Modeling Land Use and Segregation in American Cities

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Abstract: Race and class segregation in America dramatically affects individuals' socio-economic well-being throughout their life course. Municipal land use regulations play a clear role in generating and maintaining segregation. However, to date scholars have assumed that it is wealthy and white neighborhoods that are protected by exclusionary zoning. We lack detailed land use evidence at the neighborhood level that presents a tight coupling between regulations and demographics and can explain segregation patterns within and across cities. In this paper I present results from an agent-based model of segregation showing that land use regulations are vital for producing segregation. Then, using new data from more than 2 million parcels in the Bay Area of California, I show that neighborhoods zoned single-family and low density are less diverse, wealthier, have higher home values, and have more homeowners than neighborhoods that are zoned more densely; this in turn generates segregation across neighborhoods and schools.

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Race and class segregation in America dramatically affects individuals' socio-economic well-being throughout their life course. Scholars have offered powerful evidence that people of color and lower income individuals who live in segregated neighborhoods have worse access to high quality education, job opportunities, property wealth, and public services like clean water and adequate sewer systems. They are more likely to have higher rates of chronic disease and death. They are more likely to be single parents and victims of crime. The list of negative outcomes associated with segregation is long. Despite a rapidly diversifying population and some progress toward integration, America remains a deeply segregated nation. Trounstine (2018, 2020) shows that municipal land use regulations play a clear role in generating and maintaining segregation. However, to date scholars have assumed that it is wealthy and white neighborhoods that are protected by exclusionary zoning. We lack detailed land use evidence at the neighborhood level that presents a tight coupling between regulations and demographics and can explain segregation patterns within and across cities and schools.

In this paper, I argue that privileged neighborhoods seek to use the land use process to entrench their exclusivity. First, I use an agent-based model to show that land use regulations are vital to producing segregation. Then, using new data from more than 2 million parcels in the Bay Area of California, I show that neighborhoods zoned single-family and low density are less diverse, wealthier, have higher home values, and have more homeowners than neighborhoods that are zoned more densely; this in turn generates segregation across neighborhoods and schools.

Racial Segregation and Land Use Regulation

Land use regulation is one of the most significant policy tools for local governments. In regulating the uses of land, cities can dictate what (if anything) gets built, how those buildings

will be used, the quality of the buildings, and what they will look like. Most importantly for my purposes, land use regulations specify the precise location of development. At the parcel level, cities can determine the housing that will be permitted on any particular piece of land. While it might seem intuitive that governments' land use authority would play a role in generating and maintaining segregation, the links remain fuzzy because land use regulations may simply reinforce private/market decisions, rather than providing an independent causal force.

Historical analyses reveal that the impetus to implement zoning had racist intent. Cities adopted land use regulations and formal zoning requirements when voluntary solutions were incapable of preventing the threat of racial transition (Trounstine 2018; Silver 1997; Troesken and Walsh 2017). In two landmark papers, Shertzer, Twinam, and Walsh (2016) and Shertzer, Walsh, and Logan (2016) show that the determination of which neighborhoods would be saddled with undesirable land uses was shaped by race. Areas with more immigrants and people of color were zoned more densely when zoning first adopted (Shertzer, Twinam, and Walsh 2021, Twinam 2018). Land use regulations that were purportedly race-blind were implemented in a discriminatory way. These scholars find that race was at least as strong of a predictor as existing land uses (the primary competing hypothesis) in the determination of zoning categories. Land use decisions are also tied to class. Been et al (2014) and Gabbe (2019) use parcel level data to show that cities are more likely to upzone (e.g. densify) areas with more renters.

Scholars have also tied land use regulations to ongoing patterns of segregation. Trounstine (2020) shows that whites are more supportive of stringent land use regulations than people of color, and that more stringent land use regulation is, in turn, a cause of racial segregation between cities. Pendall (2000) finds that low density zoning is associated with smaller Black and Latino populations. Rothwell (2011) reveals that anti-density regulations are

associated with changes in segregation over time. Glaeser and Ward (2009) provide evidence from the Boston area that land use restrictions change the density and demographic composition of communities. However, all of these results are driven by aggregate data – for example, whole cities that have low density zoning are whiter than cities with higher density zoning. What is missing from this picture is detailed evidence at the neighborhood level that presents a tight coupling between regulations and demographics and is capable of explaining segregation patterns within cities. Although these studies *imply* that the most privileged, whitest neighborhoods would have the most stringent land regulations, no evidence has been offered in support of this supposition.

Scholars have long debated the fundamental causes of residential segregation – but few have paid attention to land use. One school of thought in the segregation literature emphasizes economic differences between racial groups as a driver of segregation (Bayer, McMillan, and Reuben 2004). That is, if Black wealth and incomes are, on average, lower than white wealth and incomes, then segregation could occur because Black families may not be able to afford the same housing as white families. However, for inequality to cause residential segregation along racial lines, it must be the case that housing *affordability* and/or housing *types* are also segregated. Land use regulations can be used to separate housing types. Another school of thought in the segregation literature emphasizes racial preferences. There is some evidence that Blacks do not want to live in majority white neighborhoods, and so sort into communities with more people of color (Ihlandfeldt and Scafidi 2001). But scholars have shown that a more important factor shaping segregation is that whites are generally unwilling to live in neighborhoods with large black populations (Madden and Ruther 2018) and are willing to pay a housing price premium to live in a segregated (white) community (King and Mieszkowski 1973,

Cutler et al 1999). To the extent that housing values differ across neighborhoods, white willingness to pay for homogeneity will also perpetuate segregation. Once segregation patterns are established, they are very difficult to reverse. Thus, government policies that preserve existing land uses contribute to this rigidity. In short, land use regulation has the potential to create racial residential segregation by segregating housing types, segregating housing affordability, and by preventing change in the existing housing stock.

Segregation of Housing Types

The segregation of housing types is predominantly achieved (in the 21st century) by using land use regulations to *disallow* multi-family/high-density (e.g., less expensive) development in favor of detached single-family homes in certain neighborhoods, or even all neighborhoods. A brief look at any city's zoning map governing land use offers substantial evidence that land use designations segregate housing types, thereby segregating housing affordability. This serves several goals for low density neighborhoods: restricting the supply of housing, limiting congestion, reducing the possibility of free-riding/redistribution, and managing peer-effects (Trounstine 2021).

Basic economic theory suggests that the most desirable neighborhoods will attract the most development. But land use regulations change this equation – driving up prices instead of driving up development. Existing homeowners in a community will generally prefer to restrict development in order to "cartelize housing supply," (Ellickson 1973). By limiting the density of housing, residents who currently own houses will benefit from increased prices for their properties. The stronger the demand for housing in a community, the more lucrative restricting supply will be (Gyourko, Saiz, and Summers 2008; Saiz 2010). Land use regulation is needed to

achieve these goals because individual property owners have incentives to use land in a way that may generate negative consequences for their nearby neighbors (Fischel 2001; B. W. Hamilton 1975; B. Hamilton 1976; Babcock 1966). Many different types of regulations can be used to limit housing supply – for example, banning denser housing, restricting new building, enacting growth caps, placing burdensome requirements on new development, or levying development charges. These kinds of regulations prohibit an individual property owner from undermining the collective goal of limiting supply by doing something like subdividing their lot, breaking a large home into flats, or selling their property to a developer interested in building a multifamily unit. Empirical work shows that more stringent land use regimes are associated with higher housing prices (Gyourko and Molloy 2014) and Lens and Monkkonen (2015) find that density restrictions are associated with income segregation – particularly protecting wealthy enclaves.

New development produces congestion and limiting development is frequently a goal of land use regulation. Most local public goods are not pure public goods (meaning they lack the features of non-rivalry and non-excludability). Goods that are non-rivalrous are those for which a person's consumption of the good does not infringe upon someone else's ability to consume it. A local park is non-rivalrous to a point; one family's children playing on the playground does not substantially limit other children's enjoyment of the playground. But if too many children try to use the playground, everyone's experience is lessened. Because local public goods are rivalrous, residents are likely to collectively prefer a limit to the total number of people who can access the community. As local public goods are only available to the people who buy or rent housing in the community proximate to their provision, land use regulations can prevent congestion and maintain the quality of public goods by restricting the number of families that can access housing in a community. There is some evidence in support of this supposition. Hilber and Robert-

Nicoud (2013) show that areas that are in high demand feature more stringent land use regulations. High quality (uncongested) public goods are valuable directly, but they are also capitalized into the price of housing (Banzhaf 2014). In fact, Banzhaf and Magnum (2018) provide evidence that a significant portion of housing values reflects a price for accessing the community; and land use regulations can play a role in determining how many people are able to access the community by dictating housing quantity and density.

Land use regulations can also play a role in determining *which* people are able to access the community. Most local services require investments that are beyond the capacity of any individual household. Although individual residents can drill wells and operate their own septic tanks, over the long run a municipal water and sewer service is a more efficient way to provide water and waste treatment and it makes sense for residents to contribute to the local tax pool to obtain these services. But local taxes are largely derived from property; and poorer households may have an incentive to buy or rent small houses in rich communities (B. W. Hamilton 1975). Their entry into the community equates to a transfer of funds from richer households because the benefits they receive in public goods are worth more than they pay in property taxes. Thus, public goods financing becomes a redistributive transfer. Land use regulation can prevent this redistribution by requiring a minimum level of housing consumption (e.g., through minimum lot sizes, preventing small square footage homes, or prohibiting renting).

Finally, land use regulations allow communities to manage peer effects. The quality of many local public goods, like education, public health, and public safety, are affected by the characteristics of one's neighbors (Oates 1981; Schwab and Oates 1991). Even a service as mundane as code inspection will yield higher quality outcomes the fewer violators there are in a community. Similar to limiting congestion, high quality public good outcomes are valued both

directly, and capitalized into the price of housing. Land use regulations are a tool that communities can invoke to bar certain types of residents from their community. Without access to information about who will be a criminal, code violator, public health compromiser, or poor student, communities may seek to ban people who they suspect will be poor quality neighbors from accessing housing in their neighborhood. A 1925 editorial in the business newspaper, *The Recorder*, makes the same argument. The author explains, property owners can "destroy property values by renting their premises to undesirable aliens," (March 4, 1925, p12). Land use regulation can be used to affect shape the *types* of people have access to a community and its public goods. For instance, land use regulations can be used to bar the development of homeless and domestic violence shelters, subsidized housing, group homes, senior housing, or college dorms. They can be used to limit access to housing to people with lower incomes or those who rent their homes by limiting high-density housing. Regulations can even prevent unrelated people from sharing a home.

In sum, there are various reasons to expect privileged residents to seek to segregate housing types and to preserve segregation once it is in place using the city's land use powers. Manville, Monkkonen, and Lens 2020 argue that the protection of single-family home neighborhoods remains a high priority for most cities. Yet, despite a general dis-preference for dense housing (Trounstine 2022), higher density housing does get built in some communities. I argue that neighborhoods that are home to concentrated populations of socio-economically privileged residents should be most likely to maintain low-density zoning, and low-density zoning should, in turn, reify the demographic composition of these neighborhoods.

The development of land use regulations and zoning maps is an intensely political process. Cities hold public hearings to gather the input of residents, an appointed planning

commission makes recommendations, and ultimately, the elected officials of the city are responsible for adopting plans. For most large cities, zoning maps and zoning ordinances were first adopted in the middle of the 20th century, roughly between the 1920s and 1970s (Gray 2022). As cities grew and developed, codes have been adjusted and amended over time. Einstein et al (2020) show that the most vocal participants in this process are largely opposed to development and increases in density. Exceptions to regulations are another way in which politics enters the land use process. In most cities, zoning ordinances allow non-conforming development under certain conditions – typically through exceptions granted to property owners by the planning commission or elected officials. As a result, we can think of the land use regulations that govern each parcel as an accumulation of past political choices. I argue that these choices ought to favor political powerful constituents: white, wealthy, property owners.

Modeling Segregation

To better understand the role that regulations might play in generating segregation, I draw on an agent-based model built in NetLogo Web (Wilensky (1999). Agent-based models are computational simulations of behavior that can be used to study the interactions between people, given a set of starting assumptions. The model that I build compares segregation patterns under different sets of assumptions. First, I analyze segregation patterns if residents only consider the race of their neighbors in their decision to live in a particular house. Then, I allow residents to consider race and wealth of their neighbors. Finally, I implement restrictive zoning in two suburbs, while allowing residents to consider the race and wealth of their neighbors. In all models, residents are only allowed to locate in houses that they can afford.

At the outset, the model sets up a community with 9 areas, each containing 289 parcels. In some versions of the model, I allow a suburb option to be enabled. If the suburbs option is

enabled, the majority of parcels in two of the 9 areas are denoted suburbs. Every parcel is given a starting land value. Land value is normally distributed with a mean equal to the 2009 median home value of $216,000 and a standard deviation of $1,500. If the suburbs option is enabled, parcels in the suburban areas have a mean value of $218,000. Parcels are shaded from black to white reflecting value.

At the start, the model is populated with two types of residents – colored green (majority) and blue (minority). The share of each type is determined by a slider. For the purposes of this paper, the minority share was set to 30%. Each resident is assigned an income. Majority income is given by a gamma distribution with mean of $76,543. Minority income is given by a gamma distribution with mean of $54,546. These means represent median household income from the 2009 ACS for white and Black Americans. Residents that have incomes below the community median are triangle shaped (poor) and those with incomes above the community median are circle shaped (rich).

Each resident determines whether she is happy or not, based on the percentage of neighboring residents that are the same color as herself. This preference is set by a slider. For the purposes of this paper, majority residents prefer 75% majority neighbors, and minority residents prefer 30% minority neighbors. If the wealth option is enabled, rich residents also consider the wealth of their neighbors. The preference is set by a slider, which is set at 50% for this paper.

When the model runs, it checks to see if any residents are unhappy with their neighbors. If a resident is unhappy, she moves to a new location. Residents move by going in the direction of the highest land value. They check to see if the parcel is unoccupied and affordable

(affordability is determined as 2.5 times the residents' income). If the suburbia option is enabled, poor residents are not allowed to locate on suburban parcels.

As the model runs, land value is updated to reflect the composition of neighbors. Land value increases $1000 if the neighbors are 60% rich and decreases $1000 if neighbors are 60% poor. The model allows unhappy residents to move 500 times and then stops.

Figure 1 shows the starting model. Figures 2-4 shows the output of the variations in assumptions – residents consider race only (Figure 2), residents consider race and wealth (Figure 3), and residents consider race and wealth in the context of exclusionary zoning (Figure 4).

Figure 1: Starting Model

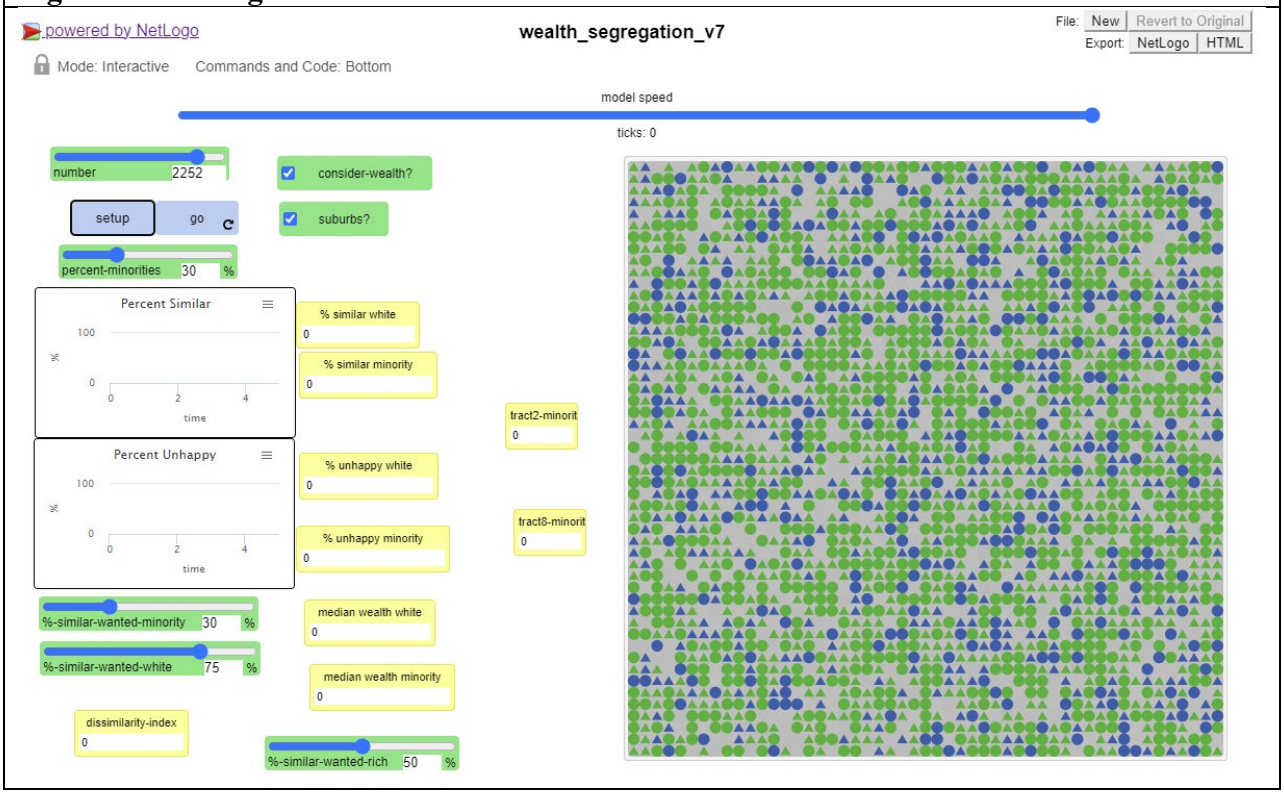


Figure 2: Residents Consider Race Only

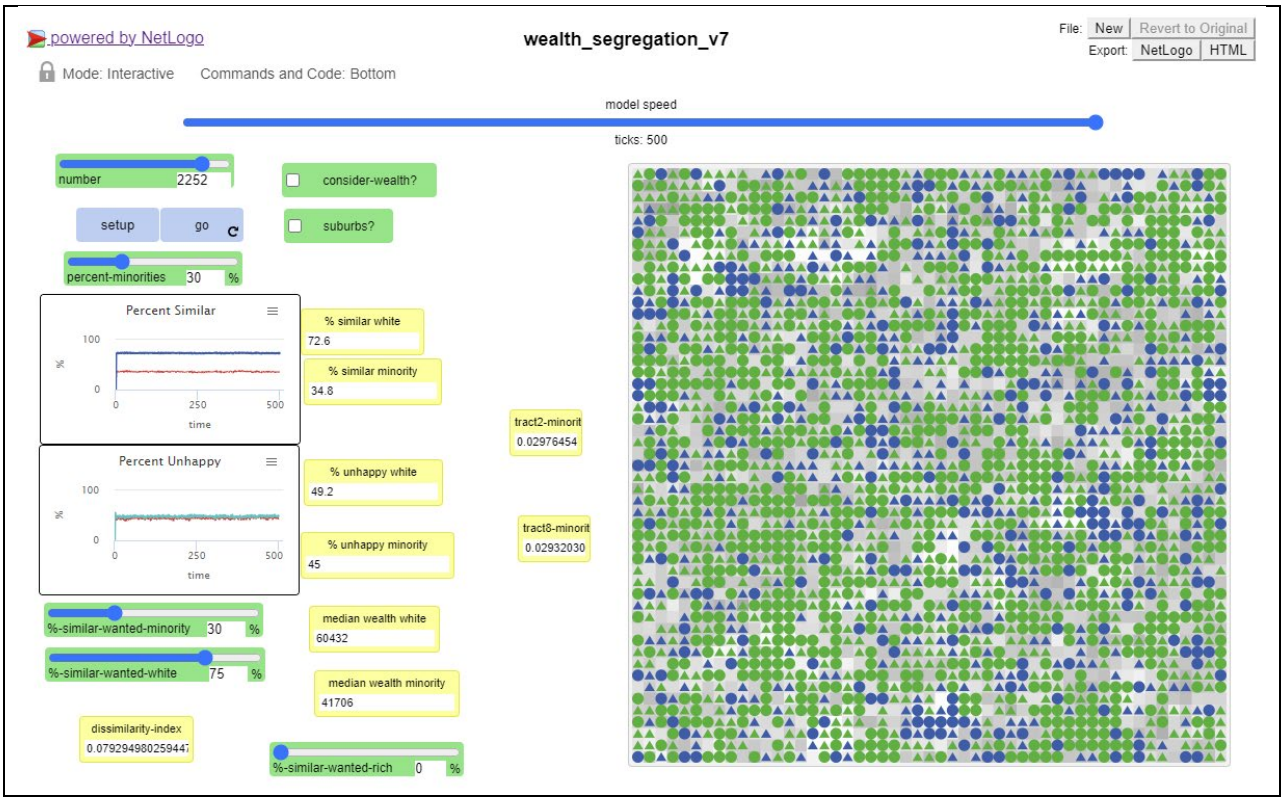


Figure 3: Residents Consider Race and Wealth

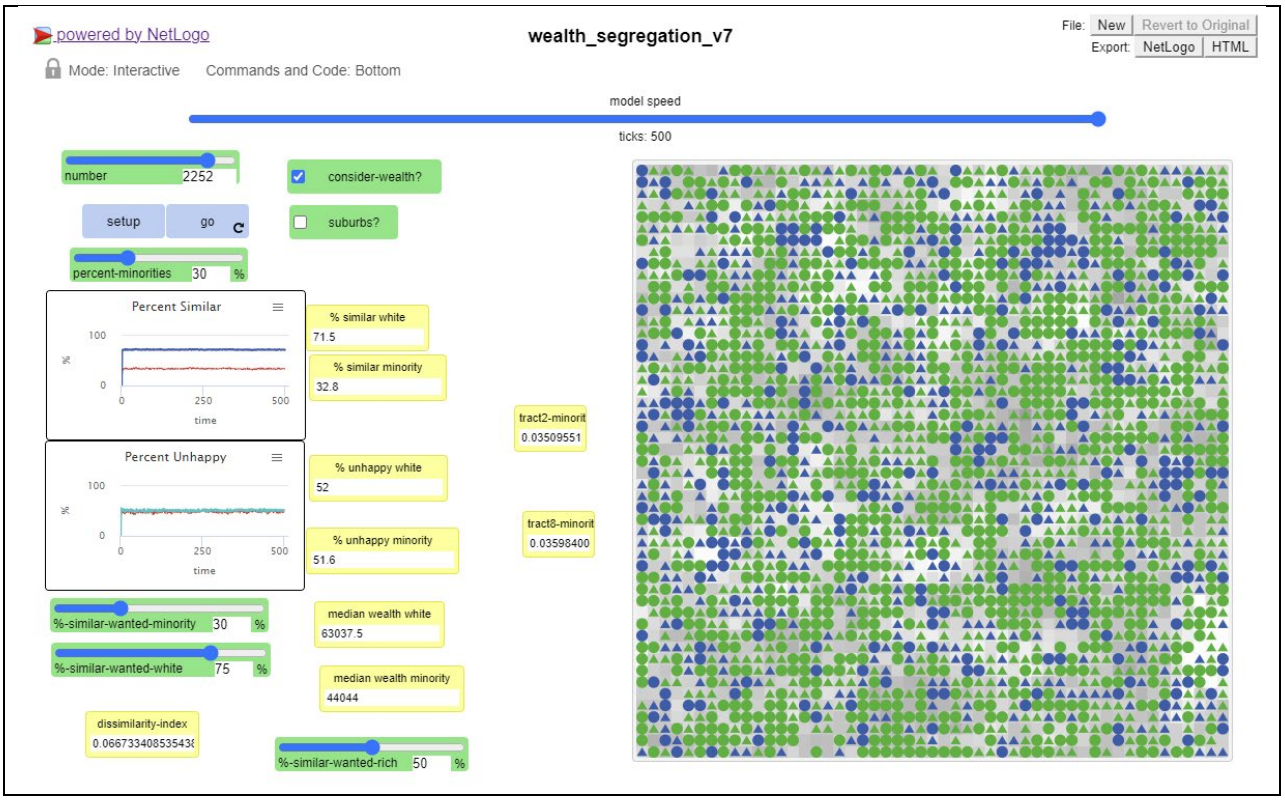
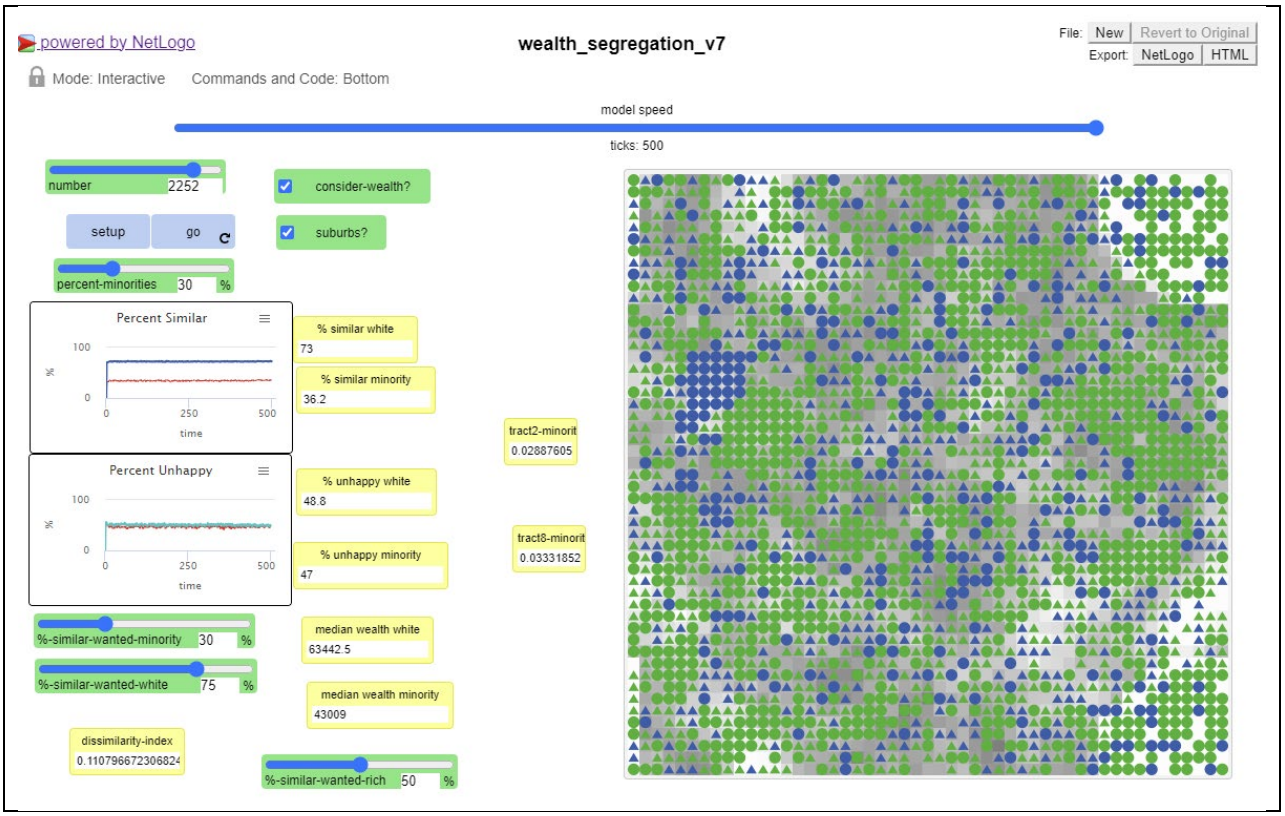


Figure 4: Residents Consider Race and Wealth in the Context of Exclusionary Zoning



The figures make clear the effect of exclusionary zoning. It produces a much more dramatic pattern of race and class segregation than preferences alone. Each model displays a variety of measures while it runs, one of which is the racial dissimilarity index calculated for the 9 areas. The measure bounces around a great deal while the residents move, but generally the result is higher in the model with exclusionary zoning. The shares of minority residents located in the two suburban areas is also lower in the model with exclusionary zoning. The pictures reveal that even though the suburban parcels begin with only a very slightly higher land value, when exclusionary zoning is in place, these parcels become much more valuable. These models provide a theoretical basis for understanding real world land use regulations. We should expect that neighborhoods with tighter regulations will be home to higher socio-economic status residents and that when land use regulations vary considerably across geographies, that we

should see demographic segregation as a result. The following sections explore these propositions.

Land Use Regulation Effects on Neighborhood Demographics

Through a National Science Foundation funded partnership through STIR labs with the Association of Bay Area Governments (ABAG), I was granted access to geocoded parcel level zoning information for all Bay Area communities as of 2021 (approximately 2.2 million parcels). I have three variables: a dummy indicator noting whether a parcel is zoned residential or something else, a dummy indicator noting whether a residential parcel is zoned for single-family or *Multifamily* use, and the maximum zoned dwelling units per acre (*Density*) for the parcel.[1] These variables were current as of 2021. I used these data to build a dataset to determine the relationship between land use designations and demographics at the neighborhood level, and the relationship between the segregation of land use designations and the segregation of residents within cities and school districts.

First, I use my two residential land use variables, *Multifamily* and *Max Density* (rescaled to run from zero to one) to predict the demographics of neighborhoods both across and within cities today. I gathered data from the 2015-2019 American Community Survey at the census block group level and spatially merged these data to the parcel data described above. I regress the block group *Percent White*, an entropy measure of *Diversity,* percent of residents that are *Renters*, percent of residents *Below Poverty,* percent of the housing that is *Single Family*, *Median Home Values*, and total number of new *Housing Permits* issued over the last 5 years. In Table 3, I present the regressions without fixed effects for cities, then in Table 4, I include city fixed effects. These fixed effects are important for interpretation. In Table 3 I am analyzing the correlation between land use regulation and demographics both across cities and within them. In

[1] These variables were encoded using each city's zoning map and general plan.

Table 4, I am only analyzing the relationship *within* each city. I cluster standard errors by block group in all models.

Table 3: Association between Land Use Regulation and Neighborhood Demographics Across All Neighborhoods												
	% White			**Diversity**			**% Renters**			**% in Poverty**		
	β	St. Err	P>|t|	β	St. Err	P>|t|	β	St. Err	P>|t|	β	St. Err	P>|t|
Max Density	-0.254	0.031	0.000	0.110	0.037	0.003	0.444	0.050	0.000	0.052	0.012	0.000
Multifamily	-0.088	0.007	0.000	0.070	0.009	0.000	0.099	0.007	0.000	0.015	0.002	0.000
Constant	0.487	0.005	0.000	1.062	0.006	0.000	0.295	0.004	0.000	0.067	0.001	0.000
N	1,590,427			1,590,543			1,590,415			1,590,415		
R^2	0.045			0.017			0.097			0.017		
	% Single Family			**Median Home Values**			**New Housing Permits**					
	β	St. Err	P>|t|	β	St. Err	P>|t|	β	St. Err	P>|t|			
Max Density	-0.932	0.061	0.000	$85,834	64,059	0.180	261.702	75.463	0.001			
Multifamily	-0.150	0.010	0.000	-$73,081	13,037	0.000	0.467	7.348	0.949			
Constant	0.752	0.005	0.000	$949,747	10,254	0.000	14.889	2.024	0.000			
N	1,590,415			1,567,240			1,590,543					
R^2	0.182			0.005			0.044					

Standard errors clustered by Census block group

Table 4: Association between Land Use Regulation and Neighborhood Demographics Across Neighborhoods Within Cities												
	% White			**Diversity**			**% Renters**			**% in Poverty**		
	β	St. Err	P>|t|	β	St. Err	P>|t|	β	St. Err	P>|t|	β	St. Err	P>|t|
Max Density	-0.086	0.028	0.002	0.085	0.035	0.015	0.412	0.042	0.000	0.063	0.013	0.000
Multifamily	-0.023	0.007	0.000	0.047	0.007	0.000	0.178	0.007	0.000	0.022	0.002	0.000
Constant	0.457	0.022	0.000	1.253	0.031	0.000	0.367	0.037	0.000	0.051	0.007	0.000
N	1,590,427			1,590,543			1,590,415			1,590,415		
R^2	0.506			0.398			0.287			0.163		
	% Single Family			**Median Home Values**			**New Housing Permits**					
	β	St. Err	P>|t|	β	St. Err	P>|t|	β	St. Err	P>|t|			
Max Density	-0.744	0.045	0.000	-$246,500	64,748	0.000	284.975	73.029	0.000			
Multifamily	-0.267	0.008	0.000	-$57,435	9,978	0.000	2.791	8.607	0.746			
Constant	0.593	0.043	0.000	$908,224	29,202	0.000	17.410	18.559	0.348			
N	1,590,415			1,567,240			1,590,543					
R^2	0.447			0.664			0.090					

Fixed effects for jurisdictions included, but not presented; standard errors clustered by Census block group

Tables 3 and 4 show that higher zoned density and multifamily designations are associated with more diversity and fewer white residents, more renters and more residents living below the poverty line. These regulations are also associated with less single-family housing, lower median home values, and (for higher zoned density) more new building permits. In short, parcel level land use regulations are HIGHLY correlated with neighborhood demographics both within cities and across them. In the aggregate then, cities that apply different development standards to different parcels should have both segregated housing types and segregated populations. In the next section I show that this is indeed the case – zoning segregation is correlated with racial segregation within cities.

Aggregate Correlation between Zoning Segregation and Demographic Segregation

To evaluate the relationship between zoning segregation and demographic segregation, I build measures of segregation using the parcel level data described in the previous sections. My main independent variable is a measure of the degree to which neighborhoods that are zoned for multifamily homes are spatially separated from neighborhoods that are zoned for single family homes. I calculate this measure between neighborhoods within each city using Thiel's *H* Index.

Theil's *H* measures the difference between the housing type zoning at the city level and the weighted average mix of housing type zoning of individual neighborhoods. The measure of housing type mix for each neighborhood and the city as a whole are influenced by the relative number parcels zoned for each type of housing, while the overall index is influenced by the relative size of each neighborhood, giving more weight to larger than to smaller places.

Theil's *H* Index is built from Theil's entropy score which is a measure of the mix of residential zoning types for a given geography.

$$E = \sum_{t=1}^{T} (\pi_t) \ln \frac{1}{\pi_t}$$

where π_t represents the proportion of parcels that are of residential zoning type *t*. The higher the entropy score, the more diverse an area is with respect to residential zoning types.[2] The score ranges between 0 and the natural log of the total number of types *T*. It is maximized when zoning types are evenly distributed across parcels.

$$\pi_t = \frac{1}{T} \text{ for all } t$$

Entropy is calculated for each neighborhood individually and for the city as a whole. It would be possible to analyze the distribution of many different housing types – but my data only include information on two basic types (single-family and multi-family zoning).

The *H* Index measures the degree to which the mix of residential zoning types in each neighborhood differs from the mix of residential zoning types in the city as a whole.

$$H = \sum_{n=1}^{N} \frac{U_n}{U_c} \left(\frac{E_c - E_n}{E_c} \right)$$

Where *U* represents total parcels in neighborhood *n* or city *c* and E is the entropy of *n* or *c*. *H* varies between 0, where all neighborhoods have the same composition as the entire city, and 1 where all neighborhoods contain only one housing type. I have one observation for each city

The *H* Index for *Multifamily Zoning Segregation* serves as my main independent variable. I calculate a similar index for my dependent variables, *Race* and *Class Segregation*. In the case of race segregation, the groups used to calculate entropy are white residents and non-white residents. For class segregation, I use the share of individuals earning less than 50% of the area median income (AMI), those earning 50-80% of the AMI, those earning 80-120% of the

[2] Where any housing type is equal to 0, the natural log is set to zero, as is the convention in the literature (Iceland 2004).

AMI and those earning above 120% of the AMI.[3] In each analysis I control for the share of the city population that is white and the share of the population in each income group. Table 5 presents the results.

Table 5: Multifamily Zoning Segregation Predicts Class and Race Segregation within Cities

	Income Segregation				Racial Segregation		
Variable	β	Std. Err	P>|t|		β	Std. Err	P>|t|
Multifamily Zoning Segregation	0.075	0.016	0.000		0.085	0.025	0.001
% White	-0.001	0.018	0.945		0.025	0.030	0.402
% <50% AMI	0.130	0.044	0.004		0.180	0.071	0.012
% 50-80% AMI	-0.095	0.087	0.275		0.135	0.139	0.333
% 80-120% AMI	-0.047	0.090	0.603		-0.150	0.145	0.303
Constant	0.052	0.022	0.019		-0.001	0.035	0.985
N	108				108		
R^2	0.336				0.253		

Note: OLS regressions

Table 5 reveals that segregating the type of housing across neighborhoods is positively associated with segregation along race and class lines. When some neighborhoods are zoned for multifamily housing while others remain zoned only for single-family homes, we are more likely to see the segregation of income groups and the separation of people of color from white residents. It is also interesting to note that about a quarter to a third of the variation in demographic segregation is explained by the variation in zoning segregation.

Because most children attend a school that is near to their home, residential segregation is highly correlated with school segregation (Johnson and Nazaryan 2019, Frankenberg 2013). To determine the degree to which land use regulations are also associated with school segregation, I

[3] These data are from the U.S. Department of Housing and Urban Development, Comprehensive Housing Affordability Strategy Data, 2014-2018, Table 7. Income groups are based on HUD calculations for Area Median Income (AMI). HUD calculates the AMI for different metropolitan areas, and the nine county Bay Area includes the following metropolitan areas: Napa Metro Area (Napa County), Oakland-Fremont Metro Area (Alameda and Contra Costa Counties), San Francisco Metro Area (Marin, San Francisco, and San Mateo Counties), San Jose-Sunnyvale-Santa Clara Metro Area (Santa Clara County), Santa Rosa Metro Area (Sonoma County), and Vallejo-Fairfield Metro Area (Solano County). The AMI levels in this table are based on the HUD metro area where this jurisdiction is located.

gathered data from the National Center for Education statistics and the California Department of Education and combined these data with the parcel information described above. We downloaded elementary school attendance boundaries for 2015-2016 from the School Attendance Boundary Survey.[4] For the demographic composition of schools, I use cumulative enrollment data from 2018-2019.[5] First, using GIS, I determined which parcels intersected each school catchment area and calculated the share of residential parcels that were zoned for *Multifamily* development for each school and each district. Then, I calculated the share of students in each school and each district that is *White* and *Non-White*, and *Socioeconomically Disadvantaged* and *Not Socioeconomically Disadvantaged*. I used these values to calculate Theil's H indices of zoning segregation, income segregation, and racial segregation between schools within districts. I regress income and race segregation on zoning segregation using OLS and present the results in Table 6.

Table 6: Multifamily Zoning Segregation Predicts Class and Race Segregation within School Districts

	Income Segregation				Racial Segregation		
Variable	β	Std. Err	P>|t|		β	Std. Err	P>|t|
Multifamily Zoning Segregation	0.269	0.051	0.000		0.282	0.046	0.000
% White	-0.084	0.036	0.022		-0.023	0.033	0.476
% Disadvantaged	-0.074	0.030	0.017		0.050	0.027	0.067
Constant	0.097	0.027	0.000		0.004	0.024	0.850
N	132				132		
R^2	0.280				0.326		

Conclusion

Determining whether land-use regulations play a role in maintaining and perpetuating segregation is crucial to our understanding of patterns of inequality. Historical accounts of land-use regulation development reveal that many cities aimed to preserve the socio demographic

[4] https://nces.ed.gov/programs/edge/data/SABS_1516.zip
[5] https://www.cde.ca.gov/ds/ad/filesenrcum.asp

characteristics of their communities through restrictive land use policies (which appear racially unbiased on their face). I find support for the proposition that land use regulations are associated with demographics across neighborhoods and between cities. I show that neighborhoods with lower density zoning have fewer residents of color, higher home values, and more residents above the poverty line. In the aggregate, this means that there is a strong relationship between segregation and land use across both neighborhoods and schools. Cities with stringent land-use regulations often argue that these regulations preserve the character of their neighborhoods and avoid the negative externalities of development, but this work suggests that these regulations serve to preserve the exclusivity of wealthier and whiter neighborhoods at the expense of a more diverse residential population.

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