Risk Disclosure and Home Prices: Evidence from California Wildfire Hazard Zones

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Damages from wildfires have increased dramatically in recent years. This study uses a boundary discontinuity design to estimate the effect of wildfire hazard disclosure on house prices. Using the universe of single-family sales transactions from the Zillow ZTRAX program in California from 2015 through 2022, we find that, on average, homes that faced disclosure requirements sold for approximately 4.3 percent less than nearby homes that did not. Price impacts are higher in recent years, following several damaging wildfires. Our findings highlight the use of disclosure regulations to ensure that disaster risks are reflected in housing markets.

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1. Introduction

The growing exposure of people and property to natural hazards such as floods and wildfires is a significant contributor to the rising costs of disasters in the United States (Higuera et al. 2023). Homes in the wildland-urban interface (WUI), the transition zone between natural and developed lands where the built environment intermingles with forested areas, account for most of the properties lost in wildfires (Kramer et al. 2019). By some accounts, the WUI is the fastest growing land use type in the conterminous US (Radeloff et al. 2018), and more than 600,000 new homes are expected to be built in in high wildfire hazard areas in California alone by 2050 (Mann et al. 2014).

Whether people consider disaster risks when making decisions about where to live, and whether such risks are capitalized into house prices, are open questions. One of the challenges to answering these questions in an empirical setting is causal identification. Disasters, such as floods and wildfire risks, are often highly correlated with natural amenities: proximity to rivers and oceans in the case of floods, and, in the case of fire, forested landscapes, access to public lands, and views. Thus, distinguishing the effect of risks from amenities can be difficult. Furthermore, whether home buyers fully understand risks and how they vary across properties, and the extent to which they incorporate risks in their decision-making is unclear.

Tackling the issue of correlated amenities and missing or incomplete risk information is more straightforward for floods than wildfires due to the fact that the federal government officially designates high flood risk areas, Special Flood Hazards Areas (SFHAs), commonly referred to as the 100-year floodplain. When a home is located in an SFHA, the homeowner is required to have flood insurance when they have a federally backed mortgage on the property and the SFHA
designation must be disclosed upon sale of the property. This provides a spatial delineation of risks. Some studies have combined this spatial distinction with the timing of major flood events in a differences-in-differences hedonic regression (Bin & Polasky, 2004a; Kousky, 2010; Atreya, Ferreira, & Kriesel, 2013; Atreya & Ferreira, 2015; Beltran, Maddison, & Elliott, 2019). Others have used a boundary discontinuity design, comparing home sales in close proximity to, and on either side of, the SFHA boundary to isolate the effect of flood risks on home prices (Bakkensen & Ma 2020).

The wildfire setting has some important differences from the flood setting. Insurance is generally provided through standard homeowners insurance policies, not a wildfire-specific policy, and there is not a federally mapped high wildfire hazard zone. It is thus unclear the extent to which homebuyers understand the risks when purchasing a home in wildfire-prone areas. Perhaps for these reasons, the literature on hedonic pricing of wildfire risks is thin.

In California, however, wildfire risks may be better understood among homebuyers than in other states, at least in some locations. California law requires that sellers of properties in certain designated wildfire hazard areas disclose this information to buyers. Wildfire hazard disclosure requirements are determined based on properties’ locations with respect to mapped wildfire hazard categories and the jurisdiction responsible for wildfire management. Where the State of California is responsible for wildfire management, so-called State Responsibility Areas (SRAs), disclosure is required anywhere the state classifies as a Fire Hazard Severity Zone (FHSZ). In areas where local jurisdictions are responsible for managing wildfires, Local Responsibility Areas (LRAs), disclosure is required only in very high FHSZs. In this study, we refer to these two types of areas where disclosure is required as “regulated” and identify, throughout the state, the geographic boundaries between regulated areas and unregulated areas. We then focus on the
extent to which wildfire risk disclosure affects home prices, which provides some evidence, in turn, on how wildfire risk may affect homebuyer’s decisions.

We use a boundary discontinuity design (BDD, see for e.g. Black, 1999; Turner, Haughwout, & Van Der Klaauw, 2014; Bakkensen & Ma, 2020) comparing sales of homes that are nearby but on either side of a regulated area boundary. The primary identifying assumption required under this research design is that while disclosure requirements change abruptly at the boundary, unobserved variables that may be correlated with wildfire hazard vary continuously across it, at least within some distance band close to the boundary. Using the fact that disclosure requirements are also determined by wildfire management responsibility—i.e., whether a property is in an SRA or LRA—we compare nearby properties that face similar levels of fire hazard but different disclosure requirements. Specifically, in our main results, we compare prices of nearby homes within high FHSZs that do and do not face wildfire hazard disclosure requirements.ii In this way, our empirical methods should isolate the effect of risk disclosure on home prices.

Using data from the Zillow ZTRAX program on home sales in California from 2015 through 2022, a period of unprecedented wildfire activity and damages, we find that, on average, high FHSZ homes within 300-m of the regulated area boundary that faced disclosure requirements sold for approximately 4.3 percent less than homes within 300-m that did not face these requirements. Consistent with expectations, homes within moderate FHSZs also sold for less if they were subject to disclosure requirements; the discount is 2.6 percent. We investigate geographic heterogeneity in our results by estimating separate regressions for northern and southern California. The estimated impacts are stronger in southern California. When we estimate separate effects by year, we find that the magnitude of the price discount increases in
the later years of our sample, 2020 and 2021, which followed several years of large and damaging fires.

This study contributes to a literature that attempts to uncover household risk preferences with respect to natural hazards and the effect that these hazards have on home prices. Within this literature two primary empirical approaches have been used. First, many studies in the flood context (e.g. Bin & Polasky, 2004b; Kousky, 2010; Bakkensen, Ding, & Ma, 2019; Gibson & Mullins, 2020), have used difference-in-differences approaches that make use of hazard events for identification. A common finding is that prices within high-hazard areas decline relative to low-hazard areas following nearby hazard events, but that these declines are short-lived, usually lasting no longer than 2-3 years. In one of the few studies applying the difference-in-differences approach to wildfires, McCoy and Walsh (2018) use data from Colorado and find a price discount for properties in high wildfire risk areas after a fire and that the discount is larger and more immediate for properties that have a view of a burn scar from a recent fire. Another study, Huang and Skidmore (2023), in the same issue as the present paper, studies the effects of smoke on home prices and finds that smoke induced by upwind fires decreases home values for up to three years.

A second somewhat less common approach in the literature has been to use policy-based information treatments. Studies adopting this approach have often analyzed changes in house prices using difference-in-differences strategies centered on adoption or revisions to disclosure policies or hazard maps. For example, Pope (2008) found that following the implementation of a flood risk disclosure law in North Carolina in 1996, the prices of homes in SFHAs declined by approximately 4% relative to homes outside SFHAs. Donovan, Champ, & Butry (2007) found that following the online publication of wildfire risk ratings in Colorado Springs, Colorado,
wildfire risk, which had previously been positively correlated with home price, became negatively correlated.

A few studies using policy-based information treatments have also used boundary discontinuity designs. Bakkensen & Ma (2020) use SFHA boundaries to identify flood risk preferences from home prices. They find that home prices are approximately six percent lower just inside the flood zone, where buyers tend to receive more information about flood risks, even though flood risk varies continuously across, and in close proximity to, the flood zone boundary. Finally, in the study most closely related to this one, Garnache (2020) analyzes how revisions to California’s FHSZ maps affect house prices. Focusing on seven counties in southern California, Garnache (2020) compares changes in home prices just outside a new boundary to changes in home prices just inside and finds that newly regulated homes drop in price by between 3 and 6 percent.

Hedonic studies in other contexts have estimated the impact of information and disclosure programs on property sales prices and rents. Most notably, several studies have found that energy and “green” property certifications, which typically provide a label or “score” to indicate energy efficiency and other hard-to-observe environmental features of properties, tend to increase prices and rents. These results have been found for residential (Walls et al., 2017; Brounen & Kok, 2011) and commercial properties (Brolinson, Palmer, & Walls, forthcoming; Eichholtz, Kok, & Quigley, 2013).

Our paper makes several key contributions to the relatively small literature estimating the capitalization of wildfire hazard into home prices. First, we make use of very recent data, from 2015 through 2022, a period during which wildfire damages in California rose dramatically. Second, our data set includes transactions from across California rather than small geographic
areas common in many hedonic analyses. This facilitates use of the BDD approach and allows us to consider spatial heterogeneity across regions of the state. Third, while our main results use a pooled cross section-time series dataset with seven years of data, we also estimate our model on separate single-year cross sections. This addresses the critique that, due to changes in population and preferences, samples using multiple years may mix different hedonic equilibria, obscuring the interpretation of the estimates as a welfare measure (Kuminoff & Pope, 2014; Banzhaf, 2021). Further, by estimating our model separately by year, we are able to consider how preferences to avoid wildfire hazard may have changed over our study period. Finally, our empirical strategy, using regulated boundaries in areas classified as having the same level of fire hazard, achieves the twin goals of isolating the impacts of risk disclosure requirements and reducing omitted variables bias from unobserved amenities that are correlated with wildfire hazard.

2. Wildfire Hazard Disclosure Laws in California

California law requires sellers of properties in designated wildfire hazard areas to disclose this information to buyers in a Natural Hazard Disclosure (NHD) statement, which is used for disclosure of a variety of state and federally-designated hazards (Troy & Romm, 2007). The NHD statement, which warns property buyers about hazards, as well as the potential for challenges in obtaining insurance and developing the property, is mandated to be disclosed prior to escrow, at which point buyers have a three-day period during which they are allowed to back out of the purchase.

For wildfire, disclosure requirements are determined based on the degree of wildfire hazard (i.e., the Fire Hazard Severity Zone) and the jurisdiction responsible for wildfire management in the
location (i.e., “responsibility areas”). Within California, jurisdictional responsibility for wildfire management is divided across Federal Responsibility Areas (FRAs), State Responsibility Areas (SRAs), and Local Responsibility Areas (LRAs), areas where the Federal, State, or local governments, respectively, have financial responsibility for managing wildfires. These areas roughly correspond to federal lands, unincorporated non-federal lands, and lands under the jurisdiction of a local fire department.\(^iv\)

The wildfire hazard component of disclosure requirements is based on Fire Hazard Severity Zone maps. Within SRAs, moderate, high, and very high FHSZs are designated by CAL FIRE based on fire history, vegetation, and modeled predictions of fire behavior. Within LRAs, CAL FIRE makes recommendations regarding the boundaries of FHSZs; however, local communities make the final decision regarding whether these are adopted. Most communities across California have done so.\(^v\) During the period of our data, disclosure regulations and building codes applied to only very high FHSZs within LRAs. Other FHSZ classifications were not formally adopted within LRAs, but CAL FIRE maintains data on modeled fire hazard levels in these areas. As a result, local and state responsibility areas within the state now comprise three FHSZ classifications. Table 1 shows the combination of responsibility areas and FHSZs where disclosure is and is not required.

Building codes requiring fire-resistant building materials, as well as maintenance of areas clear of vegetation (“defensible space”) around homes were implemented in California beginning in the 1990s, and substantially strengthened in 2008 with passage of the “Chapter 7A” building codes, which included requirements for house siding, eaves, vents, doors, windows, and decks, in addition to requiring fire-resistant roofing materials for new construction.\(^vi\) Like the disclosure requirements, building codes applied to all FHSZ categories in SRAs and to the very high FHSZ
category in LRAs. In our main analysis, we focus our attention on sales of properties built prior to 2008 to focus on disclosure impacts to prices and reduce effects of building codes.

3. **Empirical Strategy**

A basic model of the effect of wildfire hazard on home prices is given by the equation:

\[
\ln(p_{i,t}) = \alpha + \beta x_{i,t} + \gamma z_{i,t} + \delta w_{i,t} + \nu_t + \epsilon_{i,t}
\]

where the dependent variable \( \ln(p_{i,t}) \) is the logarithm of housing price for property \( i \) sold at time \( t \). \( x_{i,t} \) represents the property's structural characteristics; \( z_{i,t} \) represents neighborhood characteristics attached to the property at time \( t \), where we have separated out wildfire risk \( w_{i,t} \), our neighborhood characteristic of interest; \( \nu_t \) represents time period fixed effects (e.g., year and month of sale); and \( \epsilon_{i,t} \) denotes an idiosyncratic term that is unobserved by the researcher.

Recovering implicit prices of wildfire risk requires that buyers are informed of and attentive to the wildfire risks they face. It is unclear whether this full information requirement can be satisfied for homes in wildfire hazard areas since there are no federally-mapped wildfire zones and there is no separate wildfire insurance policy requirement. Thus, unknowing buyers might have been willing to pay less for a property with high wildfire hazard had they known about the exposure risk; ignoring imperfect information over risks would attenuate willingness to pay to avoid those risks. Our focus on the price capitalization of disclosure helps us understand the extent of the information problem in hedonic valuation of wildfire risks.

To accomplish this, we exploit spatial variation in where disclosure laws in California enforce provision of information about wildfire hazard. Specifically, we define a binary treatment
variable \( \text{Regulated}_{i,t} \) equal to 1 if the property is located in a State Responsibility Area (SRA) or in a Local Responsibility Area (LRA) with a very high FHSZ designation, and 0 otherwise.

When California's Chapter 7A building codes were passed in 2008, the wildfire hazard disclosure requirement coincided with additional construction requirements for newly-built homes. Therefore, we focus on sales of properties built before 2008, when building codes for new properties built in regulated areas were much less stringent; we argue that differences in price for regulated and unregulated homes built during this period are therefore likely to be driven by differences in disclosure requirements.

In addition, we face the prevalent problem of omitted variable bias. While we have collected data on a host of neighborhood amenities (e.g., proximity to protect lands and school quality), it is impossible to collect all relevant neighborhood information that covaries with wildfire hazard. This is particularly true because the same attributes that drive wildfire hazard---e.g. proximity to forests or other wildlands---are also valued as an amenity by many homebuyers.

We attempt to alleviate the omitted variables problem with various strategies. First, we include fixed effects at high spatial resolution and allow for county-specific time trends (Kuminoff, Parmeter, & Pope, 2010). Second, we focus on a sample of property sales near the disclosure regulatory boundary, and compare properties on either side of the same boundary segment, similar to a regression discontinuity design (Imbens & Lemieux, 2008). The identifying assumption in this design is that while disclosure requirements vary discontinuously at the regulated-unregulated boundary, unobserved attributes that affect home price do not; if amenities and other attributes do not change discretely at the regulatory boundary, any change in price at the boundary should be attributed to disclosure of wildfire risks.
Regulated areas are defined in part as a function of wildfire hazard (see section 2). We are concerned that in places where regulated and unregulated status differs due to differences in designated wildfire hazard severity, there may be differences in unobserved amenities across the boundary, in addition to differences in disclosure requirements. Therefore, we restrict the sample to transactions in only high FHSZs and near boundaries between SRAs and LRAs. This allows us to better control for unobserved variation in amenities that are correlated with disclosure. While this comes at the expense of reducing variation in wildfire risk, we retain variation in wildfire risk regulation. We modify our empirical specification to include these additional fixed effects and sample controls:

$$\ln(P_{i,t}) = \alpha + \beta X_{i,t} + \gamma Z_{i,t} + \delta \text{Regulated}_{i,t} + \nu_{c(i),t} + \nu_{b(i)} + \nu_{g(i)} + \epsilon_{i,t}$$  \hspace{1cm} (2)$$

\[ \forall i \ s.t. \ BoundaryDist_i < |B \ km|, \ FHSZ_i = \text{high}, \]

\[ BoundaryType_{b(i)} = \text{high FHSZ LRA/high FHSZ SRA} \]

where $\nu_{c(i),t}$ represents county-by-year fixed effects, $\nu_{b(i)}$ represents fixed effects for the boundary segment nearest to each transacted property, and $\nu_{g(i)}$ represents fixed effects at the 250km$^2$ grid cell level (which we discuss in greater detail in Section 4). We limit the sample to high FHSZ properties within B km of boundaries between high FHSZ LRAs (unregulated) and high FHSZ SRAs (regulated). Our sample limitation, in conjunction with the boundary and grid cell fixed effects, allow us to identify effects of hazard disclosure on property values by comparing the sales of properties on either side of the same regulated boundary.

A potential problem created by the use of the LRA-SRA boundary for identification is that LRA-SRA boundaries frequently coincide with boundaries between incorporated and unincorporated
areas, which may differ with respect to taxes, regulations, and public good provision.

Fortunately, there exist unincorporated LRAs; therefore, it is possible to separate the effect of being in an incorporated area from the effect of wildfire hazard disclosure.

Our empirical strategy importantly assumes that homebuyers in areas where disclosure is not regulated are mostly unaware of wildfire risk, or at least are less aware of wildfire risk than homebuyers in areas where disclosure is regulated. This is similar to assumptions in studies of flood risk and home certification schemes for energy efficiency, i.e., that disclosure through flood maps or “green” labels provides information that homebuyers would otherwise not have. If this assumption is violated in our setting, our estimates of wildfire risk disclosure will be biased towards zero. We evaluate the effectiveness of our strategy when we present our findings.

4. Data

This study uses data on home sales prices provided by the Zillow ZTRAX program. ZTRAX data include both comprehensive transactions records and assessors' data. Transaction records provide information about property sale dates and prices; they can be linked within the ZTRAX database to the assessors' data to provide information on the characteristics of each property. Property characteristics included in the assessors' data include lot size, the year buildings on the property were built, square footage, number of bedrooms, number of bathrooms, and an array of other building and property characteristics.

From the Zillow ZTRAX database, we assembled a data set describing property sales in California from 2015 to March 2022. We focused on years since 2015 because in this time California has experienced a dramatic increase in wildfire activity and damages from wildfires;
as of January 2022, fourteen of the most destructive wildfires in California state history had occurred since 2015 (California Department of Forestry and Fire Protection, 2022b). Further, we restrict our data set to arms-length purchases of single-family residential homes. We also drop transactions that include the exchange of multiple distinct properties. After these sample restrictions, we are left with an initial data set containing 1.56 million observations.

For each transacted property in the data set, we use CAL FIRE spatial data to identify the location relative to responsibility areas and fire hazard zones, and to measure distance from the boundary between “regulated” areas (where disclosure laws apply) and “unregulated” areas (where they do not). A map of FHSZs within SRA and LRA areas is included in panel A of Figure 1. A more detailed view of FHSZs in a single county, San Diego County, is provided in panel B. As the state map shows, SRAs cover a larger land area. However, among properties in FHSZs, nearly 70 percent of transaction observations in (352,000 out of 519,000) correspond to properties in LRAs.

Following a procedure described by Bakkensen and Ma (2020), we divide boundaries between regulated and unregulated areas into discrete segments using the Polygon to Line tool in ArcGIS, and we measure the distance from each transacted property to its nearest boundary segment. Our design makes use of boundary fixed effects to ensure that we are identifying differences in price between properties on either side of the same boundary segment. Therefore, it is important that boundary segments are neither too long (in which case boundary fixed effects would insufficiently account for differences across neighborhoods) nor too short (in which case boundary effects would eliminate too much variation from our sample).
Our boundary segments are 3.4 km on average, and on average there are 1,183 transacted properties nearest to each one. We judge this to be a reasonable length. Nevertheless, boundary segments necessarily vary in length and some very long boundary segments result from use of the ArcGIS tool. Therefore, in addition to boundary segment fixed effects, we divide California into a 250-sq. km hexagonal grid and include fixed effects for each cell. For properties along long boundary segments, these cell fixed effects account for differences in home prices across cells that may vary in unobserved neighborhood characteristics that affect home prices.\textsuperscript{xiv}

As discussed in section 3, we are concerned that where boundaries between regulated and unregulated areas exist due to differences in fire hazard, differences in amenities across these areas may confound identification of the effects of disclosure. Therefore, in our primary regressions we restrict our attention only to properties that are closest to boundaries between high FHSZ LRAs and SRAs. These properties face significant wildfire hazards; however, they face different disclosure requirements depending on whether they are within the LRA or SRA. With the sample restricted to properties in high FHSZ areas, our primary final data set contains 164,019 observations over the 2015-2022 period. In robustness checks, we also estimate effects of disclosure requirements for properties in moderate FHSZs.

In addition to the property and structural characteristics obtained from ZTRAX, we assembled property and neighborhood-level covariate variables from a variety of sources. We measure wildfire hazard at the property-level based on Wildfire Hazard Potential (WHP), an ordinal measure created by the US Forest Service to measure the potential for a site to experience a difficult to contain wildfire. We use data on historical fire perimeters from the USGS Monitoring Trends in Burn Severity project to identify transactions for properties that had been within a fire perimeter within five years prior to the year of sale.\textsuperscript{xv} Using the USGS Protected Area Database,
we measure the distance of each property to the nearest area classified under GAP Status 1 or 2, a possible source of amenity values for homeowners. To separate effects of location within incorporated areas, which frequently coincide with the boundary of unregulated LRAs, from exposure to disclosure requirements, we gather data on the extents of California incorporated areas from California Department of Forestry and Fire Protection (2022a). We use Summary File 1 data from the 2010 US Census data to measure the share of white residents within each property’s block group. Finally, we measure school district quality using data from the California Department of Education on the percentage of students in each property’s district who met or exceeded math and language arts standardized testing standards.

Summary statistics for our property characteristics, including transaction value, are included in Table 2. The average price of properties in our sample is $625,000. As expected, fire hazard, measured by WHP, is higher among regulated than unregulated properties. Two percent of properties in our overall sample, and six percent of properties in regulated areas, had been within a fire perimeter in the five years prior to the observed sale. Regulated and unregulated properties are similar with respect to the number of bathrooms and bedrooms; however, regulated properties tend to have greater floor space, smaller lots, and were built more recently, on average. School district quality, as measured by achievement with respect to testing standards, is higher among regulated properties. As well, regulated areas contain a higher proportion of white residents, and they are nearer to protected areas. This is because these properties are often located in rural State Responsibility Areas, which is underscored by the fact that only 47% of regulated properties are within incorporated areas, as compared to 84% of unregulated properties.
5. Results

We begin by using data on property-level wildfire hazard potential (WHP) to explore the raw correlation between WHP and housing prices in our sample. This naive specification demonstrates our concerns about correlated risks and amenities. We then turn to our main results, using the boundary discontinuity approach for property sales in high FHSZ areas for a pooled sample of sales over the 2015-2022 time period. We follow this with two robustness checks—one that includes sales in moderate FHSZs and one that separates the sample into incorporated and unincorporated areas—and specifications that allow for heterogeneity in effects by year and by region.

5.1 Results from Naïve Model

Our concerns regarding estimates of equation 2 can be seen in Table 3, which regresses log housing prices on log wildfire hazard potential (WHP) under different sets of controls to isolate wildfire risk's effect on prices. Evidence that homeowners are willing to pay to avoid wildfire risk is weak. In the specification with tract-level fixed effects, we find that wildfire risk is positively correlated with housing prices (column 3), consistent with Wibbenmeyer & Robertson (2022) and viewshed analyses in McCoy and Walsh (2014). This counter-intuitive result is likely driven by omitted variables bias. The problem is compounded if we assume that buyers are cognizant of the risks when they are not.

5.2 Main Results

In light of the estimates in the previous section, we turn to identifying the effects of wildfire hazard disclosure on home price using the boundary discontinuity design described by equation
2. We first present results that do not limit the sample based on distance to the regulatory boundary in Table 4. The variable of interest is Regulated, which is an indicator for whether a property is located within an area that requires wildfire risk disclosure. All else equal, one would expect the coefficient to be negative. All specifications include the same set of house and neighborhood controls and fixed effects for year and month of sale at baseline. Standard errors are two-way clustered at the county and year level for all specifications.

Column 1 begins with the sample of all house sales. Prices are generally higher in areas with disclosure requirements than areas without. This is unsurprising since disclosure requirements apply in areas with high wildfire hazard—which also tend to be rich in amenities (e.g., proximity to protected areas). This is alleviated when we limit the sample to high Fire Hazard Severity Zones (FHSZs) in column 2. Here, there is still variation in disclosure regulation but reduced unobserved variation in correlated positive amenities, though effects are not precisely estimated. In column 3, we focus on properties built before 2008, so that we remove any confounding effects from additional regulation that apply to houses built in 2008 or later. We then progressively add fixed effects: Column 4 removes correlated price changes due to county-specific trends with the inclusion of county-by-year fixed effects, column 5 includes census tract fixed effects, and finally column 6 adds 250km² grid cell fixed effects to limit the comparison to properties sold within a neighborhood to further control for correlated amenities. With the above controls, we find that property sold in areas that require wildfire risk disclosure sell for 4.9% lower than areas that do not.

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6 This figure is based on applying the Halvorsen-Palmquist correction to the coefficient in column 6 of Table 3 (Halvorsen and Palmquist 198).
We next consider only houses sold in the vicinity of the regulatory boundary. We include boundary fixed effects to compare houses near the same boundary. As well, because boundaries can span long distances, we include 250km$^2$ grid cell fixed effects to control for differences across neighborhoods. Appendix Figure A1 presents a binned scatter plot of logged price at various distances to the regulatory boundary, where the region to the left side of the vertical, dashed line is unregulated and the region to the right is regulated. We fit a fourth-degree polynomial to visualize the trend in prices across the boundary. The figure indicates that prices fall by around 3\% at the boundary. Moreover, the trend in prices suggests that the magnitude of the price decrease would increase if one expanded the sample around the regulatory boundary.

Table 5 presents the point estimates with the sample restricted to diminishing boundary distances, or ‘bandwidths,’ around the boundary. At 10km on either side of the regulatory boundary, we find that disclosure regulation reduces housing prices by 2.5\% \( (p<0.01) \). As we narrow the boundary, the estimated magnitude of the discount increases somewhat (in absolute value). At a bandwidth of 300 meters (our preferred boundary sample), we find that properties in areas that require disclosure sell for a discount of about 4.2\% \( (p<0.01) \). The magnitude of the effect is comparable to existing work using disclosure laws to value wildfire hazard (Troy & Romm, 2007; Garnache, 2020); it is smaller than the effect estimated in McCoy and Walsh (2018) after a major wildfire event. As mentioned above, if homebuyers understand wildfire risks without disclosure, our estimate is biased toward zero. Our finding of a statistically significant negative effect of approximately 4\% within 300 meters of the regulation boundary suggests that indeed disclosure is filling an information gap, which is reflected in differences in house prices.
We investigate the extent to which the price discount that we measure is driven by changes in correlated attributes at the regulatory boundary. We regress a house attribute on an indicator for location within a regulated area, controlling for boundary, grid, county-by-year, and month fixed effects, as well as location within an incorporated area, and present the coefficient on Regulated in Table 6. The results give an adjusted average difference in observed characteristics between the regulated and unregulated sides of the boundary. We estimate these regressions for each attribute using different bandwidths so that each cell in Table 6 presents the coefficient and standard error from a separate regression.

Restricting the sample to a narrow bandwidth around the regulatory boundary does not eliminate differences in observed attributes between regulated and unregulated areas; however, with the exception of distance to protected areas, which is marginally significantly different between regulated and unregulated areas, estimated differences would likely bias our coefficient of interest toward zero. Wildfire hazard, as measured by Wildfire Hazard Potential, is higher in regulated than in unregulated areas, even after restricting the sample to areas classified as high FHSZ. However, as shown in Table 3, WHP is positively correlated with price, other things equal; therefore, we would expect that higher WHP in regulated areas would positively bias our estimates. Nevertheless, within a neighborhood around the boundary between regulated and unregulated areas, we estimate negative effects of disclosure requirements on home price. A similar argument applies for lot size, which we would also expect to positively impact home prices, and language arts test scores. Additionally, while we find differences in WHP at the boundary, we do not detect significant differences in the likelihood of being affected by a wildfire event in the last five years (Within fire). This helps to limit the price effects being driven by other differences associated with disastrous events (e.g., a salience or recency bias). Homes in
regulated areas are further from protected areas, after controlling for other home attributes, which is contrary to expectations given that regulated high FHSZ areas are within typically more rural SRAs.

5.3 Robustness

We next assess the robustness of our estimated effects. Our main estimates focus on high Fire Hazard Severity Zones (FHSZs) in order to limit variation in unobserved heterogeneity while retaining variation in disclosure. We can similarly estimate our effects of interest while focusing on moderate FHSZs because properties in SRAs with moderate fire hazard severity are required to disclose risks while those in LRAs are not. Appendix Table A1 re-estimates the boundary discontinuity regressions under different bandwidths, but for moderate FHSZs. The price discount associated with regulated disclosure ranges from 1 to 2.6 percent for bandwidths between 200 and 400 meters, though estimates are not statistically significant.

In light of earlier evidence that regulated areas coincide with more rural locations, we re-estimate our main boundary discontinuity regressions (with a 0.3km bandwidth) by limiting the sample based on whether the property is located in an incorporated area. We present these results in Appendix Table A2 for both High and Moderate FHSZs. We find that the price discount associated with disclosure is higher in magnitude when limiting to incorporated areas: prices fall by 9.2% \((p<0.01)\) and 3.7% (not statistically significant) for High and Moderate FHSZs, respectively. Impacts for un-incorporated areas are smaller in magnitude (around -2 percent), but effects are not statistically significant. If the price effects we found earlier were driven by regulated areas coinciding with rural areas, then limiting the sample based on incorporation status should attenuate the magnitude of the price effects for all samples.
Our strategy to identify housing price impacts of wildfire risk is based on cross-sectional variation in information disclosure. This strategy lends itself well to investigating the price impacts separately by year, which allows us to recover willingness-to-pay measures that do not require the hedonic equilibrium to be stable over time. Because our sample spans more than six years, changes in population and preferences (for both wildfire risk and other amenities) may mix different hedonic equilibria, which obscures the interpretation of the estimates as a welfare measure (Kuminoff & Pope, 2014; Banzhaf, 2021). We re-estimate our main results for each year from 2015 to 2021 and results are shown in Appendix Table A3 and plotted in Appendix Figure A2. Although not all estimates are statistically significant, estimates are generally more precise once we allow for larger bandwidths of 0.4km or 0.5km, also shown in Appendix Figure A2. Overall, there appears to be an increase in the magnitude of effects of regulated status on home prices over the study period, though differences between coefficients are likely not statistically significant. This downward trend would be consistent with increasing salience of wildfire risk during this period.

5.4 Heterogeneity

Last, we explore geographic heterogeneity in willingness to pay to avoid wildfire risks by estimating our model separately for southern California and northern California. Results are shown in Appendix Table A4. In southern California, regulated status has strong negative effects on house prices at all bandwidths. At the 300 meter bandwidth, there is a 6% reduction in house prices in regulated areas, larger than the effect we find for the state as a whole. All of the coefficients for the northern California region are smaller (in absolute value) than those for southern California, and they are not significantly different from zero. In part, this may be due to
the smaller sample size. But it also may be due to heterogeneity in the high hazard zones in northern California, which cover geographic areas from the wine country counties near the coast to the high Sierras. Southern California high fire hazard areas, by contrast, are more homogeneous, mostly in the coastal ranges and not inland (which is primarily desert).

6. Discussion

In this paper, we use information on home sales in California to estimate the effect of wildfire disclosure on house prices. We address two empirical challenges that arise when attempting to analyze disaster risk impacts in housing markets: (1) risks are positively correlated with amenities and (2) homeowners may be uninformed when making home purchase decisions. We do this by leveraging differences in wildfire risk disclosure requirements established by the State and by using a boundary discontinuity design to compare houses with similar spatial amenities. Specifically, we use data on home sales in areas the state has designated as high wildfire hazard zones but only near the boundary between areas where disclosure is required and areas where it is not.

We find that homes where wildfire hazard disclosure is required sell for 4.3 percent less, on average, than those just across the boundary, where disclosure is not required. The median value of homes in regulated areas near the regulatory boundary is $557,000, thus our results suggest an approximately $21,500 reduction in willingness-to-pay for high hazard homes as result of risk disclosure.

The key identifying assumption in our boundary discontinuity design strategy is that unobserved variables do not vary discontinuously at the regulatory boundary, which is defined jointly by the
boundaries between State and Local Responsibility Areas and by California Fire Hazard Severity Zone boundaries. Unlike previous studies, we focus specifically on boundaries between SRA (regulated) and LRA (unregulated) within high FHSZs. We limit the sample to high FHSZs to allay concerns about correlation between different fire risk levels and unobserved amenities. To address remaining differences between SRA and LRA areas within high FHSZs, notably rurality and incorporation status, we adopt two strategies. First, we control for a broad suite of observable property and neighborhood-specific variables. Second, we collect data on incorporated status, control for effects of incorporated status on price, and in robustness tests, estimate effects of disclosure separately for incorporated and unincorporated areas. While it remains possible that some of our observed effects are driven by unobservable variables, most of the observed variables that appear to differ across the boundary would likely bias our estimated effects upward, toward zero.

The magnitude of our estimates, and how they vary across years and within California, give us some confidence that they reflect homebuyers' attitudes about wildfire hazard and not other factors. They also suggest that disclosure of risks is filling an information gap in the housing market. Our estimates are roughly consistent with those in the (limited) existing literature. Troy & Romm (2007) use the passage of California Assembly Bill 1195 in 1997, which consolidated wildfire hazard disclosure requirements in the state, and found that homes in areas requiring disclosure sell for 5% less if they were near a recent wildfire perimeter than if they were not. Garnache (2020) uses changes in California Fire Hazard Severity Zone maps and a repeat sales approach and finds that properties in Southern California with newly imposed disclosure requirements experience price declines of between 3 and 6 percent.
Our analysis uses data from across California for a recent seven-year recent time period, 2015-2021, which allows us to examine temporal and spatial variation in our estimates. We find that the estimated effects increase in magnitude (in absolute value) over the study period, a period during which wildfire frequency and severity were rising. However, we find sizeable and statistically significant impacts in Southern California, which appear to be driving our estimates for the state as a whole.

Our results have a number of important policy implications. First, they indicate that availability of information regarding risk may be a factor in determining demand for homes in high hazard locations. This is consistent with findings for disclosure of flood risks (Pope, 2008). Second, as wildfire activity and development within high fire hazard areas both continue to increase across the western United States (Abatzoglou & Williams, 2016; Mann et al., 2014; Radeloff et al., 2018), disclosure requirements could play a role in mitigating further increases in exposure to risk. Third, we document heterogeneity in price discounts over time, revealing that concern about wildfire hazard among homeowners may be increasing. Rising insurance premiums within high fire hazard areas could be contributing to this concern, thus an important question for future research is how these changes will shape the future of development and exposure to risk in high fire hazard areas.

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i California divides Fire Hazard Severity Zones within the state into moderate, high, and very high categories. We will discuss these zones in greater detail in section 2.

ii While we limit our main analysis to High FHSZs to control for unobserved wildfire hazard correlates, our results are robust to limiting the sample to moderate FHSZs, where there is also variation in regulation.

iii Almost all counties in California have prepared Community Wildfire Preparedness Plans (CWPP), which are necessary for receiving some sources of federal wildfire mitigation funding (Federal Emergency Management Agency 2020; Jakes et al. 2012). These Plans are another potential source of information about wildfire risk but while they include some risk mapping, they are mainly focused on communicating ways that households can reduce flammable materials and structure ignitability. Homebuyers are not required by law to be informed of a CWPP upon purchase of a home.

iv FRAs do not precisely correspond to federal lands because under a policy known as the ‘balance of acres’ arrangement, state and federal agencies have traded fire responsibilities in some areas to maximize efficiency (Starrs
et al., 2018). Such swaps are especially common in areas with a high degree of checkerboarding due to nineteenth and twentieth century land disposal policies.

Following a map revision process that began in 2007, eventually over 92% of communities CAL FIRE identified as containing very high FHSZs either adopted or believed they had adopted the very high FHSZ maps (Miller, Field, & Mach, 2020). Most communities adopted the very high FHSZs by 2009; however, some communities in southern California adopted hazard zones as late as 2012.

For a more detailed review of changes over time in California building codes related to wildfire hazard, see Baylis & Boomhower (2022).

Data are provided by Zillow through the Zillow Transaction and Assessment Dataset (ZTRAX). More information on accessing the data can be found at http://www.zillow.com/ztrax. The results and opinions are those of the author(s) and do not reflect the position of Zillow Group.

In some cases, assessors' data include records for more than one building associated with a single property. For each transaction in our data set, we measured property characteristics based on those associated with the largest building, with respect to square feet, on the property.

Our data set includes all California counties with the exception of San Francisco, which is excluded because it is large, but contains insignificant high fire hazard areas.

We include in our sample properties with land use classified single family residential, rural residence, and inferred single family residential. To restrict attention to arm's length transactions, we drop transactions with sales prices below $10,000.

We define FHSZs and responsibility areas using a data set assembled by CAL FIRE to provide accurate wall-to-wall descriptions of fire hazard within SRAs and LRAs. For SRAs, the data set includes FHSZs as adopted by CAL FIRE in 2007. Local communities generally adopt only very high FHSZs, and statewide data on the precise boundaries of locally adopted very high FHSZs are unavailable. Therefore, for LRAs the data set includes boundaries of Very High FHSZs recommended for adoption by CAL FIRE. For other FHSZs in LRAs, fire hazard classifications are based on initial draft maps provided by CAL FIRE.

Federal Responsibility Areas are another category and these encompass a large area of California. However, residential properties within these mostly Federal lands comprise only 0.2 percent of transactions (1,450) in the sample; we drop these from the data set.

In addition to dropping properties within the FRA from the data set, we measure distances from regulated SRA areas to unregulated LRA areas and ignore unregulated FRA areas. This is because, due to checkerboarded federal landholdings in California (see Leonard, Plantinga, and Wibbenmeyer 2021), SRA areas are frequently near boundaries with unregulated and relatively unpopulated FRAs.

For reference, counties in California are approximately 7,300 sq. km on average. Therefore, each county contains an average of approximately 29 cells.

McCoy and Walsh (2018) find evidence that proximity to (and views of) burn scars matter for house prices. Our use of a boundary discontinuity design, comparing houses in very close proximity to each other, eliminates the need to control for this factor. For the same reason that amenities should be similar for houses on either side of the boundary, proximity to burn scars should be as well.

Protected areas with GAP Status 1 or 2 are areas that are permanently protected and have a management plan to maintain the lands in a natural state. These areas, which include national parks and wilderness areas, are distinguished from areas with lower GAP Status, which may be protected from land cover conversion but subject to extractive uses such as logging or mining.

Controls include number of bedrooms, number of bathrooms, log of lot size, age, indicators for the decade of construction, square feet, share white at the census block group-level in 2010 Decennial Census, measures of school quality (percent meeting standardized testing standards for English/language arts and Math), an indicator for location within the perimeter of any fire in the last five years, logged distance to a protected area, and an indicator for whether the area is incorporated.

We define northern and southern California based on the distinction used by the American Automobile Association (AAA). The counties in each region are listed in the footnote to Table 9.
References


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Table 1. Responsibility Area and Fire Hazard Severity Zone categories where disclosure laws apply under California AB 1195 (“Yes” indicates disclosure laws apply, “No” indicates disclosure laws do not apply).

<table>
<thead>
<tr>
<th>Responsibility Area</th>
<th>Fire Hazard Severity Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None</td>
</tr>
<tr>
<td>Local Responsibility Area (LRA)</td>
<td>No</td>
</tr>
<tr>
<td>State Responsibility Area (SRA)</td>
<td>No</td>
</tr>
<tr>
<td>Federal Responsibility Area (FRA)</td>
<td>No</td>
</tr>
</tbody>
</table>
### Table 2: Summary Statistics

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Full sample</th>
<th>Regulated</th>
<th>Not Regulated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>S.D.</td>
<td>Mean</td>
</tr>
<tr>
<td><strong>A. Wildfire Hazard</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ln(1+WHP)</td>
<td>1.69</td>
<td>2.74</td>
<td>4.13</td>
</tr>
<tr>
<td>Previous fire</td>
<td>0.02</td>
<td>0.14</td>
<td>0.09</td>
</tr>
<tr>
<td><strong>B. Property Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price</td>
<td>625,444</td>
<td>846,988</td>
<td>746,907</td>
</tr>
<tr>
<td>No. of bedrooms</td>
<td>3.362</td>
<td>0.895</td>
<td>3.28</td>
</tr>
<tr>
<td>No. of bathrooms</td>
<td>2.327</td>
<td>0.85</td>
<td>2.5</td>
</tr>
<tr>
<td>Ln(Lot size)</td>
<td>-1.543</td>
<td>0.96</td>
<td>-0.82</td>
</tr>
<tr>
<td>Year built</td>
<td>1980.67</td>
<td>24.91</td>
<td>1984.9</td>
</tr>
<tr>
<td>Sq. feet</td>
<td>1973.19</td>
<td>7739.74</td>
<td>2245.02</td>
</tr>
<tr>
<td><strong>C. Neighborhood Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pct. meeting standard – language arts</td>
<td>52.15</td>
<td>13.75</td>
<td>54.4</td>
</tr>
<tr>
<td>Pct. meeting standard – math</td>
<td>39.22</td>
<td>15.44</td>
<td>41.34</td>
</tr>
<tr>
<td>Share White</td>
<td>0.66</td>
<td>0.19</td>
<td>0.8</td>
</tr>
<tr>
<td>Distance to protected areas (m)</td>
<td>17126.2</td>
<td>14398.22</td>
<td>11679.37</td>
</tr>
<tr>
<td>Incorporated</td>
<td>0.77</td>
<td>0.42</td>
<td>0.37</td>
</tr>
<tr>
<td>Observations</td>
<td>1,556,426</td>
<td>271,413</td>
<td>1,295,013</td>
</tr>
</tbody>
</table>

*Notes: Table presents the mean and standard deviations of various house characteristics for the full sample and also by regulatory status. The time period in this sample is from 2015 to 2020.*
### Table 3: Price Regression using Wildfire Hazard Potential

<table>
<thead>
<tr>
<th>Dep. Var.: Log(Price)</th>
<th>Full</th>
<th>Add County-by-year FE</th>
<th>Add Tract FE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log(1+WHP)</td>
<td>-0.00242</td>
<td>-0.00242</td>
<td>0.00232**</td>
</tr>
<tr>
<td></td>
<td>(0.00187)</td>
<td>(0.00184)</td>
<td>(0.000960)</td>
</tr>
<tr>
<td>Observations</td>
<td>1,566,426</td>
<td>1,566,422</td>
<td>1,566,361</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.695</td>
<td>0.697</td>
<td>0.780</td>
</tr>
</tbody>
</table>

**Notes:** Table presents a regression of the log of housing price on house and neighborhood controls and the log of wildfire hazard potential (WHP), a measure of wildfire risk. Each column represents a separate regression. The baseline regression in column 1 includes house and neighborhood controls and fixed effects for year and month of sale. Subsequent columns progressively add spatial fixed effects (denoted in the column header). House and neighborhood controls include: number of bedrooms, number of bathrooms, log of lot size, age, indicators for the decade of construction, square feet, share White at the census tract in 2010 Decennial Census, measures of school quality (test scores for English/language arts and Math), an indicator for location within the perimeter of any fire in the last five years, logged distance to a protected area, and an indicator for whether the area is incorporated. All standard errors are two-way clustered at the county and year level. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
Table 4: Price Regression using Regulatory Status

<table>
<thead>
<tr>
<th>Dep. Var.: Log(Price)</th>
<th>Add FE County-by-Year</th>
<th>Add FE Tract</th>
<th>Add FE Grid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulated</td>
<td>-0.0617*</td>
<td>-0.0328**</td>
<td>-0.0507**</td>
</tr>
<tr>
<td></td>
<td>(0.0287)</td>
<td>(0.0133)</td>
<td>(0.0147)</td>
</tr>
<tr>
<td>Observations</td>
<td>1,566,426</td>
<td>141,597</td>
<td>141,546</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.724</td>
<td>0.726</td>
<td>0.780</td>
</tr>
</tbody>
</table>

Notes: Table presents a regression of the log of housing price on house and neighborhood controls and an indicator for location within a regulated area. The first column begins with the sample of house sales in high Fire Hazard Severity Zones (FHSZs). Subsequent columns either makes additional restrictions on the sample or progressively adds spatial fixed effects (denoted in the column header). All specifications include house and neighborhood controls (see Table 3 notes) and fixed effects for year and month of sale. All standard errors are two-way clustered at the county and year level. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
Table 5: Boundary Discontinuity Price Regression, High FHSZ

<table>
<thead>
<tr>
<th>Dep. var.:</th>
<th>Boundary Distance:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log(Price)</td>
<td>10 km</td>
</tr>
<tr>
<td>Regulated</td>
<td>-0.0253*</td>
</tr>
<tr>
<td></td>
<td>(0.0121)</td>
</tr>
<tr>
<td>Observations</td>
<td>139,195</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.799</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dep. var.:</th>
<th>Boundary Distance:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log(Price)</td>
<td>0.75 km</td>
</tr>
<tr>
<td>Regulated</td>
<td>-0.402**</td>
</tr>
<tr>
<td></td>
<td>(0.0153)</td>
</tr>
<tr>
<td>Observations</td>
<td>64,165</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.821</td>
</tr>
</tbody>
</table>

Notes: Table presents a regression of the log of housing price on an indicator for location within a regulated area. All specifications include house and neighborhood controls (see Table 3 notes), county-by-year fixed effects, month of sale fixed effects, and grid fixed effects. We narrow the bandwidth around wildfire regulatory boundary from 10km on either side of the regulatory boundary to 200 meters. All standard errors are two-way clustered at the county and year level. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
Table 6: Variation in Observed Variables across the Boundary

<table>
<thead>
<tr>
<th>High FHSZ, Built &lt; 2008</th>
<th>4 km</th>
<th>1 km</th>
<th>500 m</th>
<th>200 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log(1 + WHP)</td>
<td>1.28**</td>
<td>1.19**</td>
<td>1.14**</td>
<td>0.84**</td>
</tr>
<tr>
<td></td>
<td>(0.14)</td>
<td>(0.14)</td>
<td>(0.09)</td>
<td>(0.12)</td>
</tr>
<tr>
<td>No. of bedrooms</td>
<td>0.03</td>
<td>0.02</td>
<td>0.03</td>
<td>-0.03</td>
</tr>
<tr>
<td></td>
<td>(0.06)</td>
<td>(0.06)</td>
<td>(0.06)</td>
<td>(0.08)</td>
</tr>
<tr>
<td>No. of bathrooms</td>
<td>0.25**</td>
<td>0.24**</td>
<td>0.19**</td>
<td>0.10</td>
</tr>
<tr>
<td></td>
<td>(0.06)</td>
<td>(0.07)</td>
<td>(0.07)</td>
<td>(0.08)</td>
</tr>
<tr>
<td>ln(Lot size)</td>
<td>0.88**</td>
<td>0.79**</td>
<td>0.63**</td>
<td>0.51**</td>
</tr>
<tr>
<td></td>
<td>(0.15)</td>
<td>(0.15)</td>
<td>(0.12)</td>
<td>(0.10)</td>
</tr>
<tr>
<td>Age</td>
<td>-3.42</td>
<td>-3.37</td>
<td>-3.55+</td>
<td>-2.46</td>
</tr>
<tr>
<td></td>
<td>(2.21)</td>
<td>(2.31)</td>
<td>(1.93)</td>
<td>(2.12)</td>
</tr>
<tr>
<td>Year built</td>
<td>3.42</td>
<td>3.37</td>
<td>3.55+</td>
<td>2.46</td>
</tr>
<tr>
<td></td>
<td>(2.21)</td>
<td>(2.31)</td>
<td>(1.93)</td>
<td>(2.12)</td>
</tr>
<tr>
<td>Log(Sq. feet)</td>
<td>0.13**</td>
<td>0.12**</td>
<td>0.10*</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>(0.03)</td>
<td>(0.04)</td>
<td>(0.04)</td>
<td>(0.05)</td>
</tr>
<tr>
<td>Share of White residents</td>
<td>0.03**</td>
<td>0.02**</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>Pct. meeting standard – language arts</td>
<td>2.68**</td>
<td>2.39**</td>
<td>1.15*</td>
<td>1.00*</td>
</tr>
<tr>
<td></td>
<td>(0.96)</td>
<td>(0.84)</td>
<td>(0.55)</td>
<td>(0.44)</td>
</tr>
<tr>
<td>Pct. meeting standard – math</td>
<td>2.60**</td>
<td>2.25**</td>
<td>0.79*</td>
<td>0.63+</td>
</tr>
<tr>
<td></td>
<td>(1.03)</td>
<td>(0.89)</td>
<td>(0.35)</td>
<td>(0.32)</td>
</tr>
<tr>
<td>Previous fire</td>
<td>0.01</td>
<td>0.01</td>
<td>-0.00</td>
<td>-0.01</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.02)</td>
<td>(0.02)</td>
</tr>
<tr>
<td>ln(Distance to protected areas)</td>
<td>0.04</td>
<td>0.04</td>
<td>0.09+</td>
<td>0.07**</td>
</tr>
<tr>
<td></td>
<td>(0.06)</td>
<td>(0.06)</td>
<td>(0.05)</td>
<td>(0.03)</td>
</tr>
<tr>
<td>No. of obs.</td>
<td>71,406</td>
<td>65,864</td>
<td>45,996</td>
<td>37,204</td>
</tr>
</tbody>
</table>

Notes: Table presents results from regressions of a house attribute on an indicator for location within a regulated area. Coefficients for Regulated are presented in the table, and all other coefficients are omitted; each cell presents the coefficient and standard error for a separate regression. The variables WHP, Sq. Feet, Lot size, and Distance to protected areas are logged. All regressions include boundary, grid, county-by-year, and month of sale fixed effects, and a control for location within an incorporated area. All standard errors are two-way clustered at the county and year level. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
Figure 1. Fire Hazard Severity Zones within State and Local Responsibility Areas in California (panel A) and San Diego County (panel B)

*Note:* Shaded areas without a stipple pattern are FHSZs within SRAs. Non-shaded areas include areas not classified as FHSZs and FRAs.