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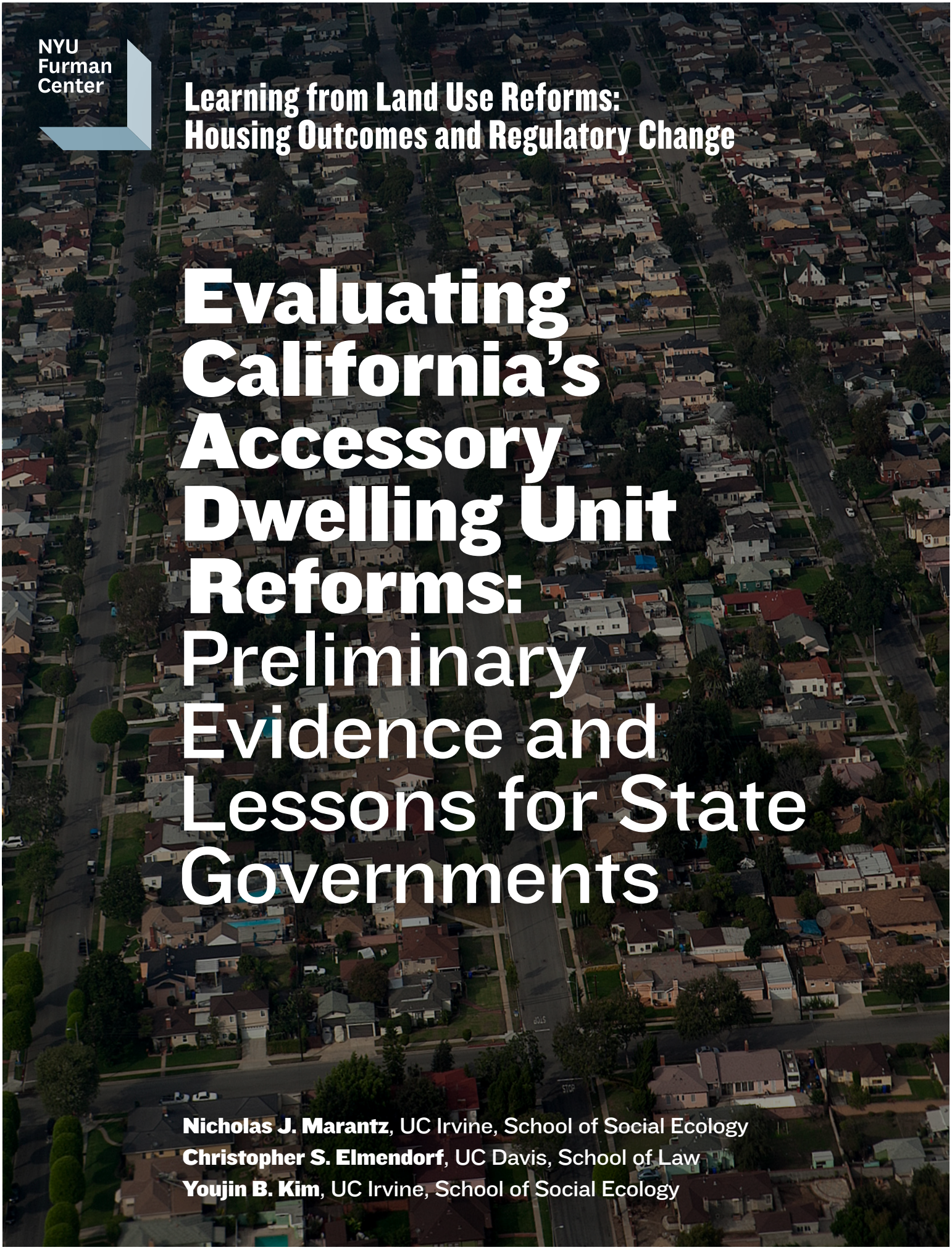
Learning from Land Use Reforms: Housing Outcomes and Regulatory Change

Evaluating California's Accessory Dwelling Unit Reforms: Preliminary Evidence and Lessons for State Governments



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Abstract

Since 2016, California has adopted several laws to facilitate the development of accessory dwelling units (ADUs), which are secondary units on residential parcels. This paper analyzes ADU permitting in the Bay Area and southern California under the newly liberalized legal regime. It uses statistical models to describe the geography of ADU development and to identify the parcel-, neighborhood-, and jurisdiction-level characteristics that are associated with ADU permitting. These analyses indicate, among other findings, that ADUs represent a substantial share of recent housing permits, that ADUs are typically permitted on parcels with relatively good access to jobs, and that the relationship between a neighborhood's ethno-racial composition and the prevalence of ADU permitting varies by county. In addition to providing guidance for state and local governments seeking to understand the likely payoff from liberalizing ADU regulation, our analyses and statistical models can help California's housing department—which is charged with policing cities' ADU regulations—to set priorities for enforcing the new laws.

Introduction

Housing advocates have long touted accessory dwelling units (ADUs)—secondary units on residential parcels—as a potential tool to address soaring housing costs in coastal metro areas. As compared with denser forms of infill development, ADUs have several potentially appealing characteristics. First, ADUs are frequently invisible from the street—they are located in back yards, existing secondary structures, or converted interior spaces, such as attached garages. Thus, as compared with multifamily housing, ADUs may be a more politically palatable way to add much-needed housing supply in single-family neighborhoods of high-cost metropolitan areas. Second, in any given neighborhood, ADUs tend to be more affordable than single-family housing, because the units are relatively small and typically have fewer amenities (e.g., lower ceiling heights, less natural light). Third, ADUs provide an opportunity for multigenerational households to enable family members to age in place.

Although ADUs may be a *relatively* politically palatable form of new development, they have engendered plenty of opposition too. In 1982, California passed its first state law limiting local governments' authority to restrict ADU development, and in 2002 the legislature made cities permit ADUs "ministerially," that is, without subjecting project applications to any discretionary standards or conditions of approval. But, even after the 2002 reforms, many cities still found ways to thwart the state's pro-ADU policy.[1] Between 2016 and 2020, the legislature enacted multiple statutes again strengthening state ADU law, and it appears that the new reforms are finally unlocking ADU potential. While California did not collect data on ADU production prior to 2018, a study of seven major California cities found a more than tenfold increase in ADU applications from 2015 to 2017.[2]

In this paper, we analyze ADU permitting under the newly liberalized California regime with descriptive data and regression models. Our descriptive analysis sheds light on the prevalence and geography of ADU permitting. Using regression models, we seek to understand which parcel-level characteristics are associated with ADU permitting and whether jurisdiction-level features that are plausibly indicative of local political support for ADUs correlate with ADU permitting. The latter exercise has at least two practical applications. First, it should help other state and local governments understand the likely payoff from liberalizing ADU regulation, conditional on parcel characteristics. Second, it should help California's housing department, which is charged with policing cities' ADU regulations, set priorities.

Our descriptive analyses demonstrate that ADUs represent a substantial share of recent housing permits, that ADUs are typically permitted on parcels with relatively good access to jobs, and that there are heterogenous relationships between a neighborhood's ethnoracial composition and the prevalence of ADU permitting. Our regression models indicate that ADUs are more likely to be permitted on larger parcels and on parcels with multiple structures (e.g., a house and a detached garage, rather than just a house). There is a nonlinear relationship between rents and ADU permitting, with ADU permitting being less likely to occur in neighborhoods where rents are very low or high, relative to rents in the low-to-middle range. In addition, cities with more HOAs permit fewer ADUs, other things equal. During our study period (2018-2021), the legislature passed new state laws

1. Margaret F. Brinig and Nicole Stelle Garnett, "A Room of One's Own? Accessory Dwelling Unit Reforms and Local Parochialism," *Urban Lawyer* 45 (2013): 519–69, https://scholarship.law.nd.edu/law_faculty_scholarship/286/.

2. David Garcia, "ADU Update: Early Lessons and Impacts of California's State and Local Policy Changes," *California Department of Housing and Community Development*, December 2017, https://www.hcd.ca.gov/policy-research/docs/accessory-dwelling-unit-update_terner-center_december-2017.pdf.

overriding HOA rules against the development and rental of ADUs. However, the negative association between HOA density and ADU permitting remained as strong at the end of our study period as it was at the beginning. This may be due to subversion of the new state laws; alternatively, it may reflect a lack of awareness, or perhaps a historical pattern in which people who are more change-resistant selected into jurisdictions with a high density of HOAs and now own the parcels to which ADUs could be added.

Our study area consists of the nine-county San Francisco Bay Area and five Southern California counties (Los Angeles, Orange, Riverside, San Bernardino, and Ventura). Collectively, these counties represent 67 percent of the state's population, and 82 percent of the parcels receiving ADU permits during our study period. We restrict the analysis to parcels zoned for single-family development, because these were the parcels that the California legislature targeted for regulatory relief.

The paper proceeds as follows. First, we describe the regulatory changes adopted by the California legislature and their potential impacts on ADU permitting. Second, we explain the challenges that remain for ADU regulation in California. Third, we explore patterns in ADU permitting in the Bay Area and Southern California. Fourth, we provide an approach for state regulators to evaluate local ADU permitting performance, as is required by California law.

We conclude by discussing three important implications for land-use law and housing policy. First, the impact of laws liberalizing ADUs will likely hinge on the characteristics of parcels and neighborhoods. Such state interventions are more powerful tools in some places than others. Second, mandates for local governments to liberalize ADU permitting should be accompanied by data collection requirements and enforcement provisions, as has been the case in California. Third, as we demonstrate, with good data it is possible to create quantitative measures to set priorities for state agencies' review of local zoning ordinances for compliance with state standards.

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Background

California has a significant housing affordability problem, which ADU development could mitigate. As of January 2023, the median rent in California was roughly 41 percent higher than the national median, and rents in the state's high-cost cities were far higher.[3] For example, in the Silicon Valley city of Palo Alto, the median rent was 89 percent higher than the national median.[4] There is widespread recognition that the high cost of housing in California stems largely from supply constraints, including barriers to greater density in existing residential neighborhoods.

Moreover, California faces serious pressures to reduce the need for development at the urban fringe, and therefore to produce housing by intensifying residential densities in areas that are already urbanized. The state confronts increased risk of wildfires at the wild-land-urban interface and has adopted ambitious goals to reduce greenhouse gas emissions, in part by cutting per capita vehicle miles traveled (VMT). In addition, as noted above, ADUs provide an opportunity for multigenerational households to enable family members to age in place.

ADUs could thus respond to several pressing needs, by facilitating more intense development of already-developed places and providing a relatively affordable type of housing. Nevertheless, the same forms of neighborhood opposition that frequently thwart efforts to build townhomes and apartments have also, in the past, limited options for ADUs.

California legislators have long recognized the potential benefits of ADUs and the need to address localized opposition. In 1982, the state adopted a law explicitly authorizing municipalities to allow ADUs and prohibiting municipalities from barring ADUs, with some exceptions.[5] Municipalities, however, could still limit ADU development by imposing cumbersome and unpredictable discretionary review requirements on applications for ADUs.[6] As a result, in 2002, the legislature revised the relevant statute to compel non-discretionary review processes for ADUs, among other provisions.[7]

3. "California Rental Market," Zillow, January 23, 2023, accessed January 25, 2023, https://perma.cc/9HMH-VWRV.

4. "Palo Alto, CA Rental Market," Zillow, January 23, 2023, accessed January 25, 2023, https://perma.cc/L33W-FAPV.

5. 1982 Cal. Stat. 5500

6. For examples, see *Desmond v. County of Contra Costa*, 25 Cal. Rptr.2d 842 (Ct. App. 1993) (denying ADU permit based on perceived architectural incompatibility); *Harris v. City of Costa Mesa*, 31 Cal. Rptr.2d 1 (Ct. App. 1994) (denying ADU permit based on concerns with height and neighborhood character).

7. 2002 Cal. Stat. 6847

Nevertheless, a survey of local regulatory responses found that "most California cities appeared to comply with the state mandate by amending their zoning rules to permit ADUs, but they imbedded many costly regulatory requirements within the 'authorization' that dramatically curtail[ed] the likelihood that ADUs [would] actually be developed."[8] Local constraints included "costly off street parking and minimum lot size requirements, … restrictions on the maximum size of the ADU[,] … [and] limits on the ability of owners to lease ADUs."[9]

To address such restrictions, the California legislature again revised the relevant statute in 2016 and 2017. The revisions capped the fees local governments could impose, limited the stringency of dimensional standards (such as setback requirements), and established a strict timeline for reviews of applications.[10] Moreover, these laws limited (and in many cases eliminated) the authority of local governments to impose parking requirements on ADUs. In 2019, the legislature shortened the approval timeline, prohibited municipalities from restricting the right to build ADUs to owner-occupiers, tightened the dimensional standards (e.g., by establishing minimum and maximum square footage requirements for ADUs), and prohibited the imposition of fees on ADUs of less than 750 square feet.[11] Another 2019 bill entitled homeowners to add both an 800 square foot ADU and a smaller "junior ADU."[12] The Legislature also barred homeowners associations (HOAs) from imposing any covenant, condition, or restriction (CCR) that either "effectively prohibits or unreasonably restricts the construction or use of an accessory dwelling unit … on a lot zoned for single-family residential use",[13] and, in 2020, prevented HOAs from restricting the rental of ADUs.[14] In sum, as of 2020, ADUs should have been allowed as-of-right, provided that they were under 800 square feet, no more than 16 feet tall, and had 4-foot setbacks.

8. Brinig and Garnett, "A Room of One's Own? Accessory Dwelling Unit Reforms and Local Parochialism," 547.
9. Brinig and Garnett, "A Room of One's Own? Accessory Dwelling Unit Reforms and Local Parochialism," 547.
10. Senate Bill [SB] 1069, 2016 Cal. Stat. 4945; Assembly Bill [AB] 2299, 2016 Cal. Stat. 5044; AB 494, 2017 Cal. Stat. 4725; SB 229, 2017 Cal. Stat. 4688
11. SB 13, 2019 Cal. Stat. 5559
12. AB 68, 2019 Cal. Stat. 655
13. AB 670, 2019 Cal. Stat. 2515, 2515
14. AB 3182, 2020 Cal. Stat. 3068

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California's challenges in overseeing local ADU reform

Despite these changes, barriers may remain for ADU construction. A 2020 survey of ADU owners indicated that "obtaining local approval to build an ADU was the top challenge associated with adding an ADU," and some surveyed homeowners contended that their local governments had failed to comply with the requirements of the new state ADU laws.[15] The state legislature has attempted to address these remaining hurdles by requiring local governments to submit their ADU ordinances to the California Department of Housing and Community Development (HCD).[16] Based on its review, HCD provides guidance to local governments by suggesting amendments. If HCD finds that an ordinance does not comply with state law and the city fails to revise the ordinance to HCD's satisfaction, the agency may refer the city to the state Attorney General for enforcement.

This approach relies on "police-patrol" oversight as defined by political scientists Mathew D. McCubbins and Thomas Schwartz. Police-patrol oversight is "comparatively centralized, active, and direct," with the regulator (in this case, HCD and the Attorney General) aiming to "detect[] and remedy[] any violations of legislative goals and, by [their] surveillance, discourag[e] such violations."[17] The problem with the police-patrol approach to ADU regulation is that the entities assuming the role of the police—HCD and the Attorney General—have many other responsibilities and limited resources. At its current rate, as we explain below, HCD will not finish its first review of all city and county ADU ordinances until around 2080.

15. Karen Chapple, Dori Ganetsos, and Emmanuel Lopez, "Implementing the Backyard Revolution: Perspectives of California's ADU Owners," California ADU (UC Berkeley Center for Community Innovation, April 2021), https://www.aducalifornia.org/wp-content/uploads/2021/04/Implementing-the-Backyard-Revolution.pdf.

16. Cal. Gov't Code, sec. 65852.2(h)

17. Mathew D. McCubbins and Thomas U. Schwartz, "Congressional Oversight Overlooked: Police Patrols versus Fire Alarms," *American Journal of Political Science* 28, no. 1 (February 1, 1984): 166, https://doi.org/10.2307/2110792.

Thus, HCD needs some way to determine which ordinances to review most closely and whether to refer intransigent cities to the Attorney General. The agency could rely on "fire alarms,"[18] that is, complaints from homeowners, ADU developers, and other interested parties. Indeed, HCD has launched an internet portal for the submission of such complaints. But it's hard to know without substantial investigation whether a complaint reflects a serious problem, an anomalous incident, or a disgruntled complainer.

A more systematic way to set priorities would be to collect data on ADU production and identify jurisdictions that have underperformed relative to fundamentals by modelling outcomes as a function of parcel characteristics. In 2018, California began requiring local governments to report ADU permits with parcel-level identifiers. We use these data to illustrate the proposed approach.

Patterns of ADU permitting in the Bay Area and Southern California

Our data on ADU permitting comes from the annual progress reports compiled by HCD. Although cities in California have long been required to submit information about their housing plans to HCD, a state law adopted in 2017 significantly enhanced the reporting requirements. Most relevant to this study, cities must annually submit a spreadsheet including new housing units that received an entitlement, a building permit, a certificate of occupancy, or any "other form of readiness that was issued during the reporting year."[19] Through a process described in the Technical Appendix, we identified 43,160 parcels in the Bay Area and Southern California with at least one ADU permit.

Table 1 reports both our counts of parcels with at least one ADU permitted from 2018 through 2021 (in the column marked "ADUs") and the results of the U.S. Census Bureau's Building Permits Survey (BPS) for incorporated municipalities in the study area during the same period. The BPS data, which comes from surveys of jurisdictions, includes 275 of the

18. McCubbins and Schwartz, "Congressional Oversight Overlooked: Police Patrols versus Fire Alarms," 165–79.

19. "Housing Element Annual Progress Report (APR) Instructions," *California Department of Housing and Community Development*, 9, accessed September 13, 2022, https://perma.cc/F8XV-A3FE.

280 municipalities in our sample. The survey instructions direct respondents to report all detached ADUs and some attached ADUs.[20] ADUs are not separately reported in the BPS data, so—for example—a detached ADU would be placed in the "1-unit" structure category, along with detached single-family houses.

Given that the BPS count of permits should include a significant (albeit indeterminate) proportion of permitted ADUs, Table 1 suggests that ADUs represent about 13 percent of permits in the Bay Area and around 19 percent of permits in the Southern California study area. Within both regions, there is significant variation. In the Bay Area, Marin County—located on the other side of the Golden Gate Bridge from San Francisco—has the highest proportion of ADUs. But that proportion is driven by the low number of total units permitted from 2018-2021 per capita in Marin County (3 units per 1,000 people) as compared with the Bay Area region as a whole (11 units per 1,000 people).[21] In Alameda, Contra Costa, and Santa Clara Counties, all of which have relatively large numbers of total permits, ADUs account for roughly 12 to 15 percent of newly permitted units. San Francisco, which had relatively high per capita permitting (15 units per 1,000 people), had a relatively low proportion of ADUs, perhaps because its housing stock predominantly consists of multi-unit buildings.

As is the case in the Bay Area, in Southern California ADU permitting was higher in the coastal counties (Los Angeles, Orange, and Ventura), where undeveloped, unprotected land is scarcer and rents are higher than in the inland counties (Riverside and San Bernardino). Within Los Angeles County, the City of Los Angeles accounts for 70 percent of ADU permits (and thus 59 percent of total ADU permits in the Southern California study area), even though it accounts for only 40 percent of the population of Los Angeles County (and only 21 percent of the Southern California study area population).

20. Jurisdictions are instructed to report ADUs that are "detached and built on same lot as existing main structure[;] attached and built at the same time the main structure is being constructed[;] attached to main structure via a walkway[;] detached from existing structure but share utilities with main structure[; or] built over an existing detached garage - using the detached garage as the foundation for the ADU." Jurisdictions should not report ADUs that are additions, that require alterations (*e.g.*, a changed roof line in the main structure), or "conversions." See "Form C-404, Report of Building or Zoning Permits Issued for New Privately-Owned Housing Units: OMB No. 0607-0094," U.S. Census Bureau, 2021, accessed September 13, 2022, https://perma.cc/HP4B-4KVZ.

21. The denominator for the per capita statistics is measured as of 2018. See State of California, Department of Finance, "E-4 Population Estimates for Cities, Counties, and the State, 2011-2020, with 2010 Census Benchmark," Data set, May 2022, https://dof.ca.gov/forecasting/demographics/estimates/e-4-population-estimates-for-cities-counties-and-the-state-2011-2020-with-2010-census-benchmark-new/.

Table 1: New units permitted in incorporated areas, 2018-2021, by county

		Units, by structure type (Census Bureau)						ADU/ Census Tot. (%)
	Pop. (2018)	ADUs	1-unit	2-units	3-4 units	5+ units	Census Tot.	
Bay Area	**7,734,987**	**11,575**	**29,830**	**736**	**700**	**56,391**	**87,657**	**13**
Alameda	1,651,760	2,927	6,444	200	363	16,287	23,294	13
Contra Costa	1,143,188	1,143	5,412	132	28	3,615	9,187	12
Marin	262,179	495	418	54	3	204	679	73
Napa	140,340	245	443	4	20	2,433	2,900	8
San Francisco	885,716	840	104	154	102	12,541	12,901	7
San Mateo	770,927	1,899	1,371	38	28	3,619	5,056	38
Santa Clara	1,943,579	3,269	6,757	84	93	14,786	21,720	15
Solano	436,813	257	3,968	4	0	960	4,932	5
Sonoma	500,485	500	4,913	66	63	1,946	6,988	7
Southern California	**18,774,638**	**31,585**	**77,550**	**6,346**	**2,674**	**81,725**	**168,295**	**19**
Los Angeles	10,192,593	26,383	23,623	4,654	669	54,694	83,640	32
Orange	3,186,254	3,032	13,059	738	926	14,310	29,033	10
Riverside	2,397,662	668	23,764	128	491	5,473	29,856	2
San Bernardino	2,150,017	669	14,734	692	448	4,783	20,657	3
Ventura	848,112	833	2,370	134	140	2,465	5,109	16

Note: The Census Bureau aggregates building permit data for the Bay Area municipalities of Clayton, Hercules, Lafayette, Orinda, and Moraga with unincorporated Contra Costa County. This table omits these jurisdictions and all unincorporated areas.

Sources: *ADU data*: California Department of Housing and Community Development, "Housing Element Annual Progress Report (APR) Data by Jurisdiction and Year," Data set, July 28, 2022, https://data.ca.gov/dataset/housing-element-annual-progress-report-apr-data-by-jurisdiction-and-year.; *Building Permit Survey data*: U.S. Census Bureau, "Building Permit Survey," Data set, September 14, 2022, https://www2.census.gov/econ/bps/Place/West%20Region/.; *Population data*: State of California, Department of Finance, "E-4 Population Estimates for Cities, Counties, and the State, 2011-2020, with 2010 Census Benchmark," Data set, May 2022, https://dof.ca.gov/forecasting/demographics/estimates/e-4-population-estimates-for-cities-counties-and-the-state-2011-2020-with-2010-census-benchmark-new/.

Our data indicate that ADUs in the study areas are typically sited on parcels with good access to jobs and acreage sizes comparable to other parcels, in tracts with slightly lower median rents compared to the region as a whole. Figure 1 displays the distribution of tract-level jobs accessibility for the 4,797,176 residential parcels in the Bay Area and our Southern California study area. The x-axes indicate our measure of jobs accessibility, which is the distance-weighted sum of jobs within 50 miles of the centroid for the tract in which a parcel is located. This distance-weighted measure, detailed in the Technical Appendix, means that closer jobs are more heavily weighted than jobs that are farther away. The y-axis indicates the proportion of parcels at each level of jobs accessibility. The distribution of parcels by job accessibility differs substantially between the Bay Area and the more sprawling Southern California region, but in both regions, ADUs are more likely to be built on parcels with good jobs accessibility.

Figure I: Distribution of jobs accessibility for residential parcels, by ADU status

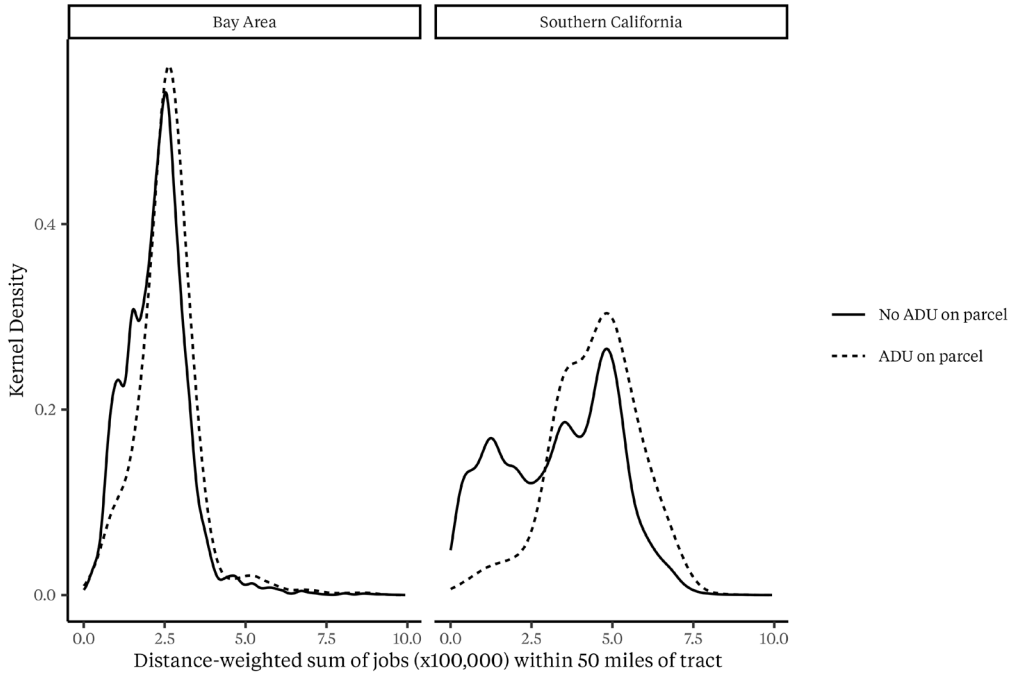

Figure 2 shows that the size of parcels containing an ADU generally mirrors that of all other residential parcels, although the smallest residential parcels are relatively unlikely to include an ADU. Figure 3 shows that, in both the Bay Area and Southern California, ADUs tend to be located in census tracts that have relatively low rents. At first glance, this is surprising, since the rental or for-sale value of an ADU is obviously higher in places with higher rents. But it may be that the disamenity value of an ADU to the occupant of a parcel's primary residence (loss of privacy or yard space) is greater in markets with higher rents.[22] Notably, this finding contrasts with earlier research examining ADU permitting through 2019 and finding that most permits were issued in tracts with median household incomes in the top two quartiles statewide.[23]

22. It is also possible that some owners of single-family homes in high-rent locations are opting not to develop ADUs because they anticipate that their parcel will be rezoned for denser, more valuable forms of development in the future, such as fourplexes or small apartment buildings. In 2021, California passed a law authorizing lot splits and duplexes in lieu of ADUs on most single-family home parcels (See SB 9, 2021 Cal. Stat. 4129), and a state policy to affirmatively further fair housing is also putting some pressure on local governments to allow multifamily housing in neighborhoods where it has been excluded in the past (see "Affirmatively Furthering Fair Housing: Guidance for All Public Entities and for Housing Elements," California Department of Housing and Community Development, April 2021, https://www.hcd.ca.gov/community-development/affh/docs/affh_document_final_4-27-2021.pdf). But given the longstanding resistance to dense development in single-family home neighborhoods, we would be surprised if homeowner expectations about future multifamily development opportunities accounted for the lack of ADU development in high-rent areas. (The lot-split and duplex bill has generated very little development activity thus far (see David Garcia and Muhammad Alameldin, "California's HOME Act Turns One: Data and Insights from the First Year of Senate Bill 9," UC Berkeley Terner Center for Housing Innovation, January 18, 2023, https://perma.cc/N9LT-GS25).)

23. Karen Chapple, David Garcia, Eric Valchuis, and Julian Tucker, "Reaching California's ADU Potential: Progress to Date and the Need for ADU Finance" (UC Berkeley Terner Center for Housing Innovation & UC Berkeley Center for Community Innovation, August 2020), https://ternercenter.berkeley.edu/wp-content/uploads/pdfs/Reaching_Californias_ADU_Potential_2020.pdf. Our findings are inconsistent with those of Chapple et al. even if we restrict our analysis to 2018 and 2019.

Figure 2: Distribution of residential parcel acreage, by ADU status

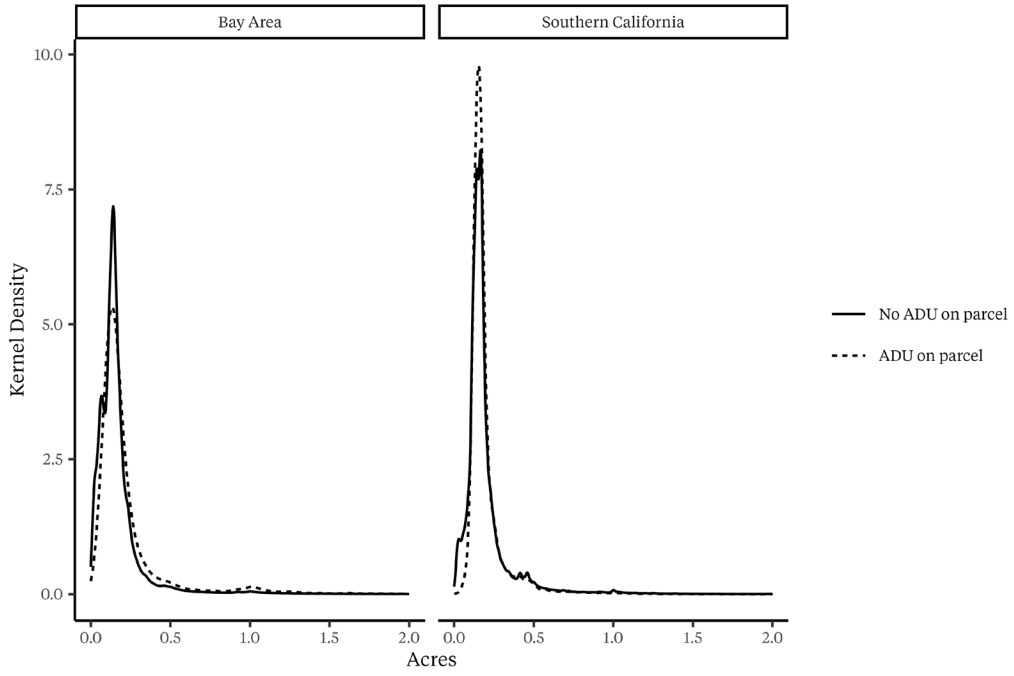

Figure 3: Distribution of tract-level median gross rent, by ADU status, for residential parcels

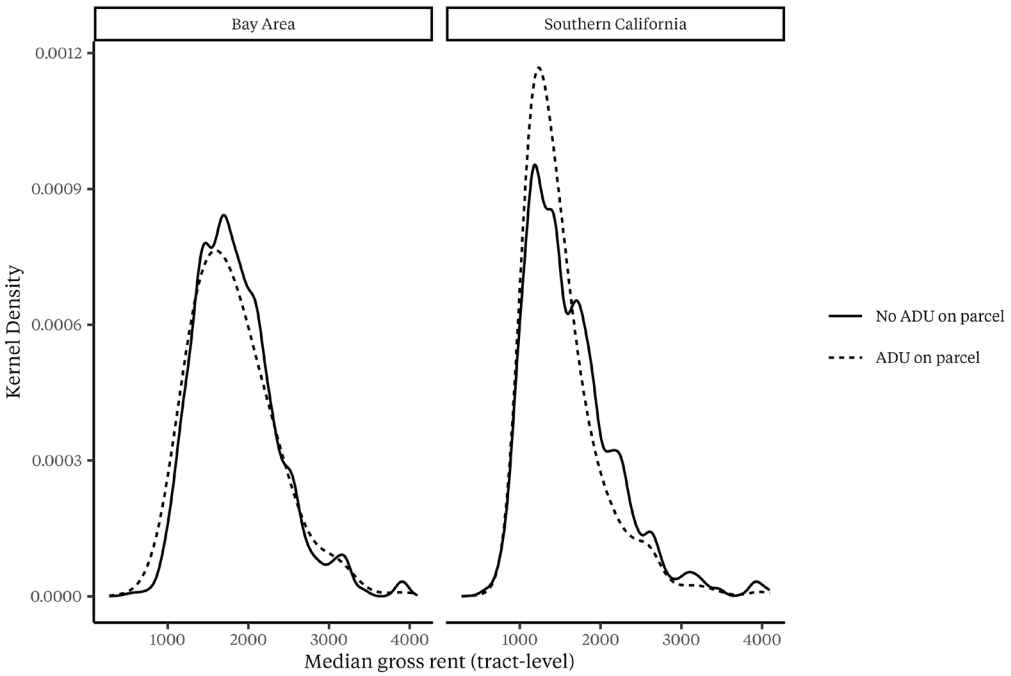

Table 2 presents statistical relationships between the ethno-racial characteristics of neighborhoods (census tracts) and the prevalence of ADU permitting. In most of the counties in our sample, there is a negative correlation between a census tract's proportion of parcels with an ADU and the percentage of the tract's population identifying as Asian. Conversely, tracts that have relatively large populations identifying as Hispanic or Latino tend to have more ADUs, although this relationship obtains more in Southern California than in the Bay Area. There is no consistent relationship between ADU permitting and Black or white population shares.

Table 2: Tract-level pairwise correlations between the proportion of residents in ethno-racial categories and the proportion of single-family parcels with ADU permits

	% Asian	% Black or African American	% Hispanic or Latino	% White
Bay Area counties				
Alameda	-0.32	0.19		0.2
Contra Costa				
Marin	-0.46			
Napa	-0.37			
San Francisco				
San Mateo	-0.19			
Santa Clara	-0.16			0.16
Solano		0.43	0.22	-0.3
Sonoma	-0.33			
Southern California counties				
Los Angeles	-0.08		0.08	
Orange	0.35		0.22	-0.42
Riverside	-0.13	-0.14	0.17	
San Bernardino		-0.12	0.26	-0.18
Ventura	-0.24		0.38	-0.33

Note: This chart displays only coefficients that are statistically significant at $p < 0.05$.

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What are the characteristics of municipalities where ADUs are permitted?

To assess whether different municipal-level attributes are related to ADU permitting, we estimate a random effects regression model, detailed in the Technical Appendix, which includes parcel-level, tract-level, and city-level attributes. The parcel-level characteristics in our models are land area and the number of existing structures, because we expect the probability of ADU development to increase with a parcel's size and the number of structures it contains. (Homeowners may perceive converting an existing structure to be the least expensive option for creating an ADU, or one which minimally impinges on their yard space.) Our tract-level variables are the median gross rent for the tract, which proxies for the rent of a home on the parcel,[24] and the proportion of the tract's land area consisting of vacant land, which proxies for alternative development opportunities.

The city-level variables are population, the percentage of housing units that are owner-occupied, and the intensity of HOAs. Marantz & Lewis find that city population is associated with more multifamily housing development, after controlling for a variety of variables that could affect the supply of and demand for such housing. This may suggest a more generally permissive attitude vis-à-vis development (including ADUs).[25] We include the percentage of occupied housing units in the municipality that are owner occupied, because—in jurisdictions where owner-occupied housing predominates—homeowners' "concerns about home values and potential neighborhood disruption are … very likely to find an outlet in local politics and a receptive ear from local elected officials."[26] We also include a measure of HOA intensity, as HOAs may limit ADU development by private regulation, by social pressure, or by local electioneering and lobbying. Recall that California did not preempt HOA restrictions on ADU development until 2019, and HOA restrictions on ADU rentals

24. For tracts where the median gross rent is topcoded in the American Community Survey data, we take the median of gross rents in excess of $3,500 (the topcoded value) for the overlapping public use microdata area from census microdata. For tracts missing gross rent data (e.g., because all housing in the tract is owner-occupied), we then impute rents by regressing rents on home values for tracts with non-missing values.

25. Nicholas J. Marantz and Paul G. Lewis, "Jurisdictional Size and Residential Development: Are Large-Scale Local Governments More Receptive to Multifamily Housing?," *Urban Affairs Review*, January 23, 2021, https://doi.org/10.1177/1078087420988598.

26. Paul G. Lewis and Nicholas J. Marantz, *Regional Governance and the Politics of Housing in the San Francisco Bay Area* (Temple University Press, 2023), 8.; See also: William A. Fischel, "The Homevoter Hypothesis: How Home Values Influence Local Government Taxation, School Finance, and Land-Use Policies," Harvard University Press, 2001, 344, https://doi.org/10.2307/j.ctv1p6hp64.

were enforceable until 2020. We are therefore interested to see whether the correlation between HOA intensity and ADU production changed in 2019 and 2020 as these new laws went into effect. Finally, we include tract-level rent as both a continuous variable and (in separate specifications) as a categorical variable representing quintiles of the rent distribution, in order to gain a more nuanced understanding of the types of parcels that have attracted ADU development.

We restrict the regression sample to single-family parcels, because the relevant revisions to state law impose uniform maximum standards that municipalities may use "to evaluate a proposed accessory dwelling unit on a lot that includes a proposed or existing single-family dwelling."[27] We further restrict the sample to urbanized areas (as defined by the Census Bureau), because—for purposes of evaluation—we are interested in whether state law has leveled the playing field for permitting ADUs in such areas. We focus on cities, rather than unincorporated areas because (1) cities generally have significantly better jobs accessibility than unincorporated areas; (2) the large majority of ADU development has occurred in cities; and (3) the politics of land-use regulation may differ significantly between cities and unincorporated areas, where counties regulate land-use and may take a hands-off approach.[28] We also drop parcels of less than 1,000 square feet and more than two acres, as well as parcels with more than four structures. Table 3 reports summary statistics of the unstandardized regression model variables.

27. Cal. Gov't Code, s. 65852.2(a)(6)

28. Michelle W. Anderson, "Sprawl's Shepherd: The Rural County," California Law Review 100, no. 2 (April 2012): 365–80, https://www.jstor.org/stable/23239882.; Jacquelyn Chase, "Bending the Rules in the Foothills—County General Planning in Exurban Northern California," Society & Natural Resources 28, no. 8 (July 13, 2015): 857–72, https://doi.org/10.1080/08941920.2015.1045643.

Table 3: Summary statistics for regression model variables

	Variable	N	Mean	SD	Min	Max
(1)	ADU Parcel (2018)	7,500	NA	NA	NA	NA
(2)	ADU Parcel (2019)	8,380	NA	NA	NA	NA
(3)	ADU Parcel (2020)	8,245	NA	NA	NA	NA
(4)	ADU Parcel (2021)	10,654	NA	NA	NA	NA
(5)	ADU Parcel (2018-2021)	34,779	NA	NA	NA	NA
(6)	Parcel sq. ft. (2016)	3,569,148	8,437	6,552	1,000	87,119
(7)	Structures on parcel (N)	3,569,148	1.3	0.5	1	4
(8)	Vacant land as proportion of tract land area (2011)	3,569,148	0.13	0.23	0.00	0.99
(9)	Tract median gross rent ($) (2012-2016)	3,569,148	1,723	567	276	4,096
(10)	City population (N) (2012-2016)	3,569,148	633,174	1,238,281	954	3,918,872
(11)	City owner-occupied residences (%) (2012-2016)	3,569,148	55.9	13.2	14.9	96.5
(12)	City HOA intensity (%) (2016)	3,569,148	11.0	13.3	0.0	70.3

Notes: For the dichotomous variables ((1)-(5)), N is the number of observations for which the variable equals one. The vintage for each variable is given in parenthesis. For variable (7), the precise vintage was not available but, as discussed in the Technical Appendix, predates 2018.

Sources: (1)-(5) "Housing Element Annual Progress Report (APR) Data by Jurisdiction and Year," Data set (California Department of Housing and Community Development, July 28, 2022), https://data.ca.gov/dataset/housing-element-annual-progress-report-apr-data-by-jurisdiction-and-year. (6) "2016 Land Use Information for Los Angeles, Orange, Riverside, San Bernardino, and Ventura Counties," Data set (Southern California Association of Governments, 2021), https://gisdata-scag.opendata.arcgis.com/datasets/.; "ParcelAtlas," Data set (Boundary Solutions, 2022), https://www.boundarysolutions.com/BSI/ParcelAtlas/pagel.html. (7) Microsoft, "Github.Com-Microsoft-USBuildingFootprints_-_2018-06-30_09-52-29," Data set, June 2018, https://archive.org/details/github.com-Microsoft-USBuildingFootprints_-_2018-06-30_09-52-29. (8) Steven Manson et al., "IPUMS National Historical Geographic Information System," Database (University of Minnesota, 2022), http://doi.org/10.18128/D050.V17.0. (9)-(11) American Community Survey, 2012-2016. (12) "Historical Property Basic; Mortgage," Data set (CoreLogic, 2016).

One potential concern about the interpretation of our model is that some ADUs permitted from 2018 through 2021 were probably built illegally prior to that period. We are unable to distinguish ADUs that went through the permitting process after being built from ADUs that were permitted prior to construction. We expect, however, that applications for ADU amnesty would be more common in the year or two immediately following the relevant reforms, and we therefore run regression models for each year, removing from the sample parcels on which an ADU was permitted in a prior year.

Table 4 displays the results from our random effects model, which enables us to assess whether different city-, tract-, and parcel-level attributes are related to ADU permitting. Here, we display only the pooled specifications that combine all four years of the study period. As noted above, we also analyze each year separately, and we present the annual results in the Technical Appendix. In the pooled specifications, a standard deviation increase in lot

size (i.e., 6,552 square feet) is associated with a 16 percent increase in the odds of an ADU being permitted on the parcel, and an additional structure on a parcel is associated with a 33 to 34 percent increase in the odds of an ADU being permitted on the parcel.

Table 4: Random effects regression model, for all ADUs permitted 2018-2021

	(1)		(2)	
Characteristic	OR[1,2]	SE[2]	OR[1,2]	SE[2]
Parcel sq. ft. (std)	1.16***	0.006	1.16***	0.006
Structures on parcel	1.33***	0.011	1.34***	0.011
Tract median gross rent (std)	0.83***	0.006		
Median rent quintile				
1			—	—
2			1.17***	0.019
3			1.01	0.018
4			0.85***	0.017
5			0.65***	0.014
Tract proportion vacant (std)	0.74***	0.009	0.74***	0.009
Log city population (std)	0.81	0.097	0.8	0.095
City owner-occupied residences (std)	0.94	0.076	0.94	0.075
City HOA intensity (std)	0.71***	0.057	0.71***	0.057
No. Obs.	3,569,148		3,569,148	

[1] *p <0.05; **p<0.01; ***p<0.001

[2] OR = Odds Ratio, SE = Standard Error

On average, tract-level gross rents are negatively related to ADU permitting—a standard deviation increase in median rent (i.e., $567) is associated with a 17 percent decrease in the odds of an ADU being permitted on the parcel. But this average negative relationship masks non-linearities, as illustrated by dividing rents into quintiles. Relative to parcels in the first (i.e., lowest) quintile tracts ($276 - $1,230), the odds of an ADU being permitted increase by 17 percent for parcels in tracts with second quintile rents ($1,231 - $1,483). In the third quintile ($1,484 - $1,774), both the direction and the statistical significance of the results are sensitive to the year of measurement, and in the pooled model the results are not statistically significant. For parcels in the fourth and fifth quintiles tracts (with median rents of respectively, $1,775 - $2,145 and $2,146 - $4,096), the odds of receiving an ADU permit are lower than for parcels in first quintile tracts (15 percent lower in the fourth quartile and 35 percent lower in the fifth quintile). As expected, the proportion of land in a tract that is vacant is negatively associated with the odds that a parcel received an ADU permit.

Among the city-level variables, only HOA intensity (which is only moderately correlated with owner-occupancy) is statistically significant. A standard deviation increase in HOA intensity (13.3 percentage points) is associated with a 29 percent decrease in the odds of an ADU being permitted on a parcel. Notably, as the annual models in the Technical Appendix indicate, the correlation between HOA intensity and ADU production did not weaken over the course of the four-year study period. It may be that HOAs have found extra-legal ways to thwart ADU production notwithstanding the changes in state law. Or maybe homeowners are not yet aware of their right to build and rent an ADU in derogation of HOA rules. Still another possibility is that the people who selected into cities with a large proportion of HOAs are, on average, more averse to neighborhood change than people who bought elsewhere, and this aversion to change makes them less interested in adding an ADU to their property.

The proportion of owner-occupied residences is negatively associated with ADU permitting, but this relationship is not statistically significant in any specification. Contrary to expectations, the log of population is negatively associated with the odds of a parcel receiving an ADU permit, but the association is statistically significant only in the 2018 and 2019 specifications, indicating that the relationship (to the extent that it exists at all after controlling for the other variables) varies by year.

A strategy for monitoring local compliance with state ADU law

Due to many municipalities' longstanding efforts to undermine state laws intended to foster ADU production, California requires HCD to review local ADU ordinances. HCD must notify municipalities of any defects, and—if a non-compliant municipality does not satisfactorily amend its ordinance—HCD may refer the matter to the state Attorney General.[29] Between October 2018 and October 2022, HCD reviewed ordinances for 35 jurisdictions (33 municipalities and 2 counties).[30] There are 482 municipalities and 58 counties in California. Thus, at its current average rate of 8.75 ordinances per year, HCD will finish reviewing all city and county ordinances sometime around 2080.

29. Cal. Gov't Code, sec. 65852.2(h)

30. California Department of Housing and Community Development, "Accessory Dwelling Units (ADU); ADU Ordinance Review Letters," Microsoft Excel, Data set, 2022, https://www.hcd.ca.gov/sites/default/files/docs/policy-and-research/ordinance-review-letters/adu-ordinance-review-letters.xlsx.

Clearly, HCD must somehow prioritize its review, but the relevant statute does not provide criteria to guide review. The relevant legislative command to HCD presumes that HCD will review every city and county ADU ordinance—a pure police-patrol approach, with a patrol for every jurisdiction. The available evidence suggests that HCD may already be prioritizing its review to focus on jurisdictions where review might have a bigger payoff. Table 5 compares attributes of the 33 cities whose ordinances HCD has reviewed with cities whose ordinances HCD has not reviewed. On average, the 33 municipalities that have undergone review have better jobs accessibility, higher rents, higher median household incomes, and a higher population than municipalities without reviewed ordinances. (The Technical Appendix details the construction of our standardized measure of jobs accessibility.) T-tests of the differences in means are statistically significant for jobs accessibility and median gross rent.

Table 5: Comparison of Municipalities, Based on ADU Ordinance Review by HCD

	Mean values	
	Not reviewed	Reviewed
	(N = 433)	(N = 33)
Jobs accessibility (std)	**-0.05**	**0.63**
Median gross rent ($)	**1,611**	**1,891**
Median household income ($)	85,252	96,125
Total population	55,216	243,365

Notes: Bold face font indicates that a t-test of means is statistically significant at $p < 0.05$. Sixteen California cities are missing from the sample of unreviewed cities; three of these do not have median rent data in the ACS, and jobs accessibility scores could not be calculated for thirteen small or recently incorporated cities, as explained in the Technical Appendix.

That said, it is not entirely clear whether HCD is intentionally targeting its reviews based on the attributes included in Table 5. For example, HCD has reviewed the ADU ordinance of the City of Needles, which is located in the Mojave Desert, has a population of 4,959, a median gross rent of $623, a median household income of $33,265, and the lowest jobs accessibility score of any municipality in the state.

Even assuming HCD is directing its reviews to some extent, however, there is a need for improved targeting. HCD should target its reviews not only at large and centrally-located places, but also at those where local barriers are most likely to be found. Simply counting the number of ADU permits that a municipality has issued would be inappropriate for this purpose, precisely because many of the factors that drive demand for ADUs are beyond a municipality's capacity to address: the attributes summarized in Table 5 are largely outside

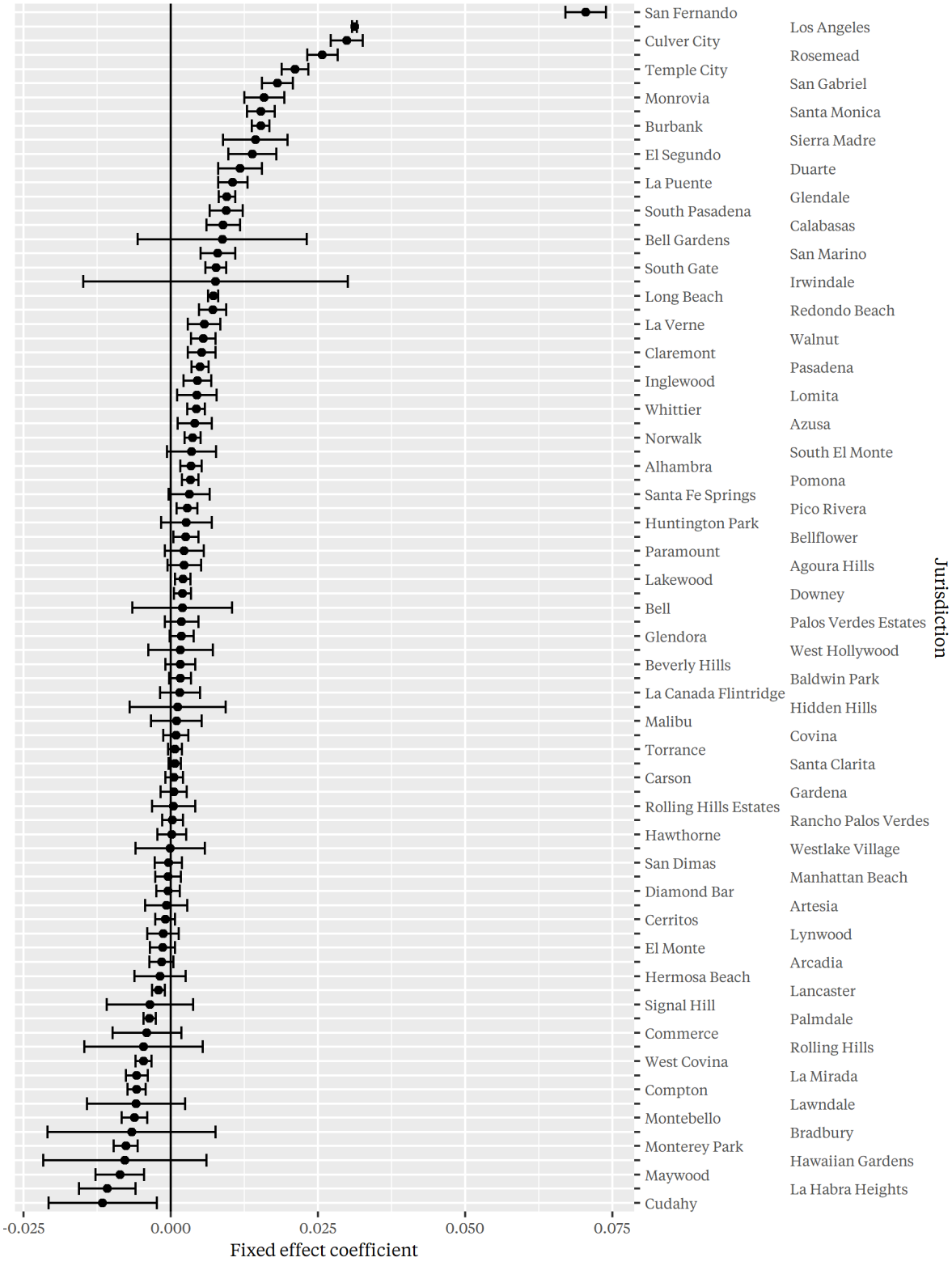
of a municipality's control. By statistically controlling for some of these external factors, we provide a method for HCD to better target its oversight to those municipalities that need to amend their ordinances to facilitate ADUs.

Using our sample of single-family parcels in the Bay Area and Southern California, we assess the probability that a parcel received an ADU permit from 2018 through 2021 as a function of (1) the median gross rent in the census tract where the parcel is located (both as a continuous variable and binned into quintiles); (2) the proportion of the census tract consisting of vacant land; (3) the area of the parcel; (4) the number of buildings on the parcel; and (5) the municipality where the parcel is located. (The Technical Appendix describes these variables in greater detail.) Median gross rent serves as a proxy for housing demand; the proportion of vacant land in a census tract indicates the availability of substitutes for ADU development (i.e., detached single-family houses); the buildable area of a parcel indicates the amount of unbuilt land available for an ADU, and parcels with more existing structures should more easily be able to accommodate an ADU in one of those structures. We include a fixed effect for each municipality, which captures the residual effect on ADU permitting of a parcel's location in a particular municipality, after controlling for the other variables. This approach is superior to simply counting the proportion of single-family parcels receiving an ADU permit, because the latter strategy would not account for parcel-level and neighborhood-level attributes that are largely outside the control of local governments.

Figure 4 illustrates the application of this model to municipalities in Los Angeles County.[31] The dots illustrate the city-level coefficient indicating the probability of a typical parcel, with typical tract-level characteristics (rents and vacant land), receiving an ADU permit if the parcel and tract were located in that city. The black lines on either side indicate the 95 percent confidence interval around the point estimate. Thus, for example, in the City of San Fernando, where eight percent of single-family parcels had ADUs permitted from 2018 through 2021, the fixed effect coefficient indicates that a single-family parcel is 6.7 to 7.4 percent more likely than the mean single-family parcel in Southern California and the Bay Area after holding equal rents, tract-level vacant land, parcels' buildable area, and the number of existing structures on those parcels.

31. Although there are 88 cities in Los Angeles County, our sample includes only 85. Two cities, Industry and Vernon, have no single-family zoning, and we were unable to match building footprint data for Avalon, the only incorporated area on the otherwise uninhabited Santa Catalina Island.

Figure 4: Jurisdiction fixed effects, with 95% confidence intervals



If all jurisdictions were equally likely to permit ADUs, after controlling for parcel- and tract-level characteristics, then we would expect zero (indicated by the vertical line) to be within the confidence interval for 95 percent of all jurisdictions. The fact that zero is within the 95 percent confidence interval for only 47 percent of the jurisdictions in Los Angeles County (and 37% of the jurisdictions in our full sample) suggests that additional city-level factors continue to affect ADU production.

One factor HCD should consider in setting review priorities is whether a jurisdiction's fixed-effect is negative, and significantly so. These municipalities are permitting fewer ADUs than expected, given the attributes of the relevant parcels and neighborhoods. As Figure 4 illustrates, in Los Angeles County the most extreme outliers are Cudahy, La Habra Heights, Maywood, Monterey Park, Montebello, La Mirada, Compton, West Covina, Palmdale, and Lancaster. Notably, only two of these jurisdictions (West Covina and Palmdale) had been reviewed as of October 2021.

To be sure, other factors should figure into priority setting too, such as jobs accessibility and the number of parcels in a jurisdiction that are prime candidates for adding an ADU. Of the above-mentioned poor performers in Los Angeles County, seven of the remaining eight jurisdictions are in the top quartile of jobs accessibility among cities statewide, and six are in the top decile.

Notably, the demographics of the seven unreviewed jobs-accessible jurisdictions vary significantly (Table 6), suggesting that HCD might tailor its responses based on the needs of different jurisdictions. For example, the median annual household income in these jurisdictions ranges from $47,050 (in Cudahy) to $181,591 (in La Habra Heights), and homeownership rates in these two cities are, respectively, 14 percent and 92 percent. A low-resourced city, such as Cudahy, where renters predominate, may face different challenges in accommodating ADUs as compared with a high-resourced city, such as La Habra Heights. By identifying underperformers, our model can thus be used for prioritizing technical assistance as well as for prioritizing enforcement.

This prioritization strategy for review need not be restricted to ADUs. For example, California legislation adopted in 2022 to promote mixed-income and below-market-rate residential development on parcels zoned for commercial use involves a similar review-and-refer structure. The law requires by-right approvals for projects that meet standards governing

affordability, density, union labor, and location.[32] HCD is charged with reviewing local implementation of this requirement and, when necessary, making referrals to the Attorney General. Just as HCD can use our technique to identify cities where ADU permitting on single-family parcels lags based on parcel and neighborhood characteristics, so too could it identify cities where residential permitting on commercially zoned properties lags.

Table 6: Characteristics of unreviewed, underperforming, and jobs-accessible cities in Los Angeles County

	Compton	Cudahy	La Habra Heights	La Mirada	Maywood	Montebello	Monterey Park
Population							
Total	96,083	23,003	5,651	47,957	25,477	62,828	61,153
% Asian	1	0	20	21	1	13	65
% Black or African American	27	1	0	2	0	1	1
% Hispanic or Latino	69	96	20	44	97	80	27
% non-Hispanic white	1	2	50	30	1	6	6
% foreign born	29	43	28	26	48	37	52
% below poverty line	17	29	2	6	21	11	11
Median household income	62,297	47,050	181,591	97,672	54,535	66,584	68,497
Housing							
Total units	24,921	5,775	1,970	14,679	6,332	19,119	20,318
% detached single-family	65	43	98	79	54	49	56
% owner occupied	57	14	92	77	27	44	51
Median gross rent	1,329	1,443	NA	1,774	1,227	1,543	1,627
Median value	423,000	434,200	945,800	629,900	481,800	557,400	667,300

Source: 2017-2021 American Community Survey

32. AB 2011, 2022 Cal. Legis. Serv. Ch. 647 (West)

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Conclusion

Our analysis shows that the impacts of laws liberalizing ADUs will likely hinge on the characteristics of parcels and neighborhoods. In the Bay Area and Southern California, larger parcels and parcels with more structures are more likely to receive an ADU permit, after controlling for a variety of tract- and city-level attributes. On average, tract-level gross rents are negatively related to ADU permitting, but this average negative relationship masks non-linearities, as ADUs are more likely to be permitted in lower-middle income tracts (i.e., those in the second quartile of the income distribution) than in low-income tracts (i.e., those in the first quartile). Among the city-level variables that we included in our regression model, only HOA intensity is consistently related to ADU permitting, and the relationship is negative. Notably, the new California laws that preempted HOA restrictions on ADU development (in 2019) and ADU rental (in 2020) did not weaken the correlation between HOA intensity and ADU production.

Our analysis also shows that requirements for local governments to liberalize ADU permitting should be accompanied by data collection and enforcement provisions, as has been the case in California. With good data it is possible to create quantitative measures to set priorities for state agencies' review of ADU ordinances. As we demonstrate, state agencies can develop relatively simple quantitative models to prioritize their review of local laws. By prioritizing their review of local ordinances, these agencies can target technical assistance where it is most needed and, if necessary, focus enforcement actions where they may be most effective.

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Technical Appendix

Our data on ADU permitting comes from the annual progress reports (APRs) compiled by HCD.[33] Each city's APR must include the current assessor parcel number (APN) and street address for every reported development project. A city's APR must also report the type of project, based on a list that includes ADUs. A single project may appear multiple times in HCD's compiled APR dataset if, for example, the project receives a building permit in one year and a certificate of occupancy in a subsequent year. In addition, HCD does not validate the APR data, and—as a result—the dataset includes some erroneous APNs.

In order to generate an unduplicated count of parcels on which at least one ADU was approved from 2018 through 2021, we first filter the compiled APR data from HCD to include only ADUs in the study counties. We then select rows that are uniquely identified by jurisdiction, APN, and street address. We merge this dataset with parcel data from the Southern California Association of Governments and Boundary Solutions, which maintains a proprietary database of digitized parcel boundaries.[34] The Southern California Association of Governments (SCAG) parcel data includes consistent information on zoning and land use as of 2016, but the Boundary Solutions data (which covers the Bay Area) does not. For the Bay Area, we combine geodata compiled by the Othering & Belonging Institute, which categorizes residential zoning as of 2020.[35]

We drop parcels in unincorporated areas, because our analytical focus is cities, for reasons described in the main text. We are able to merge 52,480 (96%) of the 54,584 ADU observations from HCD. We create a unique ID for each parcel and reduce the dataset to one observation per unique ID, creating an unduplicated count of 43,160 parcels with at least one ADU permit.

We merge the ADU permit data with tract- and jurisdiction-level demographic data, which comes from the 2012-2016 American Community Survey (ACS) and predates our first year of ADU data (2018), mitigating concerns about endogeneity. Data on HOAs comes from CoreLogic, a firm that aggregates data from county assessors and recorders. For each property in its mortgage dataset (including properties mortgaged as of 2016), CoreLogic

33. California Department of Housing and Community Development, "Housing Element Annual Progress Report (APR) Data by Jurisdiction and Year," Data set, July 28, 2022, https://data.ca.gov/dataset/housing-element-annual-progress-report-apr-data-by-jurisdiction-and-year.

34. Southern California Association of Governments, "2016 Land Use Information for Los Angeles, Orange, Riverside, San Bernardino, and Ventura Counties," Data set, 2021, https://gisdata-scag.opendata.arcgis.com/datasets/.; Boundary Solutions, "ParcelAtlas," Data set, 2022, https://www.boundarysolutions.com/BSI/ParcelAtlas/page1.html.

35. Stephen Menendian et al., "Single-Family Zoning in the San Francisco Bay Area: Characteristics of Exclusionary Communities," Data set (Othering & Belonging Institute, 2020), https://github.com/OtheringBelonging/BayAreaZoning.

indicates whether a condominium rider or a planned unit development rider was recorded. We initially planned to use these indicators to create a parcel-level variable identifying whether a property is covered by an HOA's CCRs, following Clarke and Freedman,[36] but analysis of the data suggests a high probability of false negatives. Since the recordation of riders does not appear to vary systematically by county (i.e., our concerns about under-counting apply to all counties in our sample), we create a jurisdiction-level measure of the proportion of mortgaged properties with a relevant rider, providing a relative measure of the extent to which potential ADU sites in a jurisdiction are encumbered by an HOA's CCRs. The footprint data comes from Microsoft Maps, which derives building footprints by applying computer vision algorithms to satellite raster imagery. Microsoft's publicly available building footprint data is periodically updated, so—in order to ensure that the building footprints predate our study period—we obtain archival data from archive.org, which Microsoft posted to GitHub on June 13, 2018.[37] Although the archived dataset does not include the capture date for the footprints, we believe that most (if not all) were captured prior to 2018, both because the data were posted in 2018 and because as of March 2021, a Microsoft employee indicated that the average vintage was roughly 2012.[38]

We generate our measure of jobs accessibility by calculating the distance-weighted sum of jobs within 50 miles of census tract centroids (in the case of Figure 1) and block group centroids (in the case of Table 5). We use a linear decay function, following Salon,[39] who notes that weighting by inverse distance squared "quickly renders jobs beyond 10 miles to have little effect on the [jobs accessibility] variable," which is problematic in the California context. The census tract and block group distances come from the National Bureau of Economic Research (NBER),[40] and the job counts come from the 2016 vintage of the Work-place Area Characteristics dataset from the Longitudinal Employer-Household Dynamics database.[41] For Table 5, we aggregate the jobs accessibility data to the city level by weighting each block group in a city by the proportion of the city's population aged 18-64 living in the block group and aggregating the weighted values by city. Block group *BG* is assigned to

36. Wyatt Clarke and Matthew L. Freedman, "The Rise and Effects of Homeowners Associations," Journal of Urban Economics 112 (July 1, 2019): 1–15, https://doi.org/10.1016/j.jue.2019.05.001.

37. Microsoft, "Github.Com-Microsoft-USBuildingFootprints_-_2018-06-30_09-52-29," Data set, June 2018, https://archive.org/details/github.com-Microsoft-USBuildingFootprints_-_2018-06-30_09-52-29.

38. Nikola Trifunović, "[Information Request] Time Period of Source Imagery · Issue #58 · Microsoft/USBuildingFootprints," GitHub, March 8, 2021, https://github.com/microsoft/USBuildingFootprints/issues/58.

39. Deborah Salon, "Quantifying the Effect of Local Government Actions on VMT," California Air Resources Board (Institute of Transportation Studies, University of California, Davis, February 14, 2014), 18, https://ww2.arb.ca.gov/sites/default/files/classic//research/apr/past/09-343.pdf.

40. National Bureau of Economic Research, "Block Group Distance Database," Data set, 2014, https://www.nber.org/research/data/block-group-distance-database.

41. U.S. Census Bureau, "Longitudinal Employer-Household Dynamics," Data set, 2016, https://lehd.ces.census.gov/data/.

city *C* if more than 50 percent of the population of *BG* lives in *C*. As a result, we are unable to generate values for eleven small cities that consist exclusively of block groups in which 50 percent or less of the population lives in the city. Because the NBER dataset is based on 2010 vintage census data, we are also unable to generate values for two cities that incorporated after the 2010 Census.

To assess whether different city-level attributes are related to ADU permitting, we estimate a random effects model, in which the city-level variables are given a model which is estimated simultaneously with the parcel-level regression. Our random effects model takes the following form:

$$\Pr(\mathrm{ADU}_{i,j} = 1) = \mathrm{logit}^{-1}(\beta^0 + \beta^{\mathrm{P}} * \mathrm{P}_{i,j} + \alpha_j + \epsilon_{i,j}),$$
$$\alpha_j \sim \mathrm{N}(\beta^{\mathrm{C}} * \mathrm{C}_j, \sigma^2),$$

where $\Pr(\mathrm{ADU}_{i,j} = 1)$ is the probability of an ADU being permitted on parcel *i* in city *j* during the study period, $\mathrm{P}_{i,j}$ is a column vector of parcel-level characteristics, α_j is determined through a group-level model based on a vector of attributes *C* for city *j*, and $\epsilon_{i,j}$ is a vector of errors.

For the purpose of policy analysis, we use a fixed effects model, which assigns coefficients and standard errors to each city, enabling us to compare city performance after controlling for parcel-level characteristics that may affect ADU development. Our fixed effects model takes the following form:

$$y_{i,j} = \beta^{\mathrm{P}} * \mathrm{P}_{i,j} + \beta^{\mathrm{FE}} * \mathrm{FE}_j + \epsilon_{i,j},$$
$$\epsilon_{i,j} \sim \mathrm{N}(0, \sigma^2),$$

where $y_{i,j}$ is the probability of an ADU being permitted on parcel *i* in city *j* during the study period, β^{P} and β^{FE} are row vectors of coefficients, $\mathrm{P}_{i,j}$ and $\epsilon_{i,j}$ are defined above, and FE_j is a column vector of fixed effects equal to one if parcel *i* is in city *j* and zero otherwise. We omit the intercept term, because we are interested in evaluating jurisdictions with respect to the population mean, rather than a reference jurisdiction. We pool the permitting data over the four-year study period to limit the influence of any single year on the evaluation of municipal permitting performance.

As described in the main text, the parcel-level characteristics in our models include parcel area, the number of existing structures, and the median gross rent for the tract (measured both as a continuous variable and divided into quintiles), and the proportion of land in the tract that is vacant. For our random effects models, we add three city-level variables: the log of population, the percentage of housing units that are owner-occupied, and the intensity of homeowners associations. We standardize all right-hand-side variables (other than the count of structures) both for ease of interpretation and to facilitate model fitting. Table A-1 provides estimates from both the pooled model (reported in the main text) and the annual models.

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Table A-1: Random effects regression model

	Pooled				2018				2019				2020				2021			
		(1)		(2)		(1)		(2)		(1)		(2)		(1)		(2)		(1)		(2)
Characteristic	OR[1,2]	SE[2]	OR[1,2]	SE[2]	OR[1,2]	SE[2]	OR[1,2]	SE[2]	OR[1,2]	SE[2]	OR[1,2]	SE[2]	OR[1,2]	SE[2]	OR[1,2]	SE[2]	OR[1,2]	SE[2]	OR[1,2]	SE[2]
Parcel sq. ft. (std)	1.16***	0.006	1.16***	0.006	1.17***	0.012	1.16***	0.012	1.18***	0.012	1.17***	0.012	1.14***	0.012	1.14***	0.012	1.16***	0.01	1.16***	0.01
Structures on parcel	1.33***	0.011	1.34***	0.011	1.41***	0.024	1.43***	0.025	1.32***	0.022	1.33***	0.022	1.28***	0.022	1.29***	0.022	1.29***	0.02	1.30***	0.02
Tract median gross rent (std)	0.83***	0.006			0.84***	0.012			0.86***	0.012			0.82***	0.012			0.84***	0.011		
Median rent quintile																				
1			—	—			—	—			—	—			—	—			—	—
2			1.17***	0.019			1.34***	0.046			1.25***	0.041			1.09*	0.037			1.08*	0.032
3			1.01	0.018			1.16***	0.043			1.07*	0.037			0.94	0.034			0.94*	0.03
4			0.85***	0.017			0.94	0.04			0.94	0.037			0.75***	0.032			0.83***	0.03
5			0.65***	0.014			0.69***	0.031			0.69***	0.029			0.62***	0.027			0.65***	0.025
Tract proportion vacant (std)	0.74***	0.009	0.74***	0.009	0.71***	0.018	0.71***	0.019	0.72***	0.018	0.72***	0.018	0.77***	0.018	0.77***	0.018	0.75***	0.015	0.75***	0.015
Log city population (std)	0.81	0.097	0.8	0.095	0.60**	0.102	0.59**	0.099	0.73*	0.109	0.72*	0.105	0.78	0.103	0.78	0.104	0.88	0.116	0.88	0.117
City owner-occupied residences (std)	0.94	0.076	0.94	0.075	0.86	0.101	0.86	0.1	0.87	0.09	0.88	0.089	0.87	0.077	0.87	0.077	0.99	0.088	0.99	0.088
City HOA intensity (std)	0.71***	0.057	0.71***	0.057	0.75*	0.088	0.74*	0.086	0.69***	0.071	0.69***	0.07	0.71***	0.063	0.71***	0.063	0.75**	0.066	0.75***	0.065
No. Obs.	3,569,148		3,569,148		3,569,148		3,569,148		3,561,648		3,561,648		3,553,268		3,553,268		3,545,023		3,545,023	

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