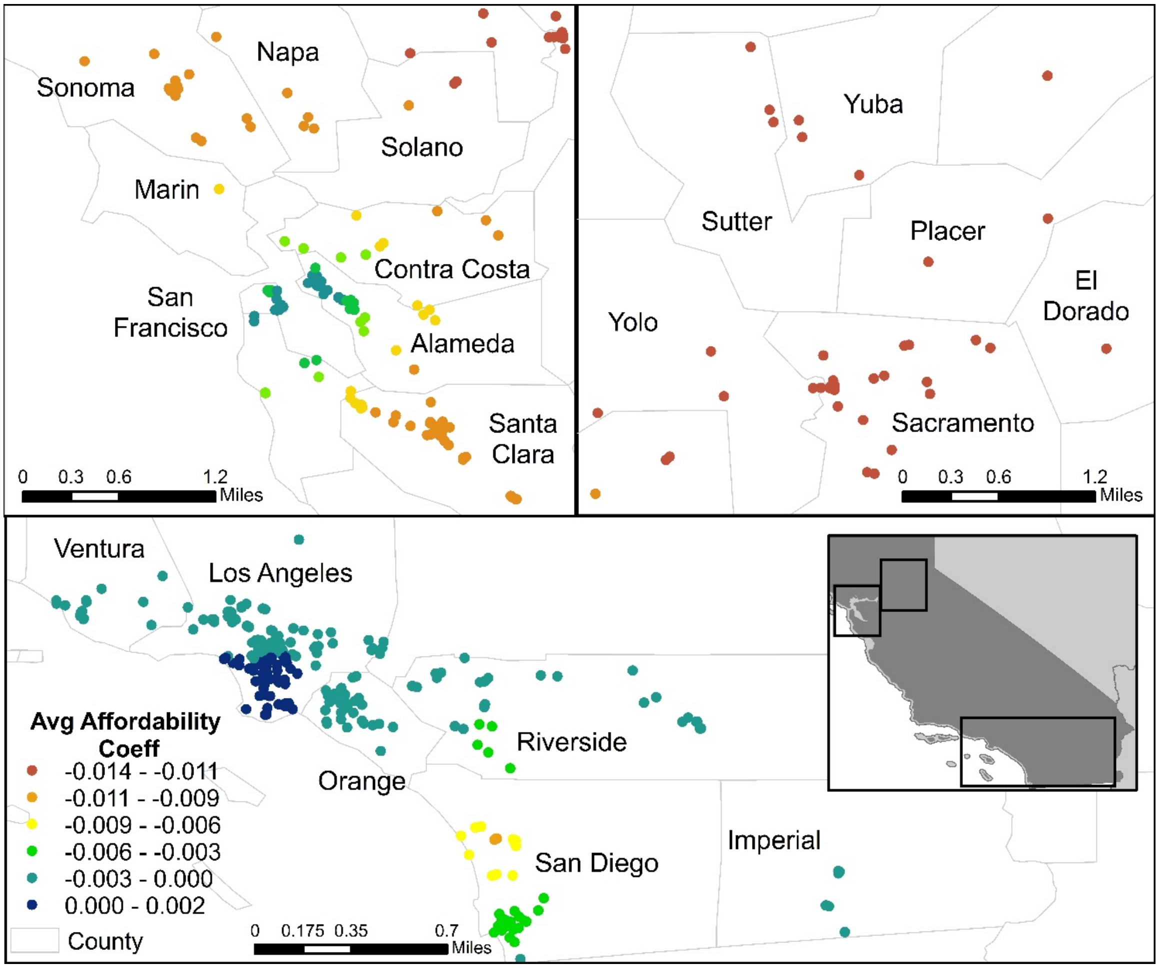

Figure 27: Spatial Variation in Average Affordability Coefficient in Geographically Weighted Regression

The spatial variation in the impact of the prevailing wage is presented in Figure 28. The prevailing wage has its largest effect on affordable housing development costs in the San Francisco Bay Area, followed by the Greater Sacramento region. There is a cluster of projects with high coefficient values in west Los Angeles County, and it appears the effect of the prevailing wage on housing costs is higher in Orange County. In contrast the effect is lower, but still positive, in south Los Angeles County as well as San Diego County. The cost of participating in state programs, which mandate prevailing wages, is thus higher for projects in Northern California. This means state dollars invested in Northern California are not producing as many housing units on a per dollar basis relative to state investments in housing in the south. The impact of state dollars, as measured by units produced, is smallest in the Bay Area due to this requirement.

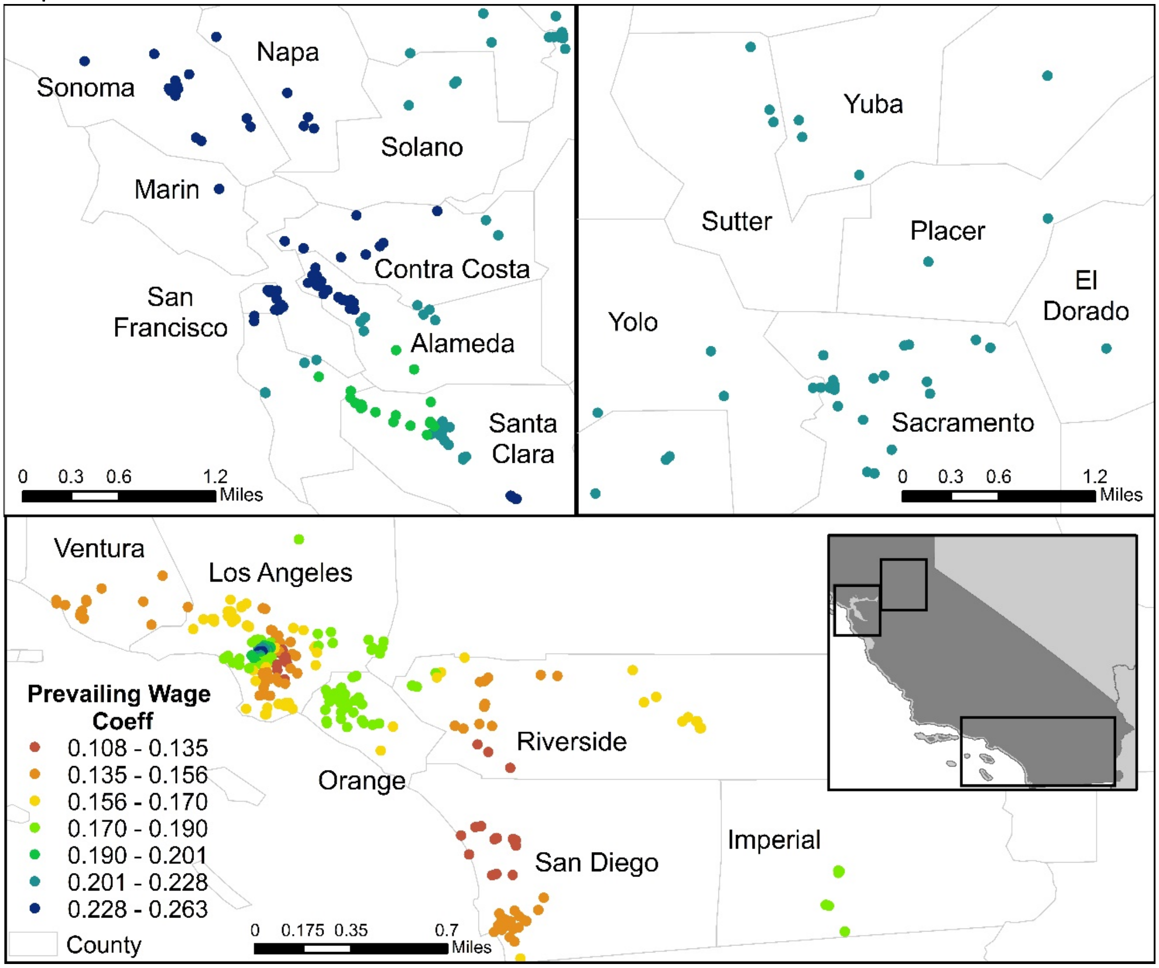

Figure 28: Spatial Variation in the Prevailing Wage Coefficient in Geographically Weighted Regression

Finally, we present the spatial variation in the impact of underground parking in Figure 29. The effect of underground parking is highest in the Greater Sacramento area and in the suburbs north of San Francisco, followed by the Bay Area proper. It may be that because underground parking is less common in Sacramento the effect of the variable is magnified there relative to overall total development costs. Its effect is lowest in the Los Angeles area. Based on these results, suburbs and communities in the greater Sacramento area in particular should avoid zoning and regulations that force affordable developers to build underground parking.

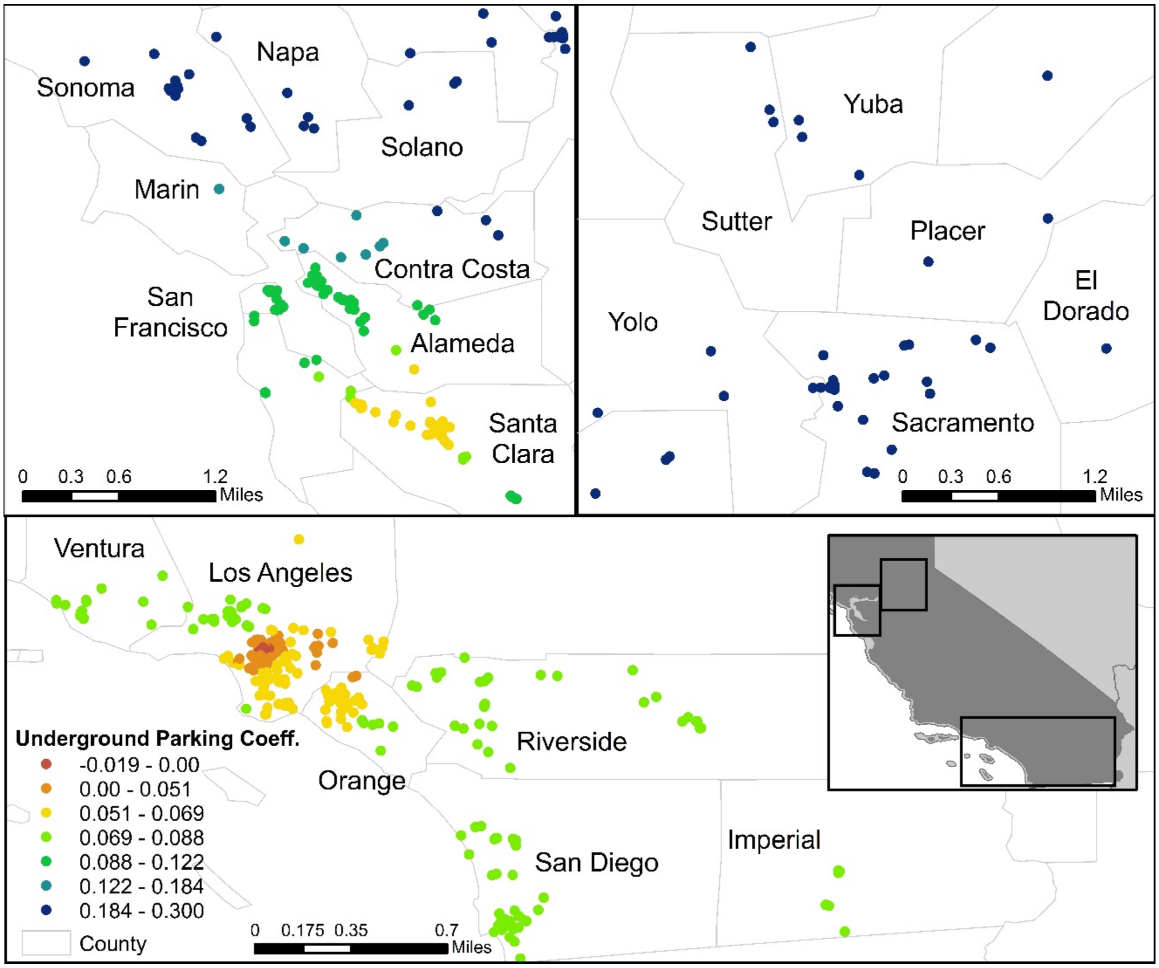

Figure 29: Spatial Variation in the Underground Parking Coefficient in Geographically Weighted Regression

Model 8 performs less robustly under GWR than Model 7, with an AIC at -93.19 and quasi-global r-squared of only .45. The second jobs-housing balance measure, which calculates jobs-housing balance within a five mile buffer, shows limited variation across space, with the coefficient ranging only between 0.058 to 0.077 Figure 9. This suggests the effect of improved jobs-housing balance has relatively similar effects on housing costs regardless of region. Our results appear to also be insensitive to the buffer scale at which we calculate the effect of jobs housing balance on project costs.

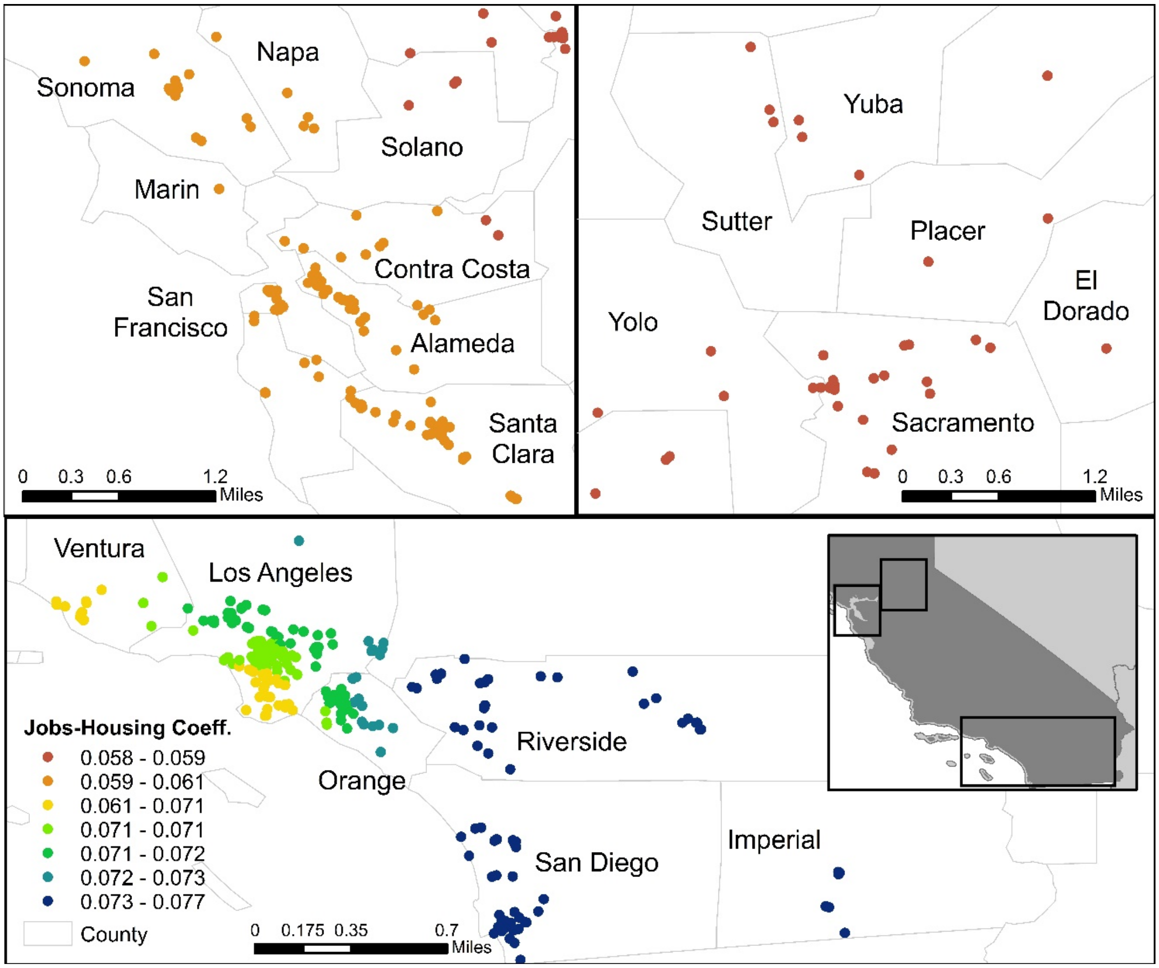

Figure 30: Spatial Variation in the Jobs-Housing Balance (5 Mile Buffer) Coefficient in Geographically Weighted Regression

As with the previous jobs-housing balance metric, the impact of this measure is highest in San Diego County and the Inland Empire, and is lowest in the San Francisco Bay Area. The difference between the two jobs-housing balance measures may be in the nature of the spatial concentration of jobs across these four regions. However, that they show similar trends across the state lends confidence to our analysis. Regardless of the buffer distance used on jobs-housing balance, policies pushing affordable housing to locate in jobs rich areas will have a greater impact on costs in more suburban counties like Riverside and San Diego than in the Bay Area.

Comparing Models' Effectiveness
According to both the Akaike Information Criteria and residual sum of squares, traditional ordinary least squares (OLS) with spatial indicator variables performed best for the two models we tested with all three techniques. Geographically weighted regression (GWR) explained the least amount of variability in the data. These model diagnostics are presented in Table 11.

Table 11: Comparing Spatial Modeling Approaches With RSS And AIC

	OLS	Spatial Lag	GWR
Model 7	13.68	14.71	15.91
	-272.7	*-256.58*	*-238.29*
Model 8	13.82	14.85	23.19
	-267.7	*-252.1*	*-93.19*

These findings corroborate the conclusions of others who have examined the relative effectiveness of spatial approaches in modeling housing markets (*151*). Whether we choose the more efficient but biased OLS (due to spatial autocorrelation), or the unbiased but less efficient spatial lag approach, the key independent variables of interest yield coefficients with the same signs and significance levels, inspiring confidence in the robustness of the findings.

Conclusions

We do not find that the state's focus of prioritizing affordable housing integration with rail transit and job access is increasing the costs of providing affordable housing. None of our measures of rail transit or job access significantly affect development costs (per unit), with the exception of jobs-housing balance. A one unit increase in the jobs-housing balance within 2.5 miles of a project's census tract increases development costs by 2.9%, while a one unit increase in the jobs-housing balance within 5 miles of a project increases development costs by over 5%. The magnitude of these effects is greater in southern California, particularly in San Diego County. Within northern California, the effects are greatest in Santa Clara County (Silicon Valley). These results are intuitive, as jobs growth has been identified as a primary driver of increasing housing costs in that region (*153*). But these results should not bring dismay, that moving from a community with one job per housing unit to two jobs per housing unit will, on average, increase costs at or under 5% is a small price for a dramatic increase in job accessibility.

Our cost models confirm previous analysis that suggests economies of scale exist in affordable housing development: as the number of units rises, per unit cost declines. We find that including commercial space on sites increases costs, although this effect is weaker or potentially reversed in and around downtown and west Los Angeles. We find that adhering to prevailing wage laws increases development costs by 15% on average, with the effect higher in the San Francisco Bay Area and lower in Southern California. Underground parking significantly increases costs as well.

We found a very thin body of research estimating the drivers of affordable housing project costs. Given the volume of tax dollars expended on supply side affordable housing construction programs, additional research should refine and expand on the models presented here and elsewhere in the literature. This analysis should focus on the role of regulatory requirements and incentives placed on competitively allocated subsidies for affordable housing including and beyond the prevailing wage and locational impacts measured here.

Limitations

We preferred to include some sort of indexed variable of minimum parking requirements for sites, in line with the literature (102). However, in the TCAC applications many applicants listed the total number of parking spaces provided instead of the minimum parking requirements despite clear instructions requiring the regulatory information. As a result, we could only use the total number of parking spaces required, although we found this variable to be strongly co-linear with the total number of units (correlation .71), making us uncertain it would produce significant results. We were also unable to identify projects' actual heights or identify any variables on material quality, which have been found to have a significant and positive effects on project costs (21, 22).

Conclusions

This report offers new insights on the performance of affordable housing policies and programs that are designed to move sustainable transportation goals forward. It is crucial that federal, state and regional policies are coordinated to address the spatial imbalances between the locations of jobs and housing, as this will lessen residents' commute burdens and vehicle miles of travel (1, 2). While challenges remain, the promise of California's SB 375 to improve regional commute and housing cost outcomes is largely validated by this research, assuming the requisite policy recommendations are in place.

The re-scaling of housing voucher thresholds holds the potential to dramatically improve the landscape for voucher recipients, increasing the number of units they can afford to access in jobs and transit rich communities. But this comes at a clear cost: a reduction in overall units accessible to voucher holders, and dramatic losses of voucher access in neighborhoods currently affordable to voucher holders. This analysis will prove valuable to the Department of Housing and Urban Development, local public housing authorities, local governments and local advocacy organizations all concerned with optimizing the effectiveness of housing voucher programs. Additional analysis should explore how this policy change may affect one other aspect of voucher recipients housing experience: namely the ability to access higher quality units.

Affordable housing proximate to rail does not show signs of being systematically more expensive than other projects, offering hope that further integration of housing and transportation planning may not be as expensive as the literature sometimes suggests. We also showed in Chapter 4 that other policy factors may actually be more pronounced in driving affordable housing costs upward, like mandatory common areas, parking requirements and prevailing wage requirements. Affordable housing developers, financiers and agencies, both in and outside of California, can benefit from this research, which will hopefully inspire other more detailed examinations of affordable housing development cost trends.

While the results of this report are promising, caution is warranted. Professionals in the field of affordable housing have described the policy process in California like “a Christmas Tree” or “the center of the spokes on a bicycle” anecdotally when providing feedback on this report. What they mean is that for new housing funding to be approved in California, it must always intersect with the interests of other political coalitions concerned with transit, food access, air quality, solar power, education, public health, racial justice or immigrants’ rights, to name just a few. In the coalition building process, the focus on simply providing adequate, affordable and available housing can be lost. This can mean costs rise and funding does not create as many roofs over the heads of those in need as it could. The significance of these results and the promise they offer for integrating affordable housing with sustainable transportation do not undermine in any way, the fact the primary purpose of the programs studied here are to house people who would otherwise be severely rent burdened or homeless.

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