The Role of Property Tax in California's Housing Crisis

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Abstract

California faces a shortage of housing according to politicians, activists, and residents. In this paper, I leverage differential exposure to the Proposition 13 tax laws to understand the impact of this policy on the production of housing in Southern California. Proposition 13 restricts property tax growth as long as the owner doesn't sell or redevelop the property, which allows me to exploit differences in market conditions at the time of prior purchase to identify the effect of these property tax limits on property redevelopment. I find that Proposition 13 discourages redevelopment and sales. In a dynamic discrete choice model of land use, I find that adopting a land value tax or other property tax reforms would increase housing production by 14-32% generating a similar or greater amount of new housing as other polices under consideration in California.

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1 Introduction

Housing is very expensive and infrequently produced in California relative to the rest of the United States of America. Los Angeles, CA has the second lowest housing production per capita among the ten largest Metropolitan Statistical Areas (MSAs) in 2019. Of the 50 largest MSAs in 2019, all six Californian MSAs have at or below median housing production per capita. Figure 1 plots single family home (SFH) prices against the new housing production per capita in metropolitan areas within the United States with at least 250 thousand people. Figure 2 plots the average of one and two bedroom rents in the same metropolitan areas against housing production. In both plots, Californian metropolitan areas are marked in red with Los Angeles as a maroon diamond. In both figures, the cost of housing is almost always high but the production of new housing is low. This suggests that the housing supply responds less to housing prices in California than in other states.

California currently faces an extreme housing crisis. High housing costs have led to homelessness, overcrowding in existing housing, and high costs of living. Los Angeles currently has a large and rising homeless population.[1] At the same time, even more people live in overcrowded housing. Los Angeles is currently the MSA with the highest rate of overcrowding and 4 of the 5 most overcrowded large MSAs are in California.[2] In addition, high rents and purchase prices raise the cost of living for most households even when they can find appropriate housing.

Recent modeling suggests that California needs to build close to 3.5 million new units of housing to have a similar number of units per capita as states like Texas.[3] To this end, local and state government agencies and elected officials have attempted to implement new policies that increase housing production. Current strategies include efforts to loosen zoning by legalizing small multiple family housing statewide, reducing or eliminating parking minimums in some jurisdictions, funding for dedicated low-income housing, exempting some housing production from environmental review, and overriding zoning in jurisdictions that fail to meet housing production targets. As shown above, these efforts have failed to solve the housing shortage in the short-term.

[1] O'Flaherty [2019]

[2] Owens

[3] Woetzel et al. [2016]

I evaluate how property tax influences housing production by examining California's Proposition 13 housing policy. Proposition 13 is a ballot initiative that limited the growth of property taxes for people who do not sell or redevelop property.Proposition 13 requires that a property owner's tax bill cannot increase by more than 2% or the consumer price index each year unless their parcel is redeveloped or sold. Property that remains in the hands of the same owner and is not redeveloped will have a lower effective tax rate over time if the value of the property consistently rises by more than 2% per year. This means that over time, the taxes paid relative to the market value fall. This creates a disincentive against selling property and investing in redeveloping property, as either action will lead to the loss of a low effective tax rate. This is an increase in the opportunity cost of redevelopment which should reduce redevelopment activity that produces new housing in already developed areas. There was an unsuccessful attempt to partially repeal Proposition 13 in 2020 to raise tax revenue.

My study focuses on the Los Angeles metropolitan area covering the City of Los Angeles, Long Beach, and their suburbs within Los Angeles County. I obtain data from the Los Angeles County Office of the Assessor from their open data website, public record requests, and web scrapping. This includes the use of every parcel of land in Los Angeles County, what taxes owners pay, and the prices associated with sales of parcels. I measure policy exposure using the ratio of the market value and the assessed value of each parcel referring to it as the effective tax rate. The assessed value is the value used to compute taxes and is determined by the policy. The final dataset describes which parcels redevelop, the effective tax rate, and other variables related to redevelopment including zoning, existing structures, and location. I use these data to determine if Proposition 13 reduces redevelopment and the production of new housing.

Housing production and prices is a classic topic in urban economics. Glaeser et al. [2006] and Glaeser [2008] describe the classic models of land use and highlight the importance of an elastic housing supply for a city to absorb demand shocks. Epple et al. [2010] provides a new strategy for estimating the housing production function of a given region. Murphy [2018] examines strategic timing of construction in the San Francisco Bay Area and Brooks and Lutz [2016] examine holdout behavior in Los Angeles. In addition to determinants of supply, researchers have studied the externalities of high end housing construction in relatively poor communities. Pennington [2020] and Asquith [2019] both find that new construction of large scale rental housing reduces nearby rents and involuntary displacement of existing residents suggesting that local residents benefit from new construction. This paper advances the current literature by examining a distortion created by the structure of California's property tax system that has a substantial impact on housing production.

Urban economists have studied Proposition 13 with a focus on its impact on migration and its distributional consequences. O'Sullivan et al. [1995a] and Fleissig [2018] find that Proposition 13 tends to benefit seniors and low income homeowners who are less likely to move and thereby accumulate a lower effective tax rate. Likewise, Hodge et al. [2018] finds that similar patterns occur in areas with lower or negative housing price growth and confirms the finding that long-term property owners are the beneficiary of Proposition 13 style policies. A large literature tests if Proposition 13 and similar policies led to less migration among homeowners. Theoretical models in O'Sullivan et al. [1995b] and İmrohoroğlu et al. [2018] argue that Proposition 13 should reduce moving rates in California. Stohs et al. [2001]; Wasi and White [2005]; Ferreira [2010]; and Miller and Sklarz [2016] find that Proposition 13 exposed households in California are less likely to migrate. Likewise, Hodge et al. [2015] and Ihlanfeldt [2011] find evidence of this behavior from similar policies in other states. This paper adds to the literature on Proposition 13 by investigating its impact on redevelopment and housing production.

Using data from Los Angeles, I first conduct a series of reduced form regressions to measure the effect of Proposition 13 on redevelopment. I regress the probability of redevelopment on the effective tax rate which measures exposure to Proposition 13. I find that the average parcel is 60% more likely to redevelop if they have no savings from the policy controlling for zoning, location, and existing structure's characteristics. However, this estimate is understated due to measurement error in the effective tax rate and endogeneity of unobserved characteristics of the parcel.

To address these concerns, I instrument for the effective tax rate. The instrument is based on variation in historic market conditions from when the current owner purchased the parcel. The instrument is valid because the purchase price of the parcel influences the effective tax rate and, holding current market conditions constant, prior market conditions should not be related to the present decision to redevelop except through Proposition 13. Under these assumptions, I can recover the effect of Proposition 13 on the probability a parcel redevelops. I find that a parcel with the typical savings from Proposition 13 will experience a 160% increase in the probability of redevelopment. The larger effect is due to the reduction in measurement error and the reduction of endogeneity from unobserved characteristics of the parcel. This analysis strongly supports the hypothesis that Proposition 13 reduces redevelopment of property in Los Angeles.

The reduced form analysis does not directly show how land use changes during redevelopment and does not directly model the dynamic effects of the policy. To overcome these limitations, I estimate an infinite period dynamic discrete choice model of land use. In the model, land owners choose between using land for single family homes, multiple family housing, and a non-housing option. They compare the rental profits, the property tax bill, and the costs of switching to a new use to make their decisions. This includes terms for the rental profit and development costs that are heterogeneous across space. These terms accounts for the difference in a small suburban apartment and high-rise apartment buildings near downtown Los Angeles. I am also able to account for the dynamic effects of Proposition 13 by directly modeling the tax bills paid by parcel owners and how they evolve conditional on real estate prices and choices. The resulting model is represented as a Bellman equation.

I estimate this model using the two-step nested fixed point method of Rust [1987] that is widely used in durable goods models in industrial organization. The University of Arizona's High Performance Computing Center is used to estimate the model due the intense computations demands the solution algorithm. The model generates estimated rental profits and redevelopment costs for housing that are consistent with data outside of the model. I then use the estimated coefficients to simulate land use choices under alternative tax schemes, a land value tax and a market value tax. Land value taxes are based on the qualities of land and not the buildings upon them which eliminates distortions from property tax on land use choices, and a market value tax that taxes real estate as a fixed percentage of the market value of land and buildings. Comparing simulated choices under Proposition 13 and alternative policies indicates that the reforms would increase housing production by 15-32% during 2006-2018. This is driven by increased conversion of non-housing property to housing and increased conversions of low-density single family housing to higher density multiple family housing.

The empirical results confirm the intuition that property taxes in California increases the opportunity cost of housing production and contribute to the present housing shortage. I find that redevelopment and housing production is discouraged by Proposition 13 in both reduced form and a dynamic discrete choice models. Adopting a tax scheme without these distortions would boost housing production and would produce a similar amount of new housing as recently passed zoning reforms.

2 Background

Proposition 13 refers to the structure of property taxes in California. The name originates from a 1978 ballot initiative that established the modern structure of California's property tax system with the goals of lowering both property tax growth and levels. The proposition established the fundamental features of property tax as one percent of the market value of real estate, and that an owner who has not redeveloped or sold their property should not have an increase in their tax bill of more than 2% or CPI whichever is lower over the prior year. An owner who acquired new property is assigned an assessed value that is usually equal to the price they paid for the property.[4] They will pay approximately 1% of the assessed value in taxes in the first year. For the following year, if they do not sell the property[5] or invest in the property through major construction the assessed value will increase by 2%. If they do invest in the property by building a new structure, making major additions to existing structures, or similar changes the assessed value is adjusted by the assessor's judgment of the change in market value from the investment. Each year moving forward, the tax bill is equal to 1% of the minimum of the assessed value or the present market value of the property. So, if a parcel's market value is below the assessed value they pay taxes based on the market value. I define a parcel's effective tax rate as the ratio between their assessed value and the market value up to one. This captures the ratio owner's tax bill to the tax bill if purchased in the present.

[4] During the time of the study this can be inherited under mild restrictions.

[5] 55+ homeowners are able to move to an equal or lower value home and retain existing assessed value.

3 Data

3.1 Data Sources

I build a unique dataset containing land use, property tax, zoning, and transactions prices for all 2.4 million parcels in Los Angeles County from public data, public record requests, and web scrapping. For each parcel in each year, I measure detailed information on the parcel, its owner, and the structures on it. I obtain my data primarily via the “Los Angeles County Open Data Portal”, the “Los Angeles County Assessor Portal” , the Census Bureau, other government agencies, and public record requests. The primary source of data is the “Assessor Parcel Data” for the years 2006 to 2020 which measures the location, structures upon the property, and tax information for each parcel in Los Angeles County. A parcel is either a piece of land and structures on that land or a specific portion of a structure usually in the form of a residential condominium unit.

I augment this data set with additional geographic information, historical sales prices, and details of the physical parcel. I add information on census tracts and blocks from the Census Bureau’s Tigerline files and the exact extent of parcels from the “Los Angeles County Parcel Boundary Map” obtained from the Los Angles County Assessor office via a public records request. I also add the most recent purchase price or reassessed value of each parcel by scrapping the “Los Angeles County Assessor Portal” during the first half of 2020. I add the zoning as of 2016 for each parcel obtained from the Southern California Association of Governments and neighborhoods as defined by the Los Angeles Times. Following the addition of these variables, I collapse all of the parcels of a specific condominium property that shares a common piece of land into a single observation per period.

I convert my data from annual to four-year periods because the process of redevelopment takes more than one year to happen. All variables but zoning, including the relevant policy variable, are measured in the first year of the period and the post-redevelopment land use is measured as of the first year of the next period. The periods are refereed to by their first year and are 2006, 2010, and 2014 which reflect choices recorded by 2010, 2014, and 2018 respectively. I call this my parcel-year dataset.

In addition to the parcel-year dataset, I built a dataset of all parcel sales at market value. Using the scrapped data from the "Los Angeles County Assessor Portal" as a base, I add in the closest in time parcel characteristics from the "Assessor Parcel Data" to create a dataset of all parcel sales within Los Angeles County. This is comprehensive for 1987-2019 as earlier years have implausibly few transactions and the data was scrapped in early 2020.

3.2 Land Uses

Throughout this paper, I define redevelopment as any change in the use of a parcel of land from the use in the first year of a period to a new use in the first year of the next period. An example of this would be the tearing down of a warehouse and building an apartment block to replace the warehouse within the next four years. To know if a parcel is redeveloped, I create a variable that defines four different uses. Each is defined such that to change from one use to another would require a major capital investment by building new structures, major renovations, or extensions to existing structures. These are determined using variables in "Assessor Parcel Data" that provide more detailed use categories and characteristics of buildings.

The different uses are listed in Table 1. Land used for housing is either a Single Family Home (SFH) or Multiple Family Housing (MFH). The difference is that a MFH parcel contains two or more homes while a SFH parcel contains a single home. Parcels used for business are either commercial or industrial. Commercial parcels either sell goods and services or office buildings while industrial parcels contains factories and warehouses that produce and store goods. I directly measure this in the "Assessor Parcel Data" which details how each parcel in Los Angeles County is used including the use and the characteristics of the use such as the size of buildings or the number of apartments on each parcel. I take the more detailed uses and separate them into categories. I also eliminate parcels that are used for key infrastructure such as roads, railroad tracks, or utility lines; dedicated non-for-profits property (primarily houses of worship); and along with publicly owned property used by government agencies including schools and public housing.

In Figure 3, I plot the land use of each parcel in my estimation sample. I include all neighborhoods as defined by the Los Angeles Times, that are within the Los Angles metropolitan area and are urbanized. Broadly a few patterns are clear. First, industrial is in highly concentrated with strips and clusters of industrial land spread around the region. Second, MFH is concentrated around individual city centers (Los Angeles City, Long Beach, and Pasadena), west and south of downtown Los Angeles, and in smaller clusters and strips elsewhere. Commercial is very common in downtowns and is often found in strips along larger roads across the region. SFH fills in the gaps between the other uses and is most common to the north and east of downtown.

Over time, the proportion of land used for MFH is growing while SFH is shrinking as Los Angeles densifies and housing prices rise. Table 2 shows the frequency of each use from 2006-2018. The frequency of parcels used for MFH grows from 14.4% to 14.8% over the study. Industrial has a very small increase while commercial grows by about .2% percent. Over the same time, the SFH share falls by about half a percentage point. This is consistent with a slow trend toward increasing density and a more MFH in the housing stock.

The characteristics of the different uses are described in Table 3. A typical single family house has 3 bedrooms and 2 bathrooms over 1,700 square feet with a market value of about seven hundred thousand. Most single family homes have similar features but there are a number of extremely valuable homes skewing the market value upward. A typical multiple family housing parcel has around six units with about half one and half two bedroom apartments of a bit less than 100 square feet each. There is a significant share of parcels with many more units bringing the averages above the 75th percentile in these characteristics. The market value likewise is skewed and about double that of the 75th percentile. Commercial and industrial parcels have similar patterns with mean size of 10 thousand and 23 thousand square footage respectively. They have an average market value of about seven million with a long right tail.

3.3 Measuring Market Value

My goal is to measure how the tax savings generated by Proposition 13 impact land use decisions. Therefore, I need to observe how large these tax savings are. This is difficult because the tax savings are not directly observable in the data as they depend on the assessed value (observed in data) and the market value of the parcel (observed only when the parcel is sold). I directly estimate this in the structural model as described below and estimate the market value of each parcel for the reduced form analysis using hedonic regressions.

I estimate market value through a series of hedonic regressions that follow the standard functional form of logged price as a function of parcel characteristics. Table 4 contains a listing of the characteristics included in each use's hedonic regression. All regressions include parcel area, census tract, and either year or city-year fixed effects. The functional forms were chosen by 10-fold cross validation to minimize the mean squared error of the levels of predicted sales prices. Broadly, most regressions features are included in a logged or third degree polynomial functional form. The final models tend to have a high R-squared value (.8+) and mean squared error of around ten percent of the average.

4 Model

My dynamic model of land use choice incorporates property taxes to evaluate how these choices are impacted by Proposition 13's assessment growth cap in a partial equilibrium setting. The model assumes that the choice of land use is a function of the rent obtained from each use, switching costs to redevelop the property, and the tax burden from the use. Owners have common beliefs about overall price levels which are based on the observable price history of the region. I describe this model and how I estimate it over the following subsections. I first describe the choice set in detail, then the state space in detail, then the single-period payoffs, next the transitions between states, and finally the full model.

4.1 Choice Set

The property owner chooses between three different uses for their parcel in the following period. All parcels have the following options: a single family home (SFH), multiple family housing (MFH), or a non-housing use that is commercial or industrial property. This is a simplification of a parcel owners decision that makes the problem tractable while still capturing most major changes in land use.

The three uses encompass a wide variety of buildings and are available for all parcels regardless of local laws. To help model variation within uses, I define a series of state variables that allow parcels to have variation in rents and switching costs from adoption of a new use. This allows me to model MFH as having different rental income and construction costs in dense, centrally located Koreatown and suburban West Covina. Now, I turn to describe these and the other states.

4.2 State Space

The model contains three groups of state variables. The first group are fixed over time and are heterogeneous across parcels, the second are the deterministic products of prior choices, and the third stochastically varies over time. I examine each group in turn below.

I specify state variables that capture the heterogeneous development options and costs for each parcel. Each measures the intensity of the adopted use. Bedrooms, denoted B, describes the size of a single family house located on a parcel. The number of apartments in multiple family housing is denoted as Apt and describes the number of apartments within the parcel. $SQFT$ denotes the number of square feet in a non-housing building if one were located on this parcel. All three of these states are fixed in both the model and in counterfactuals. These state variables are observed for any use a parcel adopts in my data set. The characteristics for uses that are never adopted in my data are those of nearby parcels that do adopt that use.

Prior choices determine two state variables. The first is the use chosen in the prior period, also known as the prior use, which is denoted u. It is used to determine if the owner will have to pay switching costs given a selected future use. It changes when the land owner chooses to adopt a new use. The second state is the assessed value of the parcel denoted as v. Following the structure of Proposition 13, it is the value that determines property taxes in conjunction with the current market value. v steadily increases at a fixed rate of 2% per year unless the property is redeveloped and then it is set at market value. These two states track the past choices of the parcel owner that impact utility today.

The final state variable measures the overall price levels in the market. The price is denoted as P and measures relative profits obtained from the rental markets. As this model is partial equilibrium, I treat this as fully exogenous in the model assuming that shifts in prices are driven by demand shocks and other forces outside and unrelated to the choices within the model.

The states allow me to describe parcels as having heterogeneous returns to adopting different uses, heterogeneous costs of adoption of different uses, and the impact of Proposition 13 on the land use choices of parcel owners.

4.3 Single-Period Payoffs

The single period payoffs to the owner of a parcel consists of the net revenue obtained from the parcel's rental profits, payment of taxes, and any costs of adopting a new use next period. The alternative-specific per period income is denoted $R(\bullet)$ and written for choosing MFH next period.

$$R_{MFH}(SFH, \bullet) = \overbrace{\alpha^{SFH} \times B \times P}^{\text{Rental Profits}} + \overbrace{\tau \min(v, V(\bullet))}^{\text{Tax Payment}} + \overbrace{\gamma_{MFH} Apt}^{\text{Switching Cost}} \tag{1}$$

The rental profits are $\alpha^{SFH} \times B \times P$ which is the rental profits parameter, α^{SFH} times bedrooms, B, times the current price level, P. The basic structure here is repeated for other land uses. The tax payment term is $\tau = 4.12$ percent (four years worth of taxes) of the assessed value, v, or the parcels market value, $V(\bullet)$, if market value is lower. I use the value at the current state as the market value for determining property taxes. The switching costs is, $\gamma_{MFH} * Apt$ the cost of switching to a MFH with Apt apartments. These parameters account for the heterogeneous costs of constructing new buildings.

The exact functional form and coefficients for each land use are listed in Table 5 and follow a similar structure. All three possible uses have a parameter for the rental profit is multiplied by the heterogeneous state and the price level. They also have a negative parameter that is multiplied by the heterogeneous state when switching into a new state as the cost of adopting a new use. I also include an intercept term in the estimation for computational reasons but it is not identified.

4.4 State Transitions

Three of the states transition over time: the existing use, u; price levels, P; and the assessed value, v.

The existing use, u, evolves deterministically by adopting the parcel owners choice of k.

The assessed value evolution in similarly straightforward, as dictated by Proposition 13. If the chosen use does not change, it increases by two percent per year between periods. If the use changes, the assessed value becomes equal to the market value at the current new state. This reflects the effect of Proposition 13, as the cap on price growth limits the growth of tax bills for owners who do not change use.[6] I estimate the market value for a new use, as a function of the states using my transactions data. I then compute the market value for each combination for heterogeneous states and land uses based on prices in 2010. Next, I extrapolate market value for other years by multiplying by each states P since market value should be approximately linear in P. The extrapolation is reasonable as P multiplicity impacts rents and the other two components of value are unlikely to occur soon (switching costs from a second redevelopment) or an approximately linear function of market value (taxes).

The evolution of the price state, $T(P)$ is based on an empirical distribution of historical real estate price changes in Los Angeles. Each period there is a draw from this distribution and it is applied to the present price level. For computational reasons, I assume prices vary from level one to four with one being normalized relative to 2010, the year with the lowest price levels in Los Angeles County within my data. This model corresponds to beliefs of parcel owners where they anticipate prices will continue generally rise as they have over the past 30 years but will stop rising and remain at four times 2010 prices.

[6]I do not model the impact of Proposition 13 on sales without land use changes and assume they only occur at the same time as a use change.

4.5 Optimization

Combining the model components leads to the following optimization problem. A parcel owner chooses their land use as a function of the existing use; anticipated choice and parcel-specific future rental revenue; any cost of adopting a new use; and present and anticipated tax burden. This choice can be written as a Bellman equation where the parcel owner chooses land use k for the next period. The observed state space is written as Ω and Ω' is the next periods state space as a function of the choice and prior state space.

$$V(\Omega, \epsilon) = \max_{k \in U} \{R(\Omega, k) + \epsilon_k + \delta E[V(\Omega', \epsilon') | \Omega, k]\} \tag{2}$$

The term ϵ_k is a choice specific error term with a logit distribution that is a shock to the switching costs. δ discounts the next periods value. The optimization occurs for each parcel i but I omit the subscript for clarity. In the next section, I discuss how to estimate this model alongside reduced form approaches.

5 Empirical Models

I estimate three sets of models to recover the effect of Proposition 13 on land use choices in California. First, I run simple regressions of the effective tax rates generated by the policy on the probability of redevelopment. Second, I run regressions with the effective tax rate instrumented to reduce bias. Third, I estimate my dynamic discrete choice model.

5.1 Regression

Using the parcel-year dataset and calculated variables described above, I estimate a series of regressions to recover the effect of Proposition 13's assessment growth cap on the probability of redevelopment and the frequency of sales. The basic functional form is as follows.

$$\overbrace{1(Use_t \neq Use_{t+1})}^{\text{Outcome}} = \overbrace{\alpha_t + \alpha_c}^{\text{Tract and Year FE}} + \beta \overbrace{TaxRate_{i,t}}^{\text{Tax Rate}} + \overbrace{\delta log(\widehat{V_{i,t}})}^{\text{Market Value}} + \overbrace{X_{i,t-3}\kappa}^{\text{Addtional Controls}} + \epsilon_{i,t} \tag{3}$$

$1(Use_t \neq Use_{t+1})$ is if the use is different in four years from t. This is the dependent variable and can be substituted with other outcomes. On the right hand side are fixed effects for census tract and calendar year. The variable of interest is the effective tax rate of the parcel and is calculated as the ratio of assessed and market value up to one. A value of one reflects assessed value equal or greater than the market value. "Market Value" controls for the present market value. There are additional controls including existing use and features of the existing use and an error term.

The correlation between the effective tax rate and the dependent variable outside of the effect of Proposition 13 must be zero. For an unbiased estimate of β all factors not controlled for must be unrelated to redevelopment or the effective tax rate. The effective tax rate comes from three factors: the price paid to purchase the parcel by the current owner, the number of years since the current owner purchased or redeveloped the parcel, and the present market value. These three factors must be unrelated to the redevelopment decision except through property taxes. This is very likely false. A parcel that was purchased at a higher price in the past will, all else equal, have unobserved to the economist features that make it particularly valuable in the current use. This will increase the estimated effective tax rate and reduce the likelihood of redevelopment leading to downward bias in the coefficient. In addition, since the effective tax rate is a function of the directly observed assessed value and a predicted market value there is non-classical measurement error that biases my coefficient toward zero. To avoid these and similar concerns, I instrument for the effective tax rate.

5.2 Instrumented Regressions

I instrument the effective tax rate using local average prices at the current owner's time of purchase. The first stage regression is as follows.

$$\widehat{TaxRate}_{i,t} = \underbrace{\psi_t + \psi_c}_{\text{Tract and Year FE}} + \underbrace{\delta log(\text{Prior Local Prices}_{i,s(i,t)})}_{\text{Local Price}} + \underbrace{X_{i,t}\rho}_{\text{Additional Controls}} + \mu_{i,t} \quad (4)$$

Like the primary regression above, this includes a set of controls with tract and year fixed effects. The outcome variable is the estimated effective tax rate. The instrument is $log(\text{Prior Local Prices}_{i,s(i,t)})$, which is the average log price of all other parcels in the same census tract with the same use purchased in the same year as when the parcel was last purchased. I denote the year the parcel i was last purchased in prior to time t as $s(i,t)$. For example, in 2010 a single family home was last sold in 2000. The prior local prices is average log price of all other single family homes in the same census tract solid in 2000. The second stage remains the same as in equation 3 with the exception that the effective tax rate values are replaced with those predicted values from the first stage.

The identification assumption is that the present choice of whether to redevelop today is unrelated (except via effective tax rate) to the average price of similar properties when the current owner purchased property. The comparison is, taking into account controls, two single family homes are in the same neighborhood and have the same observable features today. One owner purchased their house in a year when real estate was locally cheap and the other in a year when single family housing was locally expensive. I assume that the only reason for a difference in the probability that they redevelop the single family house into multiple family housing today is that the person who purchased the property in a cheaper years faces a larger increase in their marginal effective tax rate. Under this assumption, the instrumented regressions recover the true effect of the effective tax rate variation created by Proposition 13 on the probability of redevelopment.

5.3 Structural Model Estimation

I estimate the dynamic discrete choice model using the nested fixed point algorithm described in Rust [1987]. I first solve the Bellman equation for a given set of parameters and use the value function to calculate the log likelihood of the observed choices. I then optimize the likelyhood function over the parameters.

5.3.1 Measuring States

I can directly observe most of the states in the data but some require choice of values or calculation. The existing use and assessed value is directly observed in the data. I discretize B, Apt, and $SQFT$ to ensure the state space is manageable. The values are listed in Table 6 and were chosen to relatively equally divide the distribution of states so they all are similar parcels and equally common. Generally, the higher values represent both a greater variety of parcels and a lower percentage of the observations.

The final state is the overall price level. The price level is measured relative to 2010, which is when prices are lowest in my dataset. To find the price levels for each period, I compute the price ratio relative to 2010 on for each period. I do this by computing the annual change in prices in each region of Los Angeles. I do this using the repeat sales method. This works by comparing the sale price of the same parcel in different years to estimate how much prices rose each year in each region. This is done by regressing the difference in logged sale prices of two transactions of the same parcel on a panel of year-region indicator variables for the year was between the first and the second sale. The coefficient on each indicator is the annual price change in that region in that year. I then convert the coefficients to four year price change since one period is four years in my data by summing each possible combination of consecutive coefficients. I truncate this distribution to the range [-50%, 100%] and bin it over ten percentage point intervals. This gives me 15 possible shocks to P and the historic probability they occurred.

5.3.2 Bellman Computational Details

I solve the Bellman equation by use of the fixed point property. Broadly, I compute flow utility for each state and expected future value given the each alternative from an initial guess of the value function. Then, I compute alternative specific value for each option and update the value function with the log sum of the expected value of the alternatives. I then repeat the process until the value function does not change between iterations which will be the solution value.

I take as inputs $A = \{\alpha, \gamma\}$ the parameters of the problem, a matrix, "States", of all possible states states including a grid over the continuous states, the distribution of the stochastic transition of the price state, and an a initial guess of the value function. The alternative specific expected value function is as follows.

$$\bar{V_k}(\Omega) = R(\Omega, A) + \delta E[V(\Omega')] \tag{5}$$

I compute this equation in four broad steps: (1) I compute $R(\Omega, A)$ as a function of the present state, parameters and choice, (2) I compute expected future value using the empirical distribution of price changes and initial guess, (3) I compute the tax as a function of v and the initial guess, and (4) combine them into alternative specific values,which are combined as a log sum to find the value of being in a particular state. This process is repeated until the guess of the value function converges. The model is solved in R with optimization using the “Optim” command. For continuous states, I use linear interpolation of the value function when computing future value and choice probabilities. I use the asymptotic formula to compute standard errors. I use the University of Arizona’s High Performance Computing Cluster to estimate the model due to the computational intensity of repeatably solving the Bellman equation.

6 Results

I estimate the models discussed above in three different ways. First, I estimate the effect of Proposition 13 by controlling for other observable factors that impact the effective tax rate. To further reduce the variation used to just the of the variation in local historical prices, I use two stages least squares estimation using the local historical prices as an instrument for the effective tax rate. All models are estimated using robust standard errors with parcel level clustering. I use all data from metropolitan Los Angeles which as shown in Figure 3.

6.1 OLS Estimations

Table 7 contains the results of the estimation of Equation 3. I conduct three versions of the regression for outcomes of a land use change in the next four years and a sale in the next four years. Specifications vary only in what controls are used. The first regression only includes fixed effects for the census tract and year of choice. The second regression adds a control for the log market value along with existing use fixed effects, and the third adds controls for the observable characteristics of the existing use including building size zoning, and the year the building was built. I anticipate the coefficient on the effective tax rate should be positive as a higher effective tax rate will mean the current owner benefits less from the policy.

Columns (1), (2), and (3) reports the regressions with redevelopments as the dependent variable. I estimate a positive coefficient on the effective tax rate, suggesting that less policy-impacted parcels are more likely to be redeveloped. In column (3), the preferred model's coefficient corresponds to a 60% increase in the probability of a use change from repealing Proposition 13 and setting the effective tax rate to one. This is a large increase in redevelopment. As rates of home-building are low on a per capita basis in Los Angeles, this percentage increase in housing production would raise Los Angeles's to housing production rates to those of other major cities.

Columns (4-6) repeat the same regressions with the probability of a sale in the next four years as the dependent variable. All three regressions report highly significant coefficients that imply an approximately 40% increase in the probability of a parcel sale over the next four years from ending the policy. This is a large increase in the probability of a sale but is in the same general size as other research on Proposition 13.[7] All regressions are consistent with my model predictions but I have concerns about the endogenity of the results..

6.2 IV Estimations

In Table 8, I repeat these regressions but with an instrumented effective tax rate. As described above, I use variation in the price of other parcels of the same use purchased in the census tract in the same year as the instrument. The coefficients for use change in columns (1)-(3) are again all positive and significant at the 1% level. They are about 3.5 times larger and correspond to a 200% increase in redevelopment activity for the average parcel. In terms of housing production per capita, this is equivalent to changing housing production rates from shrinking rust belt cities like Toledo, OH to growing west coast cities like Seattle, WA.

The regressions on sales show a similar pattern with effect sizes remaining significant, large, and positive. The coefficients are now consistent with a 160% increase in the probability of a parcel sale for a parcel with the average effective tax rate. This is a substantially larger effect than before and suggests that Proposition 13 is a strong deterrent to reselling parcels in Los Angeles.

[7] Ihlanfeldt [2011]

Both sets of coefficients agree with the initial regressions and are much larger by about a factor of three and a half. Part of the reason for the large increase is that instrumentation eliminates measurement error in the instrumented variable. As the effective tax rate variable is calculated from a predicted variable there is error in the measurement of the effective tax rate. Second, by restricting to variation in prices among similar properties that were previously purchased at times of different local prices, I can eliminate downward bias from unobserved features of the current use that make redevelopment less (more) attractive and raise (lower) the purchase price of the parcel leading to a higher effective tax rate. These two effects combine to raise the size of the coefficients.

There are a number of limitations with these reduced form regressions. While they are informative about local average effects of the policy, they do not tell what new use will be adopted nor fully account for the fully dynamic nature of the policy. To do so in a rigorous fashion, I use a structural model that directly models the choice of land use instead of attempting to predict what parcels will change land uses.

6.3 Structural Model Estimation

In Table 9, I present the results of the structural model. The first two columns present the coefficients for revenue and switching costs. All coefficients are scaled to be between zero and one with negative coefficients between zero and negative one. The housing coefficients are precisely estimated and the correct sign. The non-housing estimations are not well estimated and are at the bounds allowed by the estimator indicating that the model finds non-housing uses very unattractive. The implied rental income and cost of adoption for non-housing are very large and not reported. These are broadly not accurate. The coefficients are difficult to interpret due to scaling so I convert them to more intuitive values.

I convert the profit coefficients to the implied monthly profit generated from each use and convert the adoption costs to dollar values. The model implies that a single family house generates $497 profit per bedroom each month and it costs approximately 354,00 per bedroom to build a SFH based on prices in 2010. In other words, a three bedroom house costs about 1 million to build (inclusive of demolition costs but not land costs) and generates about $1500 a month of profit in

2010. The profits are lower than market rents since they are net of costs. The coefficients for MFH are estimated as $387 in monthly profit per unit and cost of construction of about 227 thousand per unit. Based on typical rates of vacancy, non-collection of rent, and maintenance costs of 40% of revenue, $387 of monthly profits implies gross rents of about $860 compared to the average monthly rent of $1150 observed in 2010. This is somewhat underestimated but not extremely inaccurate. The estimation of the non-housing (Commercial or Industrial) use parameters are not well estimated and cannot be easily interpreted other than to note that the estimation finds non-housing uses very unattractive.

To simulate counterfactual outcomes, I modify the structural model's tax term to correspond to alternative policy. Then, I re-solve the model using the estimated parameters from above and simulate choices from 2006 to 2018. For each simulation, I compute the expected distribution of land use in 2018 given a policy implemented in 2006. This simulation approach does not include any changes to overall prices for real estate, zoning changes, or other effects of changes to property taxes.

I examine two alternative tax policies. The first policy is a market value tax (MVT) in which a property owner pays a tax as a fixed percentage of the market value of the land and structures. I choose a tax rate of half a percent of market value which will be approximately revenue neutral in the Los Angeles MSA over duration of the study. The second policy is a land value tax (LVT) which taxes a fixed percentage of the market value of the land but not the structures. I do not need to specify the rate of the LVT as it is choice invariant and drops out of the choice model but in practice Los Angeles County calculates the land value already and could implement a land value tax. Neither alternative tax scheme has any limits on the growth of property tax within ownership and is always a strict proportion of market or land value.

Table 10 lays out the outcomes under existing and alternative policies. Columns (1) - (3) lay out the expected number of parcels with each use under Proposition 13 (column 1) and alternative policies (columns 2 & 3). The expected distribution of land use in 2018 is similar to the real data in Table 2. The primary difference is that the simulation under estimates single family housings share by about four percentage points with the excess split evenly between multiple family housing and non-housing uses. I will use the model predictions as the benchmark to compare to avoid assigning this difference to the policy instead of the modeling. In column (2), the market value tax shows that more parcels are devoted to single or multiple family housing. There is a half percentage point increase in single family housing and a tenth of a percentage point increase in multiple family housing's share of land use. The effect is larger under the land value tax with a percentage point increase in single family housing's share and a .3 percentage point increase in multiple family housing's share of land use. This evidence leads clearly to two conclusions: Proposition 13 leads to less land used for housing compared to both alternative property tax policies and adopting a land value tax will increase land used for housing by about twice as much as a market value tax.

Columns (4) and (5) lay out the expected change in the number of housing units from moving from current policy under Proposition 13 to an alternative policy. Column (4) shows that adopting a market value tax would lead to an increase of about nine thousand single family homes and twenty-one thousand apartments. These represent a .7 and 1.2 percent increase in the supply of single and multiple family housing respectively for an one percent increase in the total housing units. Column (5) repeats the analysis for the land value tax finding a seventeen thousand (1.37%) unit increase in single family housing and a forty-five thousand unit increase (2.62%) in multiple family housing for a total increase in housing units of about two percent or sixty-three thousand units. This analysis may overstate the increase in housing because it treats a single family house with five bedrooms the same as a studio apartment when the single family house likely contains more people than the apartment and the new housing is more likely to be apartments than the existing stock. I address this concern by measuring housing supply as the number of bedrooms.

The final two columns, (6) and (7), lay out the expected change in the number of bedrooms under the alternative policies. The increase in bedrooms from single family housing is twenty-seven thousand (0.70%) from a market value tax and fifty-three thousand (1.35%) from a land value tax. The increase in multiple family housing bedrooms is thirty thousand (1.20%) from a market value tax and a sixty-six thousand (2.62%) bedroom increase from a land value tax. The percentage change in units and bedrooms is the same for multiple family housing because I assume new apartments have the same number of bedrooms per apartment as existing apartments in Los

Angeles. Under the assumption that each bedroom provides housing for one person, adopting the market value tax would of produced enough bedrooms to house the approximately fifty thousand people who were homeless in Los Angeles County in 2018.[8] The larger increase from adopting a land value tax could additionally house another seventy thousand people and help relive overcrowding of existing housing units and/or allow increased migration to Los Angeles.

To put all of this together, these relatively small changes in absolute housing supply imply a relatively large increase in housing production. The model implies an increase in housing production of fifteen percent from a market value tax and a thirty-two percent increase from a land value tax. The market value tax would raise housing production per capita to be similar to that in Philadelphia or Cincinnati and the land value tax raises housing production per capita to that of Boston. Comparing the two policies suggests that the effect of adopting a land value tax is twice that of a market value tax. The reason is that the land value tax eliminates two distortions: the Proposition 13 effect and the impact of taxing the market value of structures. The market value tax only eliminates the Proposition 13 effect which is about the same size as the impact of taxing the market value of structures. These simulations are consistent with a substantial increase in California's housing production from either policy and a larger effect from a land value tax.

There are a few limitations to these counterfactuals. First, the non-housing portions of the model is imprecisely estimated and so I cannot obtain any non-trivial confidence intervals on the policy simulation. Second, this model is partial equilibrium and does not account for price changes caused by increased supply. This should moderate my estimated effects but given the relatively small change in total supply this is unlikely to reverse the results but may moderate them somewhat. The last limitation is that this only captures one channel through which Proposition 13 can impact housing or land use. The policy also has direct impacts on the price level of real estate and disincentivizes homeowners to support the production of new housing. These effects are not accounted for in this paper and could moderate or increase the impact of reforms.

[8] Henry et al. [2018]

7 Conclusion

In this chapter, I examine the impact of the structure of California's property taxes system on the choices of property owners. I present and estimate a model that shows that Proposition 13, California's assessment growth cap, discourages the sale and redevelopment of property. Using data from the Los Angeles MSA, I find that eliminating Proposition 13 would increase property sales and redevelopment. Los Angeles could increase its housing production by around 15-32% through property tax reforms. This suggests that the structure of property taxes has a meaningful impact on the supply of new real estate development, including housing, and there is substantial room for improvement within California's property tax system.

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Table 1: Land Uses and their Definitions

Use:	Definition
Single Family Home (SFH)	A parcel that contain a single home.
Multiple Family Housing (MFH)	A parcel with with 2 or more units of housing regardless of if they are owner-occupied condominium, or cooperative.
Commercial (Com)	A parcel that is used to provide goods or services to consumers and office buildings.
Industrial (Ind)	Factories, warehouses, and other parcels used to produce goods.

Definitions of the 4 types of land use used in this study.

Table 2: Percentage of Parcels with Each Use

Use	2006	2010	2014	2018
SFH	79.89	79.54	79.37	79.28
MFH	14.41	14.63	14.72	14.81
Com	3.90	4.01	4.07	4.08
Ind	1.79	1.82	1.84	1.83

The percentage of parcels used for each year in the dataset.

Table 3: Characteristics of Land Uses

	(1)	(2)	(3)
Variable:	Mean	25th Percentile	75th Percentile
Single Family Housing			
Bedrooms	3.14	3	4
Bathrooms	2.09	1	3
Square Footage	1,732	1,172	2,002
Market Value	683,356	357,295	702,344
Multiple Family Housing			
Units	6.49	2	6
Bedrooms	9.38	4	8
Bathrooms	8.07	2	6
Square Footage	5,866	1,852	4,872
Market Value	1,867,218	412,852	909,908
Commercial			
Square Footage	9,517	1,216	6,642
Market Value	7,097,861	456,582	1,577,189
Industrial			
Square Footage	23,325	4,250	22,610
Market Value	6,956,484	707,378	2,035,199
N	4,403,378		

This table summarizes the observed characteristics of the data. All statistics are calculated separately for each use and include all observations 2006-2014.

Table 4: Characteristics used in Hedonic Regression by Use

	(1)	(2)	(3)	(4)	(5)
Variable:	Square Feet	Bed/Bathrooms	Pool	Units	Specific-Use
Single Family Homes	✓	✓	✓		
Multiple Family Housing	✓	✓	✓	✓	
Commercial	✓				✓
Industrial	✓				✓

This table lists what characteristics are used in the hedonic regressions. Functional forms were generally chosen from first to third degree polynomials and logged values via 10 fold cross validation. The criteria for cross validation was the means squared error in levels but regressions were run with logged outcomes. Specific use controls a indicators for more specifc use types including "Retail" or "Office" and are interacted with square footage terms.

Table 5: Functional Forms of Payoffs

Land Use	Rental Income	Switching Cost
Single Family Housing	$\alpha_{SFH} \times B \times P$	$\gamma_{SFH} \times B$
Multiple Family Housing	$\alpha_{MFH} \times Apt \times P$	$\gamma_{MFH} \times Apt$
Non-Housing	$\alpha_{NH} \times SQFT \times P$	$\gamma_{NH} \times SQFT$

This table displaces the functional forms of the flow utility in the dynamic discrete choice model. All α and γ variables are parameters to be estimated. Other variables are measured in the data. Non-housing includes both commercial and industrial parcels.

Table 6: States and Ranges used when Discretizing

State:	Discrete	#Values	Values
Existing Use	Yes	3	SFH, MFH, NH.
Assessed Value	No	∞	
Bedrooms	Yes	4	0-2, 3, 4, 5+
Units	Yes	8	0-2, 3, 4, 5-7, 8-12, 13-24, 25-42, 43+
SQFT	Yes	6	0-2,842; 2,843-4,949; 4,950-7,097; 7,098-11,257; 11,258-35,539; 35,540+
Prices	No	∞	

Ranges of values for discretized variables are listed.

Table 7: Effect of Proposition 13 on Land Use and Sales from OLS Regressions

	Use Change			Sales		
Variables:	(1)	(2)	(3)	(4)	(5)	(6)
Tax Rate	.00234***	.00246***	.00268***	.14752***	.14746***	.13281***
	(.00009)	(.00009)	(.00009)	(.00067)	(.00067)	(.00067)
log(Market Value)		-.00143***	-.00012		-.02551***	-.00707***
		(.0001)	(.00017)		(.0006)	(.0008)
Use FE		(X)	(X)		(X)	(X)
Characteristics Controls			(X)			(X)
N	4,388,376	4,388,376	4,349,210	4,388,376	4,388,376	4,349,210

All regressions include robust standard errors clustered at the parcel level. All columns have year and census tract fixed effects. Columns (3) and (6) include controls for zoning; year built; bedroom, bathroom, and unit counts; and other parcel characteristics of parcels and their existing use.

Table 8: Effect of Proposition 13 on Land Use and Sales from IV Regressions

	Use Change			Sales		
Variables:	(1)	(2)	(3)	(4)	(5)	(6)
Tax Rate	.01032***	.01063***	.01091***	.33574***	.33478***	.29682***
	(.00197)	(.00198)	(.002)	(.01214)	(.01215)	(.01238)
log(Market Value)		-.00158***	-.00114***		-.02905***	-.00196**
		(.00011)	(.00012)		(.00064)	(.00088)
Use FE		(X)	(X)		(X)	(X)
Characteristics Controls			(X)			(X)
First State F						
N	4,388,376	4,388,376	4,388,376	4,388,376	4,388,376	4,349,210

All regressions use the average price of other parcels of the same use in the year of prior purchase as the instrument. All regressions include robust standard errors clustered at the parcel level. All columns have year and census tract fixed effects. Columns (3) and (6) include controls for zoning; year built; bedroom, bathroom, and unit counts; and other parcel characteristics of parcels and their existing use.

Table 9: Dynamic Discrete Choice Estimated Coefficients

	(1)	(2)	(3)	(4)
	Coefficients		Implied Dollars	
	Profits	Cost to adopt	Monthly Profits (P=1)	Cost to Adopt
Single Family Housing	0.216***	-0.354***	$497	$ 354,000
(Per Bedroom)	(.0002)	(.0374)		
Multiple Family Housing	0.168***	-0.227***	$387	$ 227,000
(Per Unit)	(0.0007)	(.0112)		
N	4,981,869			

This displays the estimated coefficients from the dynamic discrete choice model. Coefficients are in hundreds of thousands of dollars.

Table 10: Dynamic Discrete Choice Counterfactual

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		E[Parcels]		E[Units]		E[Bedrooms]	
Use	Prop. 13	MVT	LVT	MVT	LVT	MVT	LVT
Single Family Housing	1,251,918	1,260,742	1,269,069	8,824	17,151	27,151	52,725
(Percent)	75.60%	76.15%	76.65%	0.70%	1.37%	0.07%	1.35%
Multiple Family Housing	264,142	267,256	270,821	20,850	45,371	30,296	65,925
(Percent)	16.03%	16.14%	16.34%	1.20%	2.62%	1.20%	2.62%
Total	1,655,677	1,655,677	1,655,677	29,675	62,522	57,446	118,650
(Percent Change)				0.99%	2.09%	0.90%	1.85%

MVT refers to a market rate tax which is a fixed percentage of the market value of land and improvements. LVT refers to land value tax which is a fixed percentage of the market value of only land.

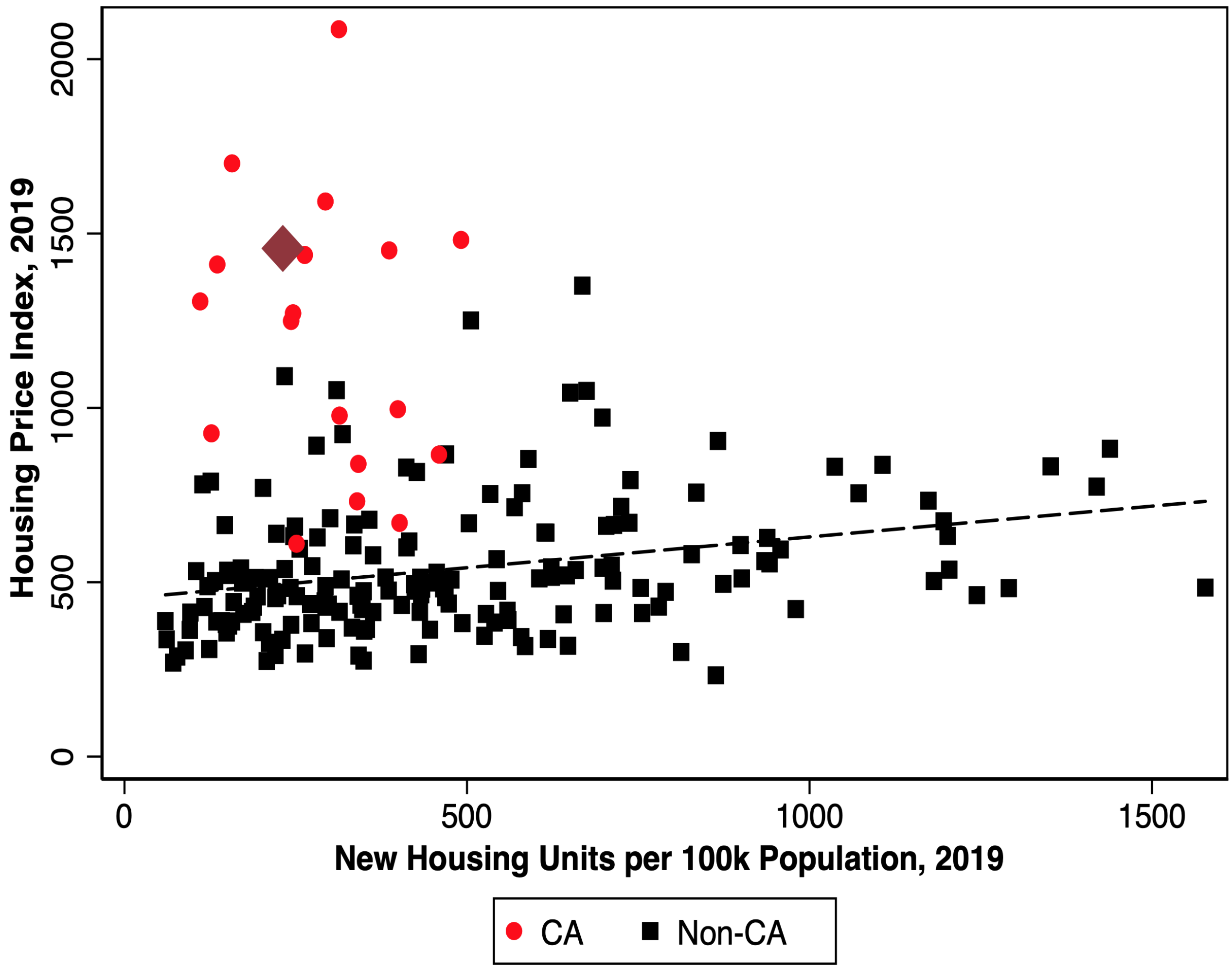

Figure 1: Single Housing Prices and New Housing Supply per capita in 2019

This compares housing prices and new housing produced in all Non-Puerto Rico Metropolitan Statistical Areas with 250 thousand or more people. Data sources: Population: Census Population Estimates, Units: Census Building Permits Survey, and Price Index: FHFA.

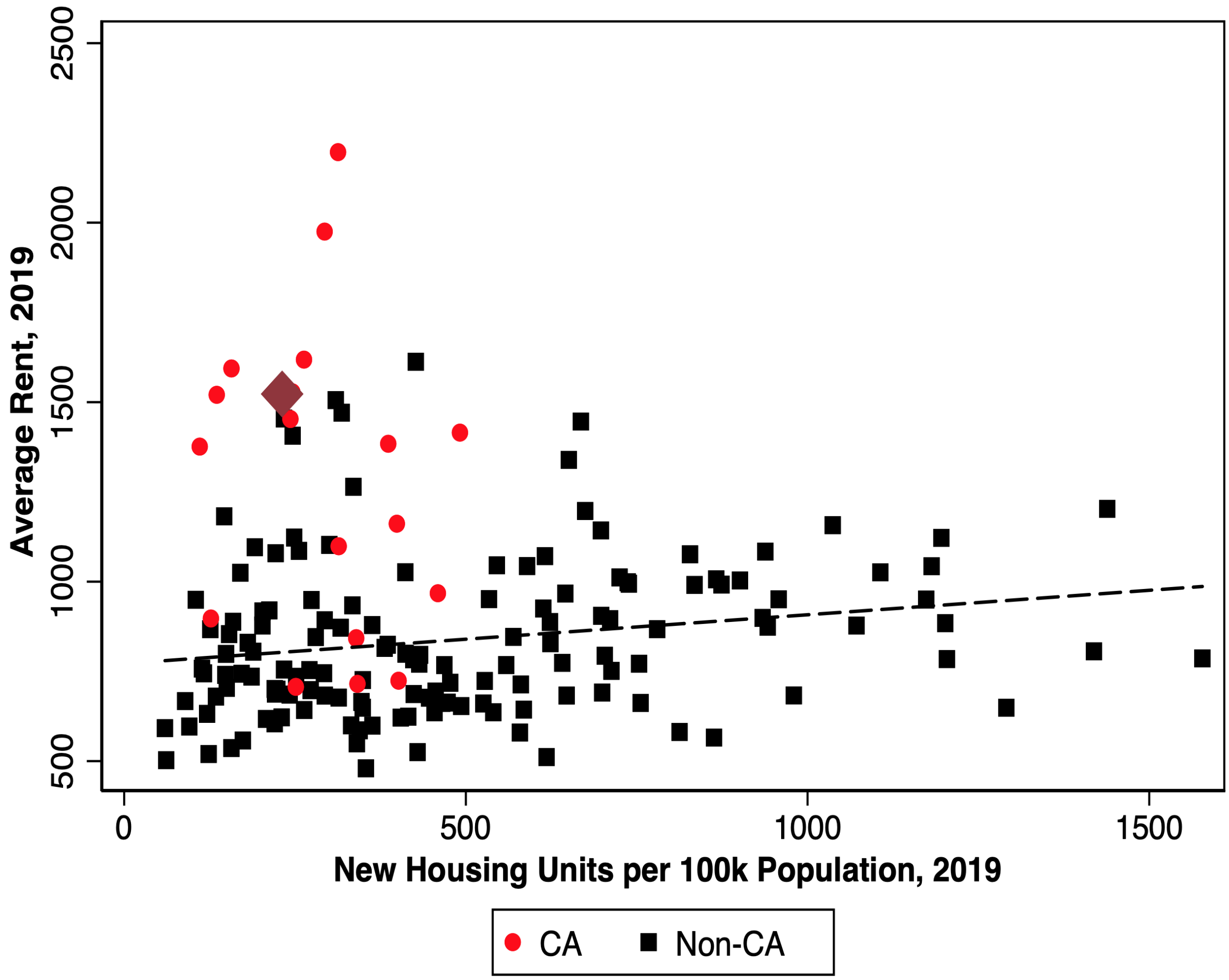

Figure 2: Apartment Rents and New Housing Supply per capita in 2019

This compares 1 and 2 bedroom rents and new housing produced in all Non-Puerto Rico Metropolitan Statistical Areas with 250 thousand or more people. Data sources: Population: Census Population Estimates, Units: Census Building Permits Survey, and Rent: American Community Survey via IPUMS.

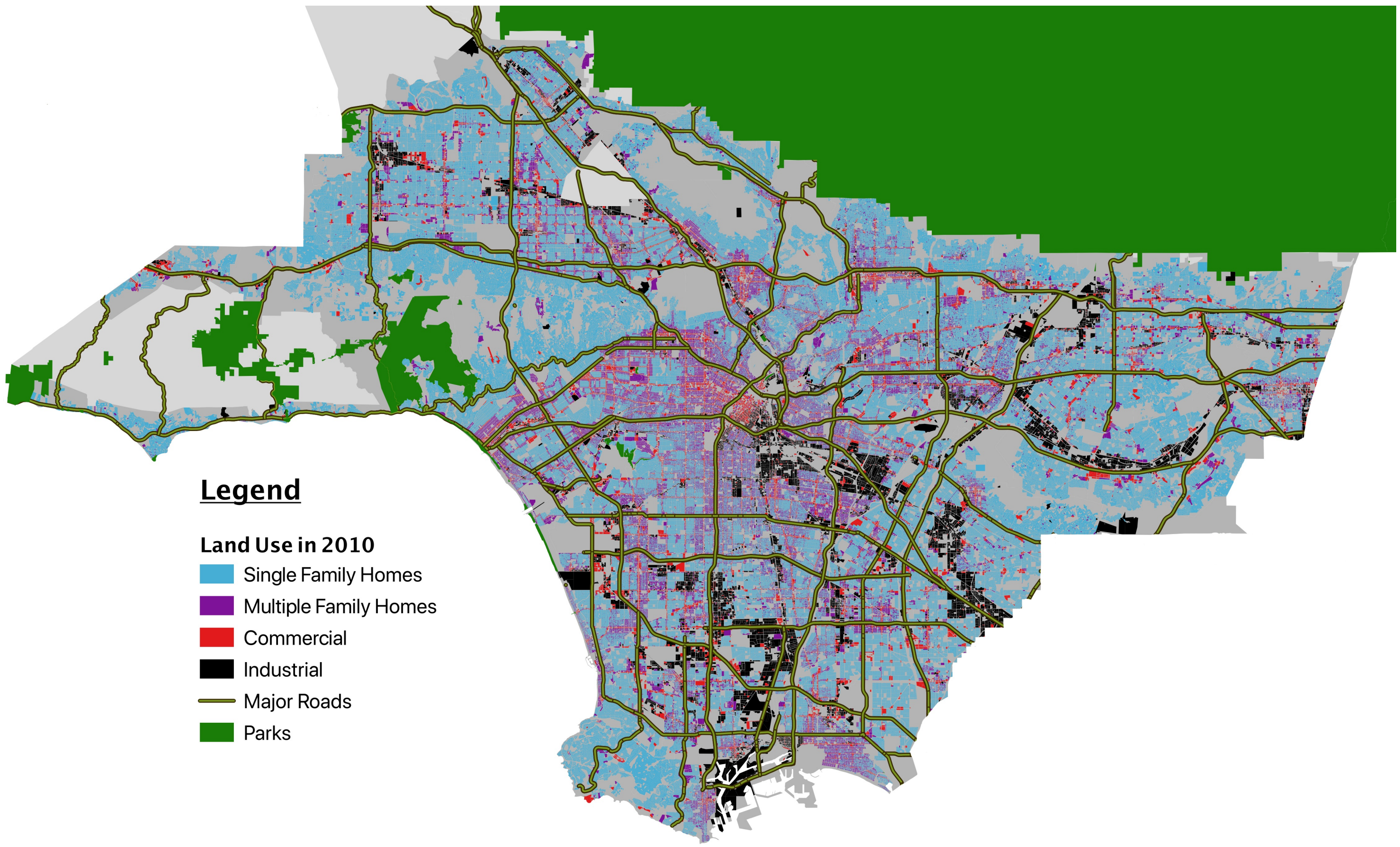

Figure 3: Areas Included in the Study and Land use in 2010

This map shows where the different uses are located within the county and the darker gray represents what areas are included in the study.