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THE IMPACT OF LAND USE REGULATION ON RACIAL SEGREGATION

EVIDENCE FROM MASSACHUSETTS ZONING BORDERS

Matthew Resseger, ***Boston Planning & Development Agency***

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Abstract

Local zoning regulations such as minimum lot size requirements and restrictions on the permitting of multifamily housing may exacerbate racial segregation by reducing in some neighborhoods the construction of units that could house prospective minority residents. Although this hypothesis has long been recognized by urban economists and other social scientists, the lack of uniform land use data across jurisdictions has made empirical progress difficult. Using detailed spatial data available for all municipalities in Massachusetts, I investigate the impact of density zoning regulation on location choices by race. Capitalizing on the geographic detail in the data, I focus on variation in block-level racial composition within narrow bands around zone borders within jurisdictions, mitigating omitted variable concerns that arise in studies focusing on larger geographic units. My results imply a large role for local zoning regulation, particularly the permitting of dense multifamily structures, in explaining disparate racial location patterns. Blocks zoned for multifamily housing have black population shares 3.4 percentage points higher and Hispanic population shares 5.5 percentage points higher than single-family zoned blocks directly across a border from them. A simulation based on these results suggests that equalizing zoning density regulation across the Boston metro area would lower segregation by half a standard deviation of the national distribution on the most common measure.

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Author Affiliation and Contact Information

Matthew Resseger
Senior Economist
Boston Planning & Development Agency
mresseger@gmail.com

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The Impact of Land Use Regulation on Racial Segregation:

Evidence from Massachusetts Zoning Borders

Matthew Resseger

1. Introduction

Since the advent of mass suburbanization in the middle of the 20th century, the racial geography of most American metropolitan areas has followed a familiar pattern. Black and Hispanic households reside in neighborhoods proximate to the dense urban core, with the population of each subsequent ring of suburbs becoming whiter and more sparsely populated. Even though racial segregation may have peaked (Glaeser and Vigdor 2012) and minority suburbanization has drawn increased attention (Weise 2004), the relationship between the black population and residential density remains striking, particularly in northern and midwestern cities.

Density is not merely the outcome of a decentralized housing market. The evolution of America's racial geography has taken place against a backdrop of longstanding local zoning laws. These local regulations have played a key role in keeping lot sizes large and multifamily housing rare in many jurisdictions. While the letter of these laws is exclusionary only toward certain classes of residential land use, many argue the true impact extends toward exclusion of classes and races of people. I explore this argument by asking whether land use regulations permitting multifamily housing and lot size restrictions within jurisdictions in Massachusetts impact the location of black and Hispanic households within the state. I focus on variation at the block level across the boundaries of zones where regulations differ.

In some cases, historians have documented that such outcomes were in fact the *intent* of the laws, pointing toward jurisdictions that enacted land use regulations in the wake of Supreme Court cases striking down communities' abilities to enforce racial segregation through public regulation in 1917 or private restrictive covenants in 1948 (Danielson 1976; Rothstein 2017). Recent empirical work by Shertzer, Twinam, and Walsh (2016) uses fine-grained spatial data from Chicago in 1920 to show that industrial and density zoning in the city's initial comprehensive zoning adopted in 1923 were influenced by the existing neighborhood demographic composition.

Beyond the intent of such laws, the causal impact of zoning regulation on residential segregation remains an open empirical question. Though the strong correlation between density and minority concentration is readily apparent in population data, the relative scarcity of comprehensive zoning datasets has made gaining traction on the question difficult. The types of statutes used to restrict building construction differ considerably across jurisdictions, leaving researchers with a maze of lot size restrictions, frontage and setback regulations, floor-to-area ratios, and specific use prohibitions coupled with procedures for negotiating allowances through layers of local bureaucracy. Fortunately, in recent years researchers and government agencies have compiled comprehensive and navigable land use restriction datasets that make progress on this question achievable.

Taking advantage of detailed spatial data made available to the public by the Massachusetts Geographic Information System (MassGIS) (Office of Geographic Information 2013), I am able to assess the impact of zoning restrictions on minority population shares at the block level within jurisdictions in the major metropolitan areas of Massachusetts. Using the geographic detail of the data, I conduct an analysis of the impact of zoning regulation on minority population shares on either side of borders where land use regulation changes.

My focus on the impact of narrow spatial variation in land use restriction circumvents many of the omitted variable concerns that arise at higher levels of geographic aggregation. While zoning regulation may be one of the driving forces of racial segregation, there are many other factors that drive minorities and whites to live in different communities. Racial residential location could also be influenced by historical settlement patterns that developed in the aftermath of the Great Migration of black people from the rural South to northern industrial cities, access to public transportation, differing willingness and ability to pay for local amenities and public goods, housing discrimination, or individual preferences for living with members of a different race. To the extent that these factors differ between places with high and low levels of land use regulation, estimates of the impact of such laws may be confounded.

By focusing on differences in racial population shares along narrow bands on either side of zoning boundaries within a given jurisdiction, I am able to minimize the impact of these other city and neighborhood factors that vary more continuously across these boundaries. Though some caution is warranted in taking these boundaries as exogenous to racial population shares, I argue that such concerns are lessened given the consistency of these laws over long time periods and given that I have restricted the dataset to boundaries not coincident with other natural and manmade features.

Using this border design, I find robust evidence that land use regulation does negatively impact minority population shares on more restrictively zoned blocks in the 2010 census. The impact of by-right allowance of multifamily housing is particularly strong for both groups, and this is as true in the suburbs as in the urban core. Permitting multifamily housing leads to a 3.4 percentage point increase in the black share and a 5.5 percentage point increase in the Hispanic share.

I conclude by extrapolating these findings to the metro-area level. I argue that equalizing zoning across the Boston metro area could lower the black/non-black dissimilarity index in

Boston by half a standard deviation of the national distribution, which is enough to move Boston from the 70th percentile to the 50th percentile. These results strongly confirm the hypothesis that zoning negatively impacts racial integration, while suggesting caution in interpreting even larger impacts found in cross-metropolitan-area studies.

The paper proceeds as follows: In section 2, I review the literature on this topic. In section 3, I discuss the MassGIS and census data used here. In section 4, I provide a simple model to motivate the empirical work and suggest mechanisms by which land use regulation might affect segregation. Section 5 presents the main results, section 6 offers discussion, and section 7 concludes this paper.

2. Literature Review

The hypothesis that restrictive zoning may lead to decreased minority residence in more stringently regulated areas and greater overall segregation has long been present in the economics literature (e.g., Downs 1973; Fischel 1985). But rigorous empirical examination of the hypothesis has been undertaken only more recently. Pendall (2000) compiled a dataset for the purpose of examining this hypothesis, gathering survey responses from planning directors in 1,168 jurisdictions across the 25 largest US metropolitan areas. Pendall estimates that, in 1980, jurisdictions allowing only low-density housing (i.e., no more than eight units per acre) had less than half the black populations compared to those without such controls and only 60 percent as many Hispanic residents. Furthermore, the growth in minority populations was lower for jurisdictions allowing only low-density housing, with the black and Hispanic populations growing 0.8 and 0.5 percentage points more slowly, respectively.

Building on an updated version of Pendall's data (Pendall, Puentes, and Martin 2006) as well as incorporating data from the Wharton Land Use Regulation Index (Gyourko, Saiz, and

Summers 2008), Rothwell and Massey (2009) study the impact of zoning restrictions on metro area level segregation across the largest 49 US metro areas. To quantify segregation, they use the *dissimilarity index* to see how evenly two racial groups are distributed across a larger area. The value of the index equals the percentage of one of the racial groups that would have to move to ensure that the racial composition of each tract mirrored that of the metro area as a whole. They find that increasing the maximum allowable density by one standard deviation decreases the dissimilarity index of a metro area by between 4 and 7 percentage points in the 1990 and 2000 cross sections, depending on the ordinary least squares (OLS) regression specification. Their point estimate implies that moving from one end of the restrictiveness distribution to the other would lower the dissimilarity index by 25 percentage points. Instrumental variables (IV) regression shows a slightly larger effect, with a point estimate of 8 percentage points for a standard deviation change. They also show that places with higher allowable densities saw larger declines in segregation between 1980 and 2000.

These findings lend credence to the hypothesis that restrictive zoning has significant effects on racial segregation. But some caution is warranted: while both sets of authors acknowledge that other differences may exist between places with strict and lax zoning regimes, their data allow limited investigation of potential omitted variables bias. In the case of Rothwell and Massey, there is concern that the instrument of year of statehood, which is highly correlated with region effects, might be acting on segregation through any number of mechanisms beyond density zoning. The regional patterns in the dissimilarity index are striking—for instance, the top nine most segregated metro areas in the 2010 census are all in the Rust Belt region of the upper Midwest (Glaeser and Vigdor 2012), suggesting a role for other channels, such as disparate impacts of the Great Migration in the early 20th century (see, for instance, Boustan 2010; Shertzer and Walsh 2019).

This paper joins a growing economic literature using fine-grained spatial data to deepen our understanding of the impacts of policies from the last century on patterns of segregation today. Aaronson, Hartley, and Mazumder (2020) use a boundary design to show how the 1930s redlining maps led to reduced homeownership rates and house values and increased the black resident share in communities on the lower-graded sides of map boundaries. These impacts grew through the 1980s before declining. Sood, Speagle, and Ehrman-Solberg (2019) use geocoded data on 120,000 historical property deeds from Hennepin County, Minnesota, to measure the lingering impact of racially restrictive covenants on housing prices, black homeownership, and the location of black residents in the area decades after such covenants were ruled unconstitutional by the Supreme Court in 1948.

Most similar to my paper, Kulka (2019) incorporates both a boundary discontinuity design and a neighborhood choice model to study income sorting across the borders between zones with differing minimum lot sizes in Wake County, North Carolina, and finds a high degree of income sorting across boundaries. By focusing on regulations that are most relevant to single-family housing, Kulka is able to employ spatially detailed home sales and Home Mortgage Disclosure Act (HMDA) data. Because my paper is heavily focused on multifamily housing, I am more reliant on the 2010 census block-level data, which are fine-grained spatially but lack data on income. Income sorting plays a role in the racial sorting documented here, and better understanding that role remains an important question.

3. The MassGIS Zoning Data

The data for this paper come from MassGIS. The spatial data available from MassGIS span a broad set of topics, including economic and housing development, transportation, natural features, local governmental boundaries, and the environment. This paper focuses primarily on the zoning data, which were compiled by MassGIS from maps sent in by each town's government or planning agency around the year 2000. The data include polygons with the precise boundaries of each zone, as well as the written bylaws corresponding to that zone, and a series of coded variables derived from these bylaws. The data used here are described extensively and explored by Wheaton and Evenson (2003) and have been used by Zabel and Dalton (2011) to examine the effect of zoning on housing prices.

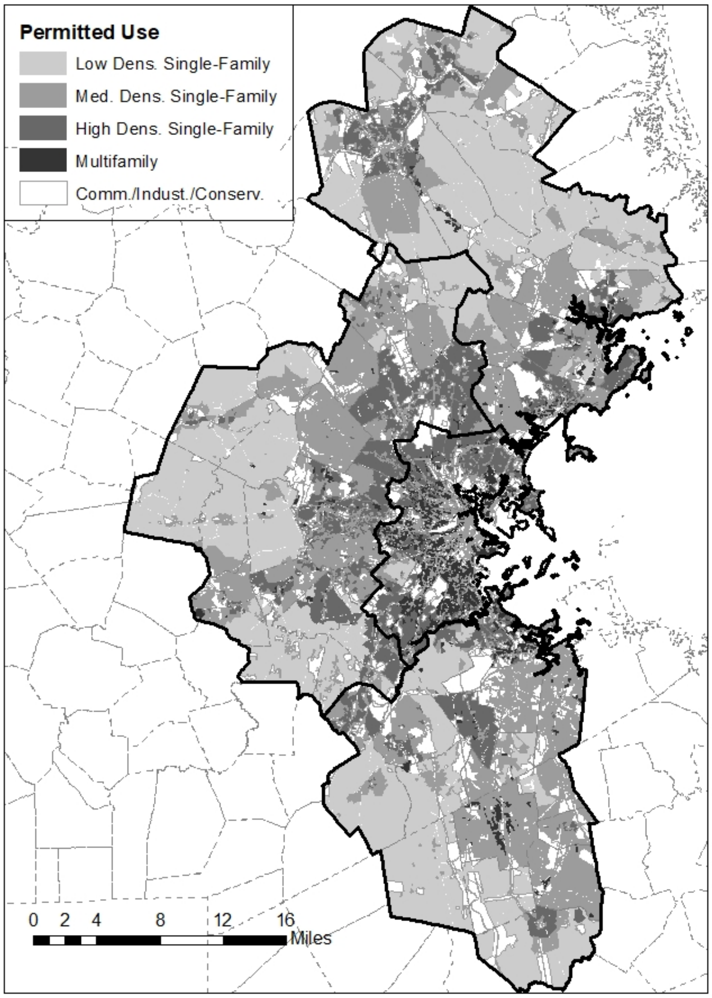
Since the completion of the first draft of this paper, MassGIS has stopped actively maintaining this dataset and has removed it from their website.[1] More recently, the Metropolitan Area Planning Council (MAPC) has developed a new Greater Boston Zoning Atlas for the 101 cities and towns in Greater Boston that make up their coverage area (Reardon, Guerrero, and Perkins-High 2020). A recent report by Dain (2019) also provides a thorough overview of the variety of approaches to multifamily housing used in Greater Boston zoning codes. Similar comprehensive datasets for other regions of the country remain rare, though researchers in Connecticut (Bronin 2021) and the Bay Area (Menendian, Gambhir, French, and Gailes 2020) have recently released data for those regions.

[1] The version of the MassGIS dataset used for this paper is available from the author upon request.

The main variables used in this paper are derived from the "primary use" variable, which classifies zones to one of 21 categories: 9 residential categories, 5 commercial categories, 2 industrial categories, 2 institutional categories, a mixed-use category, an unzoned category, and a category for land preserved for conservation or recreation. Within the residential categories, the primary focus of this paper, there are three for multifamily structures: densities of 3 to 8 dwelling units, 9 to 19 units, and greater than 20 units per acre. The remaining six residential categories break down single-family or duplex housing by minimum lot size, varying from a low category of 5,000 to 15,000 square feet (three to eight units per acre) to the largest category of 80,000 square feet and above (at least two acres per lot), as well as a category for mixed low-density agricultural and residential use.

Importantly, residential areas are coded by their densest possible use by right—that is, the densest structures that can be built without special permitting. In practice, some local zoning boards are more lenient than others in granting variances. But this coding allows an exploration of the effect of zoning laws as written, rather than as they have been interpreted over time—a variable more likely to be exogenous to current local conditions. Figure 1 shows how zoning varies across the Greater Boston area.

Figure 1. Zoning Regulation in the Boston Area



I overlay the blocks onto the zone data and classify each block by primary use if at least 90 percent of the block shares the same designated land use. I have probed the robustness of cutoffs from 75 percent to 99 percent, and the results are broadly similar. The threshold presents a tradeoff: a lower threshold introduces measurement error biasing the results downward, but a higher threshold lowers sample size, reducing power. The 90 percent threshold tends to yield similar point estimates to higher values without compromising power, whereas lower thresholds show more severe attenuation. With the 90 percent threshold, about 23 percent of blocks cannot be categorized as having a single use, 70 percent falls into one of the nine residential categories, and the remaining 7 percent have either commercial, industrial, institutional, or conservation uses.

The first column of table 1a shows summary statistics for populated blocks in Massachusetts metro areas. The majority (63.1 percent) of the blocks are in the Boston metro area, but blocks from Worcester, Springfield, and the Massachusetts portion of the Providence metro area are also included. Black households, measured as those with a black head of household in the census, make up 6.3 percent of the total, Hispanic households make up 7.7 percent, and non-Hispanic white households make up 79.8 percent.[2] The three races have strikingly different rates of renting versus owning, with black (66.5 percent) and Hispanic (75.4 percent) households renting at over twice the rate of white households (31.7 percent).

In terms of land use, 6.5 percent of blocks are zoned for multifamily residential use, with most of that being denser than eight units per acre. The 63.2 percent of land zoned for single-family use is split more or less evenly between low-density (lot sizes over an acre), medium-density, and high-density (less than 3/8 of an acre lot sizes) uses. I construct a linear measure of zoning by taking the nine categorical measures of residential zoning and assigning each the average dwelling units per acre observed in the full data for that category. This measure varies from 0.5 to 22 units per acre, with a mean of 4.1 and a median of 3.0.

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[2] Black here is defined as black alone, not in combination with other races, and includes those identifying their ethnicity as Hispanic. This is the subgroup for which the most data are available at the block level in the 2010 census. The share of black residents in Massachusetts who indentify their ethnicity as Hispanic was 10 percent in the 2010 census.

Table 1a. Summary Statistics for All Blocks and Full Border Sample

	All Blocks in Massachusetts Metro Areas			Blocks in Zoning Border Sample		
	Total	Share		Total	Share	
Household Level						
Total Housing Units	2,515,393			210,238		
Occupied Housing Units	2,353,170			198,041		
Black Head of Household	147,644	6.3%		17,906	9.0%	
Hispanic Head of Household	180,333	7.7%		13,775	7.0%	
White (Non-Hispanic) Head of Household	1,878,632	79.8%		152,248	76.9%	
Rental Units	906,254	38.5%		75,976	38.4%	
Black Renter	98,231	66.5%		11,247	62.8%	
Hispanic Renter	136,049	75.4%		10,087	73.2%	
White Renter	594,898	31.7%		47,754	31.4%	
Block Level						
Blocks	82,071			6,835		
Zone Borders				1,382		
Has Body of Water	6,375	7.8%		353	5.2%	
Zoned for Multifamily	5,354	6.5%		1,520	22.2%	
Multifamily High Density	4,438	5.4%		1,160	17.0%	
Multifamily Low Density	916	1.1%		360	5.3%	
Zoned for Single-Family	51,907	63.2%		5,315	77.8%	
Single-Family High Density	19,248	23.5%		2,007	29.4%	
Single-Family Medium Density	15,570	19.0%		2,222	32.5%	
Single-Family Low Density	17,089	20.8%		1,086	15.9%	
Boston Metro Area	51,811	63.1%		4,917	71.9%	
Urban Boston	9,112	11.1%		1,135	16.6%	
Route 128	10,282	12.5%		1,005	14.7%	
Block Level	**Mean**	**Median**	**St. Dev.**	**Mean**	**Median**	**St. Dev.**
Population	74.4	44.0	103.9	73.9	51.0	77.3
People per Acre	12.8	6.4	28.0	14.0	7.3	19.8
Dwelling Units per Acre	5.6	2.6	15.7	6.1	2.9	10.2
Rental Units per Acre	2.7	0.2	10.4	2.9	0.3	7.5
Zoned Units per Acre	4.1	3.0	4.8	5.7	4.7	5.8
Land (acres)	39.7	5.6	131.1	16.5	5.5	27.6
Dist. to City Center (miles)	17.3	15.2	12.4	15.5	13.4	11.0

Note: Population data are calculated using the 2010 US Census Summary File 1—Massachusetts, a 100 percent sample of the US population. Geographic and zoning data are constructed using GIS shapefiles available from MassGIS.

To ensure comparability between blocks, I employ several selection criteria. Starting with 82,071 blocks, I drop those with non-residential or split land use (23,079 blocks), anyone housed in group quarters (2,724 blocks), any public housing (687 blocks), land areas greater than 160 acres (3,074 blocks), and where more than 10 percent of the land area is covered by water (146 blocks). It is from this remaining set of 52,359 blocks that I draw the border samples.

To construct my border samples, I classify a block as falling on a zoning border if it intersects a 50-meter band drawn around a boundary where the type of permitted residential land use changes. I use only borders within towns and omit those that fall along highways, streams, or railroad tracks, as such barriers may serve as natural neighborhood dividing lines, and I want to ensure that blocks on both sides of the border have similar neighborhood characteristics. See, for instance, Ananat (2011) about the role of historical railroad lines in demarcating racial neighborhood boundaries.

To better understand the variation used in this study, figure 2 shows zoning regulation for Cambridge, Massachusetts, and blocks identified as being on zoning borders. Like many inner suburban areas, Cambridge residential land use is split between multifamily housing and high-density single-family housing. From the map, we can see that the south and east of the city are largely zoned for multifamily housing and commercial use, while the north and west have mostly single-family zoning. Given that differences may exist between the two regions—such as historic settlement patterns; access to popular commercial areas, parks, and universities; and proximity to heavier industry—the differences in composition is not expected to be driven entirely by land use regulation. However, focusing on the outlined blocks, it is more plausible that the differences in block composition across the black borders are the result of differential land use on either side.[3]

[3] Not all blocks surrounding borders are outlined due to those blocks failing one of the sample selection criteria. Generally, these blocks have either zero population or a positive group quarters population, or are split between two land use categories.

Figure 2. Zoning Regulation in Cambridge, MA

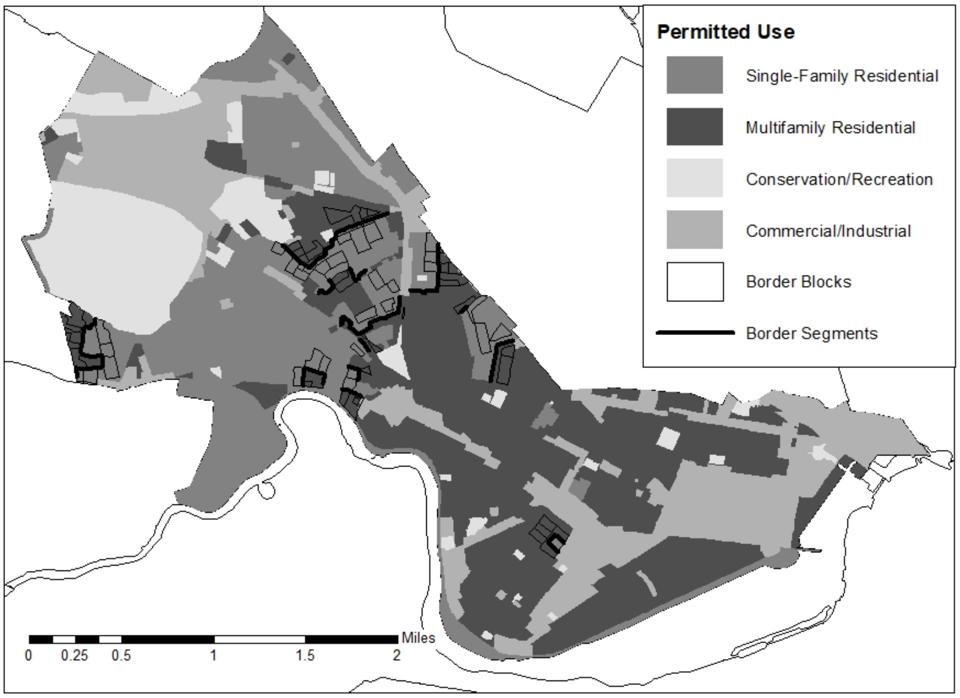


Figure 3 shows the distribution of the black population in Cambridge. Similarities between figures 2 and 3 suggest that the black population is more heavily concentrated in areas with multifamily zoning. However, focusing on variation across borders where neighborhood characteristics are held constant, patterns are harder to discern from cursory inspection.

Returning to table 1a, three main border samples are used in the analysis. The right-hand side shows descriptive statistics for blocks that lie on any zoning border where residential land use changes. These blocks are broadly similar to the full set of metro Massachusetts blocks on the left, though they have a somewhat higher share of black households (9.0 percent), are more concentrated in the Boston metro area, and are more likely to be zoned for multifamily housing.

Figure 3. Percent Black by Census Block in Cambridge, MA

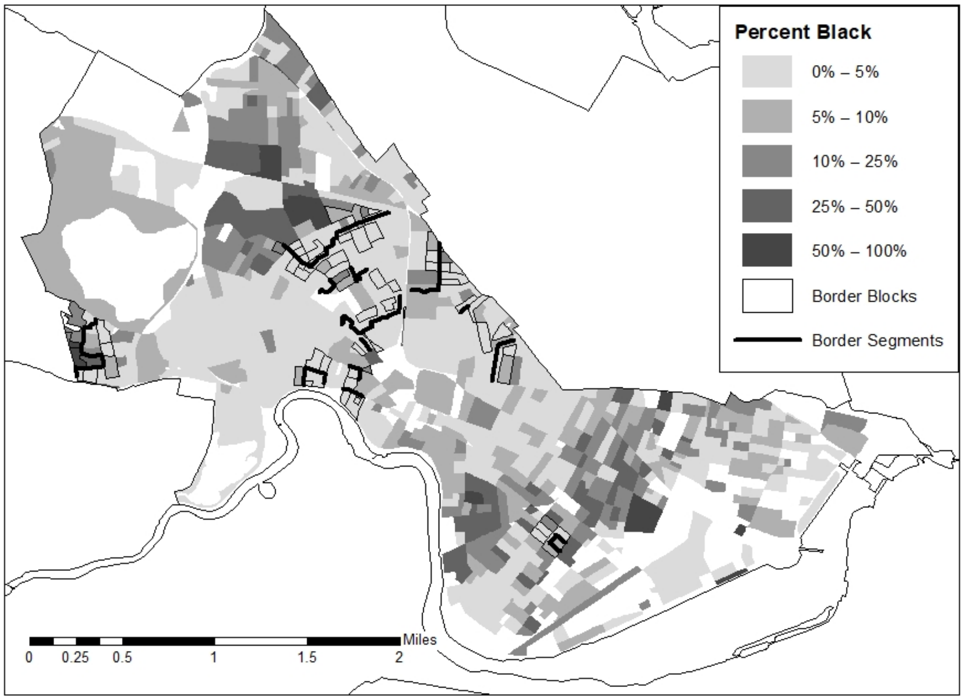


Table 1b shows descriptive statistics for two subsets of the border sample. The left column shows blocks on either side of boundaries where land use changes between single-family residential and multifamily residential. These blocks have considerably larger shares of black (13.1 percent) and Hispanic (10.0 percent) households. They are also more densely populated, have more rental units per acre, are smaller in land area, are closer to major city centers, and are particularly concentrated in Boston's urban core, defined as Boston and the nine suburban communities that lie within five miles of the city center. (See the appendix for the set of towns located in each subregion of the Greater Boston area.) The second column gives statistics for the sample comprised of blocks that lie on borders between single-family residential zones with different minimum lot sizes. These blocks have much smaller shares of black (1.7 percent) and Hispanic (2.3 percent) households, lower population densities, fewer rental units, and are more likely to be located along the Route 128 corridor in suburban Boston than in the urban core.

Table 1b. Summary Statistics for Border Subsamples

	Borders Between Multifamily and Single-Family Zones			Borders Where Single-Family Density Zoning Changes		
	Total	Share		Total	Share	
Household Level						
Total Housing Units	76,494			101,538		
Occupied Housing Units	71,629			96,602		
Black Head of Household	9,351	13.1%		1,667	1.7%	
Hispanic Head of Household	7,153	10.0%		2,190	2.3%	
White (Non-Hispanic) Head of Household	48,811	68.1%		88,445	91.6%	
Rental Units	36,671	51.2%		18,244	18.9%	
Black Renter	5,532	59.2%		716	43.0%	
Hispanic Renter	5,336	74.6%		1,052	48.0%	
White Renter	22,244	45.6%		15,464	17.5%	
Block Level						
Blocks	1,959			4,314		
Zone Borders	414			796		
Has Body of Water	25	1.3%		329	7.6%	
Zoned for Multifamily	932	47.6%		0	0.0%	
Multifamily High Density	638	32.6%		0	0.0%	
Multifamily Low Density	294	15.0%		0	0.0%	
Zoned for Single-Family	1,027	52.4%		4,314	100.0%	
Single-Family High Density	867	44.3%		1,153	26.7%	
Single-Family Medium Density	112	5.7%		2,118	49.1%	
Single-Family Low Density	48	2.5%		1,043	24.2%	
Boston Metro Area	1,387	70.8%		3,012	69.8%	
Urban Boston	666	34.0%		48	1.1%	
Route 128	77	3.9%		931	21.6%	
Block Level	**Mean**	**Median**	**St. Dev.**	**Mean**	**Median**	**St. Dev.**
Population	89.5	67.0	87.2	59.3	40.0	63.3
People per Acre	22.8	18.5	23.8	6.1	4.5	9.3
Dwelling Units per Acre	10.2	7.8	12.4	2.6	1.8	5.4
Rental Units per Acre	5.3	2.7	10.3	0.6	0.1	2.6
Zoned Units per Acre	9.0	4.7	6.2	2.7	1.9	1.4
Land (acres)	6.7	3.6	12.5	22.8	8.5	32.2
Dist. to City Center (miles)	12.5	7.4	12.1	17.6	15.9	9.6

Note: Population data are calculated using the 2010 US Census Summary File 1—Massachusetts, a 100 percent sample of the US population. Geographic and zoning data are constructed using GIS shapefiles available from MassGIS.

Finally, I make use of individual tax parcel data from MassGIS to investigate the types of structures present on each block. As with the land use regulations, these data were compiled by MassGIS through submissions from local officials. I use data for the entire Boston metro area with the notable exception of Boston itself.

4. A Model of Housing Choice and Density Zoning

Consider the housing market in the Boston metro area. I assume that the market is in static spatial equilibrium such that at price vector $P*$ everybody is living in their preferred home; that is, they are maximizing their indirect utility function:

$$V_i(H_{j,b,n}) = f[P_j^*(X_j, W_b, Z_n), X_j, W_b, Z_n] \quad (1)$$

where $H_{j,b,n}$ is a house j on block b in neighborhood n; X_j is a vector of attributes of the property, such as structure type, housing tenure, lot size, interior amenities, and distance to business districts; W_b is a vector of block-level characteristics; and Z_n is a vector of wider neighborhood characteristics, such as local amenities and public goods, neighbors, and the neighborhood's built environment.

The functional form of this relationship will not be crucial for the estimation in this paper, but I will assume it takes the linear form:

$$V_i(H_{j,b,n}) = -\alpha_i P_j^*(X_j, W_b, Z_n) + X_j\gamma_i + W_b\varphi_i + Z_n\omega_i \quad (2)$$

where the coefficients are allowed to differ across individuals.

The land use density restrictions are unlikely to enter the utility function directly. Rather, they affect individual well-being through their equilibrium impacts on the other variables in the utility function. This can be seen as an equation by introducing a small perturbation in density zoning at the block level:

$$V_i(H_{j,b,n}) = -\alpha_i \left[\tilde{P}_j^* + \left(\frac{\partial P_j}{\partial D_b} + \frac{\partial P_j}{\partial X_j}\frac{\partial X_j}{\partial D_b} + \frac{\partial P_j}{\partial W_b}\frac{\partial W_b}{\partial D_b} + \frac{\partial P_j}{\partial Z_j}\frac{\partial Z_j}{\partial D_b}\right) dD_b\right] + \left(\tilde{X}_j + \frac{\partial X_j}{\partial D_b} dD_b\right)' \gamma_i$$

$$+ \left(\widetilde{W}_b + \frac{\partial W_b}{\partial D_b} dD_b\right)' \varphi_i + \left(\tilde{Z}_n + \frac{\partial Z_n}{\partial D_b} dD_b\right)' \omega_i \qquad (3)$$

Rearranging and assuming that the derivatives take a linear form over the relevant range of zoning regulations yields the following:

$$V_i(H_{j,b,n}) = [-\alpha_i \delta_{pd} + \delta_{xd}(\gamma_i - \alpha_i \delta_{px}) + \delta_{wd}(\varphi_i - \alpha_i \delta_{pw})] D_b +$$

$$\delta_{zd}(\omega_i - \alpha_i \delta_{pz}) D_b - \alpha_i \widetilde{P_j^*} + \widetilde{X}_j \gamma_i + \widetilde{W}_n \varphi_i + \tilde{Z}_n \omega_i \qquad (4)$$

Some authors have employed a structural approach to modeling preference parameters by race based on observed racial location patterns. Recent work by Kulka (2019) incorporates minimum lot size restrictions into a discrete choice model to estimate their impact on neighborhood sorting in Wake County, North Carolina. Bajari and Kahn (2005) also employ a structural estimation strategy in the context of racial residential preferences. Bayer, Ferreira, and McMillan (2007) structurally estimate a discrete choice model on rich restricted-access census data to study the impact of residential sorting around school attendance zone boundaries.

In this paper, following Black (1999), I pursue a reduced form strategy, taking advantage of the sharp spatial discontinuities created by within-town zoning borders. Underlying this strategy is the assumption that density zoning regulation is the only thing changing exogenously at the border. The broader neighborhood characteristics should evolve together, and the residual attributes that would have existed in the absence of variation in zoning should be the same. Under this assumption, the indirect utility function simplifies to:

$$V_i(H_j) = [-\alpha_i \delta_{pd} + \delta_{xd}(\gamma_i - \alpha_i \delta_{px}) + \delta_{wd}(\varphi_i - \alpha_i \delta_{pw})] D_j + \theta_b \qquad (5)$$

where θ_b is a fixed border effect that absorbs all terms constant at the neighborhood level.

Estimating this directly would require assumptions on the error terms that would allow converting this into an equation about the observed data, which are racial shares at the block level. As I am less interested in the specific preference parameters than in the aggregate impact of density zoning, I estimate an equation relating a function of the observed block-level share of householders of a given race to the right-hand side variables in equation 5:

$$E(Y_{rb}|D) = g(\beta D_b + \theta_l) \qquad (6)$$

where Y_{rb} is the share of block b that is of race *r*; *g* is a function with range bounded by zero and one; β is some function of the differences by race in the distributions of the preference parameters and the zoning impacts on price and housing attributes; and θ_l is a dummy variable for whether the block falls near boundary line *l*.

Following Papke and Wooldridge (1996), I estimate equation 6 using what they term *fractional logit*, a technique they employ in the context of 401k participation rates, which is further described in Wooldridge (2001) and Baum (2008). I estimate the equation using Stata's fracreg command, which implements the generalized linear model for the binomial family using a logit link function. While the logit model is more frequently employed in contexts where the dependent value takes on the values 0 or 1, Papke and Wooldridge show that it can be used in a slightly altered way when the dependent variable represents a proportion. That is the case here, where the share of households on the block headed by a black householder can be thought of as an outcome of successive realizations of whether each house on the block is headed by a black householder. Constraining the predicted outcome to fall between 0 and 1 yields a better fit here than would estimating with ordinary least squares, particularly where so many blocks have black and Hispanic population shares close to 0. I cluster standard errors at the town level to allow for the error term to be correlated within town, and I report marginal effects averaged across the sample in each regression.

Although the preference parameters within the β function cannot be separately identified with this strategy, their presence in the indirect utility function provides a nice summation of the potential mechanisms through which zoning regulation might lead to changes in racial composition. Looking at equation 5, the first term, $-\alpha_i\delta_{pd}$, is a measure of individual price sensitivity that could differ on average across races multiplied by the direct impact of zoning on price holding other housing, block, and neighborhood characteristics fixed. Glaeser and Ward (2009) argue that, in theory, this direct impact should be small if the housing choice set is thick enough, though estimates of the direct price impact of zoning vary in the literature (Zabel and Dalton 2011).

The second term, $\delta_{xd}(\gamma_i - \alpha_i\delta_{px})$, shows the two channels through which changes in the housing stock that result from zoning regulations affect racial shares. People of different races may have different average preferences, γ_i, for attributes of housing, such as structure type, tenure, or lot size, though there is little direct evidence of this. More importantly, it may be that the types of housing built on the strictly zoned blocks differ in price from those on the surrounding less strictly zoned blocks, and that people of different races might on average be more sensitive to that price change. Given the differences in average income and wealth across racial groups, it is quite plausible that this price channel might play a significant role. A common argument for why density zoning is exclusionary is that it prices out poorer people who would like to live on the block but desire a quantity of housing consumption below the minimum threshold.

A final term, $\delta_{wd}(\varphi_i - \alpha_i\delta_{pw})$, represents the impact of zoning regulation on the block it applies to that does not extend to the broader neighborhood. Most importantly, this term captures the indirect impact that might result from the block-level changes in residential composition brought about by the direct impacts above. If zoning regulation causes residents of different races or incomes to be more prevalent on a block, then that may in turn change other residents' preferences for locating there. Crucially for the boundary design, it matters whether residents sort along race and income lines at the narrow block level, or at larger neighborhood geographies that span both sides of the zoning boundary. Bayer, Ferreira, and McMillan (2007) find evidence that households place significant value on their neighbors' education and income levels at the block level over and above the value they place on those attributes at the wider block group level. If that is the case here, then the boundary effect I estimate will include this sorting effect.

The term $\delta_{zd}(\omega_i - \alpha_i\delta_{pz})$ appeared in equation 4, but it is absorbed by the border effect in the regression specification. This term represents the impact of zoning-induced changes in equilibrium neighborhood characteristics on the racial composition of the broader neighborhood, first through differing preferences between races for neighborhood characteristics, and second through a price channel if zoning induces neighborhood level changes that alter the price of housing in the neighborhood. The border design will not identify this mechanism as part of the effect of density zoning regulation.

A much-studied dimension on which black and white residents might differ is preferences for the racial makeup of the neighborhood itself. To the extent these preferences are localized to the block level, they will be captured as part of the block component of the reduced form effect measured here, though they cannot be isolated directly. To the extent they operate at a broader neighborhood level, their impact will be absorbed by the border dummy variables and will not be included in the impact of zoning measured here. The failure of the border design to detect this effect is one of the main weaknesses of applying the approach in this context and suggests that the estimates here might be biased downward compared to the true long-term impact of zoning regulation. I will return to a discussion of this issue in section 6.

5. The Impact of Density Zoning on Racial Location Patterns

I focus first on the impact of density zoning on the share of occupied housing units on each block where the household head is recorded as black in the census. Using fractional logit, as discussed in the prior section, I estimate the impact of various zoning measures on the probability *p* that a given home is occupied by a black head of household.

I begin by exploring the impact of the linear zoning density variable constructed by assigning the average dwelling units per acre observed over the whole sample in each of the nine residential zoning categories to all zones in that category. This expected density measure provides a summary measure of the impact of zoning averaged over the full distribution of zoning densities in Massachusetts metro areas. I then focus on different types of zoning density regulations to understand whether certain densities or regulations are driving the overall impact.

I estimate equation 6 using fractional logit and report the average marginal effect in column 1 of table 2. This model includes border fixed effects, and standard errors are clustered at the town level, as they are in all subsequent regressions unless noted.

The marginal effect, significant at the 1 percent level, indicates that an extra unit of zoned density, measured in expected units per acre, increases the black share of householders on the block by 0.16 percentage points, where the baseline average black share is 6.3 percent in the overall population and 9 percent in the border sample. The distribution of marginal effects from the model suggests somewhat larger impacts for unit changes at higher densities and smaller impacts at lower densities.

Table 2. Black Share of Householders on Block and Zoning Density in Massachusetts Metro Areas

	Black Share of Householders						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Zoned Dwelling Units per Acre	0.0016** [0.0005]	0.0015** [0.0004]	0.0044** [0.0013]	0.0008 [0.0005]	0.0015** [0.0002]	–0.0018* [0.0008]	0.0043** [0.0013]
Distance to Major City Center		–0.0030 [0.0016]					
Block Contains Body of Water		0.0121 [0.0105]					
Border Fixed Effects	YES	YES	NO	NO	NO	NO	YES
Town Fixed Effects	NO	NO	NO	YES	YES	NO	NO
Observations	6,835	6,835	52,359	52,359	49,772	2,587	754
Blocks Included in Model	All Border Blocks	All Border Blocks	All Blocks in Sample	All Blocks in Sample	Non-Boston Blocks	All Boston Blocks	Boston Border Blocks
Black Share of Sample	9.0%	9.0%	6.2%	6.2%	4.0%	24.0%	29.3%

Note: Results shown are marginal effects from a fractional logit regression of block shares on measures of zoning density. The unit of observation in all models is the block. Blocks are included if they are in a metropolitan area, have a positive population, are zoned for residential use, have zero people living in group quarters or public housing, are less than 160 acres in land area, and have less than 10 percent of their area covered by water. A block is part of the border sample if it intersects a band of 50 meters around a zoning border where residential land use changes. Borders that coincide with bodies of water, highways, or railroads are omitted from the border sample. Standard errors are clustered at the town level—except column 6, which uses Huber-White robust standard errors.
*significant at 5 percent; **significant at 1 percent.

In column 2, I add controls for distance in miles to the metro area's main city center and whether any body of water is present on the block. Both are strong negative predictors of black population in the full sample, but the impact of density zoning on the black population is unaffected by their inclusion in the border regression. Neither shows up as a significant predictor of the black share, suggesting that the sample is reasonably well balanced on these dimensions.

I next explore whether the border design differs from simpler specifications that do less to limit the sources of variation in racial shares in the data. I first run fractional logit of the impacts of zoned density on the share of black householders on all 52,359 census blocks that meet the criteria for inclusion discussed in section 3. I then run the same model but include town fixed effects. The marginal effect in the model without fixed effects is 0.0044, more than twice the impact shown in the model that included border effects. Not surprisingly, much of the variation in the black share of the block population can be explained by the tendency of black residents to live disproportionately in jurisdictions clustered in highly urbanized areas with fewer density restrictions.

Surprisingly, controlling for town fixed effects shrinks the marginal effect to half the size of the effect measured using border fixed effects, and the effect is not significant at conventional levels. This is driven largely by the city of Boston, where the black population is more heavily concentrated in Roxbury, Dorchester, Mattapan, and Hyde Park, which are zoned mostly for low-density multifamily and high-density single-family housing; whereas the whiter areas closer to the city center are zoned for denser multifamily housing. After dropping Boston in column 5 of table 2, the town fixed effects estimate for the rest of Massachusetts looks similar to the estimates from the border design in column 1.

Taking Boston on its own in columns 6 and 7, using Huber-White robust standard errors, I compare the marginal effects of zoning density on black household share in the full sample and in the border sample with border fixed effects. The estimated marginal effect in the full sample is –0.018, significant at the 1 percent level. Reinserting border fixed effects, there is again a positive average marginal effect of 0.0043. Even though the black household share and zoning density are inversely related in the city as a whole, when focusing on comparable areas on either side of zoning boundaries, the side with less stringent density zoning restrictions is observed to have a higher proportion of black households.

This reversal highlights both the strength and the limitation of the local treatment effects identified by the border effects model employed here. By focusing on zoning boundaries where other neighborhood-level factors are similar on either side of the border, the model is more likely to capture changes in the black household share directly caused by zoning. However, when considering prospective zoning changes in areas dissimilar to existing zoning boundaries, the estimates here may prove uninformative. The estimates in this paper may not apply to downtown Boston, where dense multifamily housing is allowable but price per square foot is considerably higher than anywhere in the zoning border samples. I continue to probe effect heterogeneity in the following sections.

I repeat the same analyses for the Hispanic population in table 3 and find broadly consistent results with somewhat larger magnitudes. The average marginal effect of zoned units per acre on the share of Hispanic householders on the block is 0.26 percentage points, 60 percent larger than the impact observed for black households in table 2. Again, the estimated effect using the border design is smaller than running OLS in the entire sample of blocks. For Hispanic households, the border design also yields smaller estimates than does estimating with only town fixed effects.

Table 3. Hispanic Share of Householders and Zoned Density in Massachusetts Metro Areas

	Hispanic Share of Householders			
	(1)	(2)	(3)	(4)
Zoned Dwelling Units per Acre	0.0026** [0.0005]	0.0025** [0.0005]	0.0046** [0.0006]	0.0033** [0.0006]
Distance to Major City Center		–0.0011* [0.0005]		
Block Contains Body of Water		–0.0016 [0.0061]		
Border Fixed Effects	YES	YES	NO	NO
Town Fixed Effects	NO	NO	NO	YES
Observations	6,835	6,835	52,359	52,359
Blocks Included in Model	All Border Blocks	All Border Blocks	All Blocks in Sample	All Blocks in Sample
Hispanic Share of Sample	7.0%	7.0%	7.0%	7.0%

Note: Results shown are marginal effects from a fractional logit regression of block shares on measures of zoning density. The unit of observation in all models is the block. Blocks are included if they are in a metropolitan area, have a positive population, are zoned for residential use, have zero people living in group quarters or public housing, are less than 160 acres in land area, and have less than 10 percent of their area covered by water. A block is part of the border sample if it intersects a band of 50 meters around a zoning border where residential land use changes. Borders that coincide with bodies of water, highways, or railroads are omitted from the border sample. Standard errors are clustered at the town level.
*significant at 5 percent; **significant at 1 percent.

5.1. The Impact of By-Right Permitting of Multifamily Housing

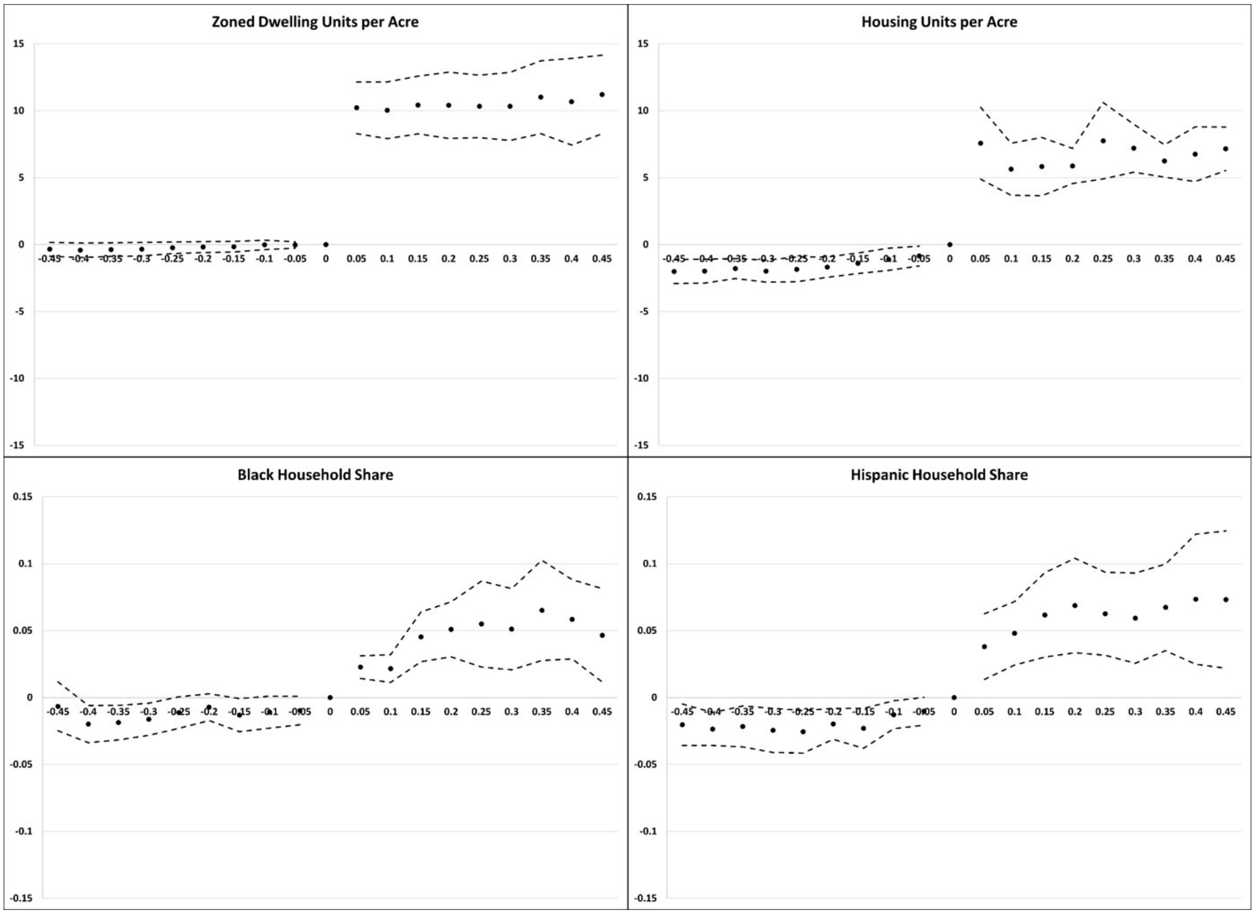
I now turn my focus to specific density restrictions, starting with by-right permitting of multifamily housing. Limiting the sample to borders where use changes from single-family to multifamily dwellings leaves 1,959 blocks that fall on 414 borders within 61 towns. The blocks are largely concentrated in the major cities of Boston, Springfield, and Worcester; in smaller cities, such as Brockton, Fall River, and Lowell; and in inner ring suburbs, such as Cambridge, Brookline, and Quincy. The land use regulation on the single-family blocks is predominately in the highest density category.

Figure 4 shows the impact of moving from one side of the boundary to the other. The four panels of the figure depict the way four variables move in proximity to a boundary between single-family and multifamily zoning. In each panel, distance to the boundary is measured in 0.05-mile increments out to a half-mile radius, with negative values reflecting blocks on the single-family zoned side of the boundary. The points depict the average value at each distance after controlling for border fixed effects. The confidence intervals reflect standard errors clustered at the town level.

The upper-left panel shows the value of the zoned dwelling units per acre variable constructed based on zoning categories. By construction there is a sharp discontinuity in density allowed by zoning on the single-family and multifamily side of the discontinuity. The upper-right panel shows how this difference in allowed density translates to observed housing unit density in the 2010 census. The side of the border zoned for multifamily housing has between 5 and 10 more housing units per acre at all distances shown.

The two bottom panels depict the impact of crossing the zoning boundary on black and Hispanic household shares. In both cases, there is a consistent and significant increase that occurs at the boundary and continues out to a half-mile radius.

Figure 4. Housing Units and Black and Hispanic Household Shares Near Boundaries Between Single-Family and Multifamily Zoning



Note: Each panel depicts the coefficients from a regression of the dependent variable on boundary fixed effects and dummies for 0.05-mile bands around the zoning boundary. Negative numbers reflect the distance from the boundary on the side zoned for lower-density housing. The dashed lines depict 95 percent confidence intervals based on standard errors clustered at the town level.

Table 4 confirms these findings. Column 1 shows the marginal effect of multifamily zoning on black household share from a fractional logit regression run within the border sample with border fixed effects. The impact of allowing multifamily housing on the share of black households on the block is 3.39 percentage points, significant at the 1 percent level. This is just over a quarter of the average black share of households for blocks in this sample. We can break down multifamily housing into low-density (up to 8 units per acre), medium-density (9 to 19 units per acre), and high-density (20 units and above per acre) levels. Column 2 shows that the point estimate is larger when crossing from single-family housing to medium-density and high-density multifamily housing compared to low-density multifamily, though Wald tests cannot reject the null hypothesis of equality between the coefficients at the three density levels.

Table 4. Impact of By-Right Permitting of Multifamily Housing on Race of Block Residents

	Black Share of Householders			Hispanic Share of Householders		
	(1)	(2)	(3)	(4)	(5)	(6)
Multifamily Housing Permitted	0.0339** [0.0054]			0.0554** [0.0127]		
Multifamily Low Density (3-8 units per acre)		0.0226 [0.0156]	(omitted)		0.0380** [0.0104]	(omitted)
Multifamily Medium Density (9-19 units per acre)		0.0339** [0.0073]	0.0773** [0.0097]		0.0566** [0.0202]	0.0190 [0.0146]
Multifamily High Density (20+ units per acre)		0.0435** [0.0160]	0.0906** [0.0092]		0.0685** [0.0194]	0.0538** [0.0119]
Border Fixed Effects	YES	YES	YES	YES	YES	YES
Observations	1,959	1,959	663	1,959	1,959	663
Blocks Included in Model	Single/ Multifamily Borders	Single/ Multifamily Borders	Multifamily Borders	Single/ Multifamily Borders	Single/ Multifamily Borders	Multifamily Borders
Black Share of Sample	13.1%	13.1%	24.6%	10.0%	10.0%	14.5%

Note: Results shown are marginal effects from a fractional logit regression of block shares on measures of zoning density. The unit of observation in all models is the block. See notes from table 2 for block and border selection criteria. Columns 1, 2, 4, and 5 use blocks that fall on a border between a single-family zone and those zoned for multifamily units. Columns 3 and 6 show blocks on borders of multifamily zones of different densities. Blocks are included if they are in a metropolitan area, have a positive population, are zoned for residential use, have zero people living in group quarters or public housing, are less than 160 acres in land area, and have less than 10 percent of their area covered by water. A block is part of the border sample if it intersects a band of 50 meters around a zoning border where residential land use changes. Borders that coincide with bodies of water, highways, or railroads are omitted from the border sample. Standard errors are clustered at the town level.
*significant at 5 percent; **significant at 1 percent.

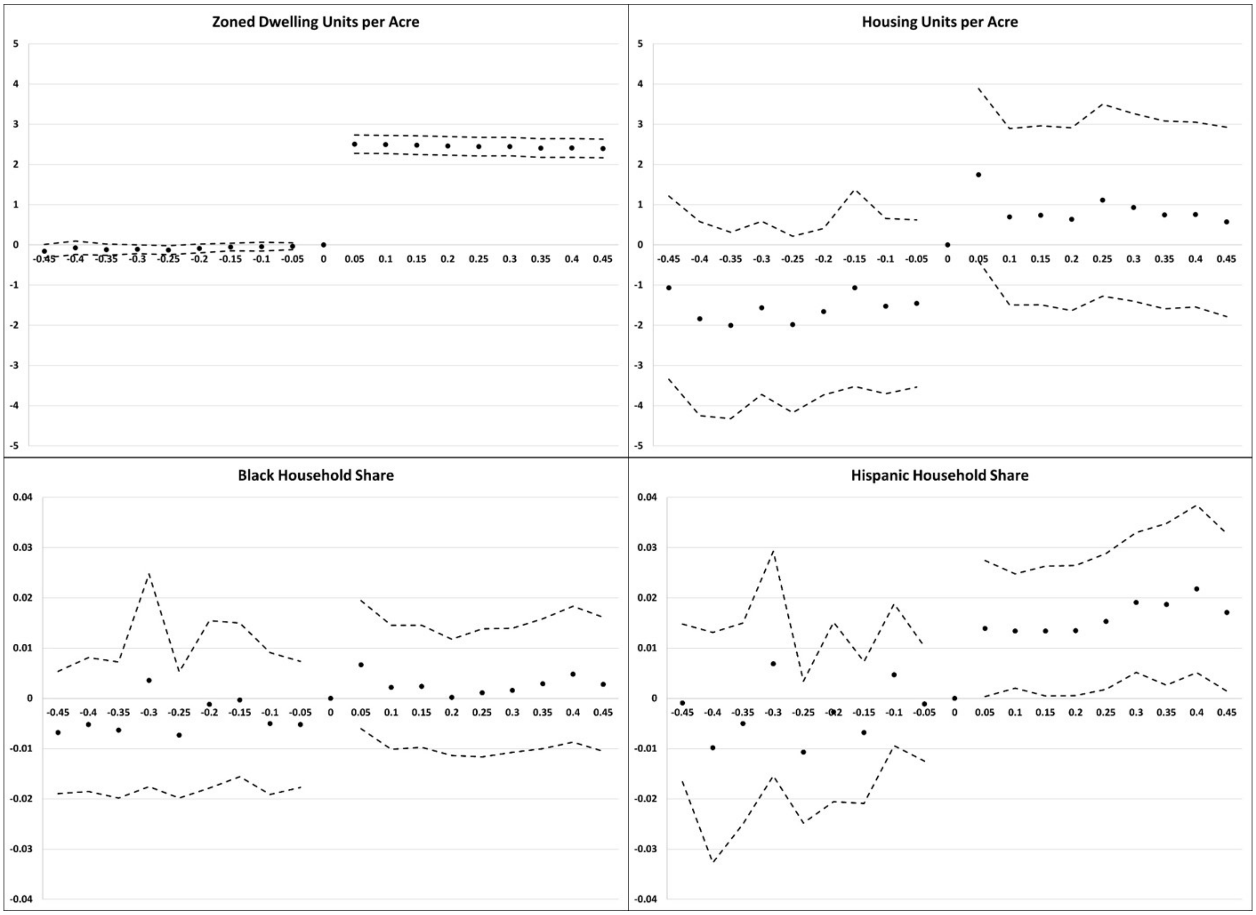
Column 3 instead uses the sample of borders between different classes of multifamily zoned housing and finds that moving from low-density multifamily housing (the omitted category) to medium-density and high-density multifamily housing yields sizable and significant positive marginal effects. The sample of borders used here, where two differently zoned multifamily districts intersect, has higher black household shares on either side of the border than the other border samples where single-family and multifamily zoning meet. The average black household share among blocks in this border sample is 24.6 percent. The marginal effects reported here suggest that in places where blocks zoned for three-unit and four-unit buildings meet zoning for denser multifamily, moving toward the side with denser zoning may increase the block household share by roughly a third.

Allowing multifamily housing increases the Hispanic share of households by 5.54 percentage points over a set of blocks where Hispanic share averages 10 percent. All three densities of multifamily housing have significant positive effects on the Hispanic share compared to single-family zoning, and, across borders where multifamily density changes, high-density multifamily zoning increases Hispanic household share compared to low-density multifamily zoning.

5.2. The Impact of Differences in Single-Family Zoning Density

The impacts of changes in single-family zoning density on the black household share are not detectable, in contrast to the sizable impacts of permitting of multifamily housing. Figure 5 shows the impact of moving across a boundary from lower-density single-family housing into higher-density (R5) single-family zoning. The point estimate for the number of observed housing units is positive at all distances, though imprecisely estimated. There is little visually discernible effect on black household shares, though there is a positive impact on the share of households with a Hispanic householder.

Figure 5. Housing Units and Black and Hispanic Household Shares Near Boundaries Between High Density and Lower Density Single-Family Zoning



Note: Each panel depicts the coefficients from a regression of the dependent variable on boundary fixed effects and dummies for 0.05-mile bands around the zoning boundary. Negative numbers reflect the distance from the boundary on the side zoned for lower-density housing. The dashed lines depict 95 percent confidence intervals based on standard errors clustered at the town level.

Table 5 confirms these results. The marginal effect of moving from low-density single-family zoning with lot sizes greater than an acre to medium-density or higher-density single-family housing are small in magnitude and insignificant for black households. The black household share on both sides of the border is small, averaging 1.7 percent in the border sample of blocks surrounding single-family zoning boundaries. Jurisdictions in Massachusetts with any zones more restrictive than the highest-density single-family zoning category have very small black populations, which makes using data from this region to explore the impact of minimum lot sizes difficult. The estimates here suggest that minimum lot sizes are unlikely to explain much of the present level of racial segregation in Massachusetts. They may, however, play a larger role in regions of the country with higher rates of black suburbanization, and conducting a similar analysis in other regions would be informative.

Table 5. Impact of Single-Family Zoning Density on Race of Block Residents

	Black Share of Householders		Hispanic Share of Householders	
	(1)	(2)	(3)	(4)
Single-Family High Density (lot sizes < 3/8 acre)	0.0022 [0.0059]		0.0124* [0.0055]	
Single-Family Medium Density (lot sizes btw 3/8 and 1 acre)	0.0008 [0.0044]		0.0023 [0.0025]	
Single-Family Low Density (lot sizes > 1 acre)	(omitted)		(omitted)	
Zoned Dwelling Units per Acre		0.0007 [0.0015]		0.0030* [0.0013]
Border Fixed Effects	YES	YES	YES	YES
Observations	4,314	4,314	4,314	4,314
Blocks Included in Model	Single-Family Borders	Single-Family Borders	Single-Family Borders	Single-Family Borders
Hispanic Share of Sample	1.7%	1.7%	2.3%	2.3%

Note: Results shown are marginal effects from a fractional logit regression of block shares on measures of zoning density. The unit of observation in all models is the block. All columns use blocks on borders between single-family zones of different densities. Blocks are included if they are in a metropolitan area, have a positive population, are zoned for residential use, have zero people living in group quarters or public housing, are less than 160 acres in land area, and have less than 10 percent of their area covered by water. A block is part of the border sample if it intersects a band of 50 meters around a zoning border where residential land use changes. Borders that coincide with bodies of water, highways, or railroads are omitted from the border sample. Standard errors are clustered at the town level. *significant at 5 percent; **significant at 1 percent.

For Hispanic households, the effect of minimum lot size is significant, with movement from one acre lot sizes to those 3/8 of an acre or less, implying a 1.24 percentage point increase in the Hispanic household share, significant at the 5 percent level. The magnitude is sizable in the context of the blocks in the sample of single-family borders, where only 2.3 percent of households have a Hispanic head. Even when limiting to the blocks that only border single-family zoning boundaries, the marginal effect of the zoned dwelling units per acre is 0.3 percentage points, similar in magnitude to the impact in the broader border sample in the first column of table 4.

While the black and Hispanic populations are of similar magnitudes in Massachusetts metro areas, the Hispanic population is dispersed over a broader set of communities, putting more Hispanic residents in places where they may be choosing between housing units near borders of single-family zones. This larger set of households in the border sample detects impacts for this group that may or may not arise for the black population were black residents more dispersed throughout the area. This highlights how the effects of zoning measured throughout this paper are specific to the context of residence patterns of black and Hispanic residents in Massachusetts as they evolved through the late 20th and early 21st century. They may differ from what would be observed in another place or time.

5.3. Heterogeneity across Areas

Some fair housing advocates have pointed to the restrictive land use regulation along the relatively affluent Route 128 corridor in Boston as having had particularly strong effects in limiting the growth of suburban minority populations (Morse 1975). However, it could be that even in the absence of restrictive land use regulation these towns would have low minority populations. To investigate, I break down the Boston portion of my sample into four subregions: Boston and nine inner ring suburbs comprising the urban core, the Route 128 corridor covering the west and northwest suburbs, and one each for areas north and south of the city, excluding some of the more distant shoreline communities. (See the appendix for a list of the cities included and a brief discussion of the construction of each subregion.)

Table 6. Heterogeneity of Effects of Zoning Categories on Racial Shares in Boston Sub-Metro Areas

	Black Share of Householders				Hispanic Share of Householders			
Boston Sub-Metro Area	Urban Core	Route 128 Corridor	North Suburbs	South Suburbs	Urban Core	Route 128 Corridor	North Suburbs	South Suburbs
Multifamily Housing Permitted	0.0440**	0.0328	0.0301**	0.0425*	0.0314**	0.0390**	0.0404*	0.0111
	[0.0091]	[0.0234]	[0.0060]	[0.0170]	[0.0075]	[0.0147]	[0.0183]	[0.0061]
Border Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Observations	696	105	191	326	696	105	191	326
Blocks Included in Regression	Single/ Multifamily Borders	Single/ Multifamily Borders	Single/ Multifamily Borders	Single/ Multifamily Borders	Single/ Multifamily Borders	Single/ Multifamily Borders	Single/ Multifamily Borders	Single/ Multifamily Borders

	Black Share of Householders			Hispanic Share of Householders		
	(2b)	(3b)	(4b)	(6b)	(7b)	(8b)
Boston Sub-Metro Area	Route 128 Corridor	North Suburbs	South Suburbs	Route 128 Corridor	North Suburbs	South Suburbs
Single-Family Low Density (lot size > 1 acre)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
Single-Family Medium Density (lots btw 3/8 and 1 acre)	–0.0258	0.0060**	–0.0043	0.0004	0.0107	0.0015
	[0.0291]	[0.0017]	[0.0099]	[0.0036]	[0.0073]	[0.0083]
Single-Family High Density (lot sizes < 3/8 acre)	–0.0269	0.0213**	0.0335*	0.0136*	0.0470*	0.0187*
	[0.0296]	[0.0075]	[0.0167]	[0.0068]	[0.0186]	[0.0092]
Border Fixed Effects	YES	YES	YES	YES	YES	YES
Observations	1,037	530	361	1,037	530	361
Blocks Included in Model	Single-Family Borders	Single-Family Borders	Single-Family Borders	Single-Family Borders	Single-Family Borders	Single-Family Borders

Note: Results shown are marginal effects from a fractional logit regression of block shares on measures of zoning density. The unit of observation in all models is the block. Blocks are included if they are in a metropolitan area, have a positive population, are zoned for residential use, have zero people living in group quarters or public housing, are less than 160 acres in land area, and have less than 10 percent of their area covered by water. A block is part of the border sample if it intersects a band of 50 meters around a zoning border where residential land use changes. Borders that coincide with bodies of water, highways, or railroads are omitted from the border sample. Standard errors are clustered at the town level. See appendix for sub-metro area definitions.
*significant at 5 percent; **significant at 1 percent.

In table 6, I break down the impact of zoning on segregation within these four subregions. The upper half of the table shows the marginal effect of permitting multifamily housing on minority populations in the sample of borders where land use changes from single-family to multifamily residential. The impact on the black share is remarkably consistent across regions, always falling between 3 and 5 percentage points. This is somewhat surprising, seeing as the mean black population in the four subregions differs substantially, and suggests that permitting multifamily housing in any part of the metro area is likely to have strong positive impact on the size of the black population. The coefficient for the Hispanic household share is also consistent and significant across three of the four subregions, though it is smaller and insignificant south of the city.

The bottom half of the table shows the impact of different classifications of single-family housing. Only one town in the urban core includes a boundary where single-family density zoning changes, so I do not include that region in the table. The results for black residents show variation across regions, with an insignificant negative impact of smaller lot sizes in the Route 128 corridor and marginally significant positive impacts of higher-density zoning north and south of the city. The impact of smaller lot sizes on the Hispanic share of households is consistently positive across the three regions.

5.4. Impact on Housing Types

To better understand how land use regulation affects block racial composition, tables 7 and 8 explore the impact of zoning on the types of residential structures on the block in the Boston metro area, omitting Boston where data are not available. Though block-level census data are only informative about the total number of dwelling units and whether they are owned or rented, parcel-level assessment data subdivide the residential structures into six categories: single-family, two-family, and three-family detached housing, small (four to eight units) apartment buildings, large (nine or more units) apartment buildings, and condominiums.

Because taxes are assessed to the owners of properties, houses and apartment buildings are listed by building, whereas condos, where units are separately owned, are listed by unit. Some towns report the number of units within an apartment building, but many do not. I can impute the number of units in a building of a given type by regressing the total number of dwelling units counted in the census of each of the six building types at the block level in the full block sample. Reassuringly, the coefficients for one-family, two-family, and three-family houses from this regression are almost exactly one, two, and three, respectively, so that building a single-family house on a block corresponds to adding one dwelling unit to the block. The coefficient is roughly 5 for small apartment buildings and 30 for large apartment buildings. For condominiums, the coefficient is around 0.75, indicating that there is some measurement error in that variable likely caused by different buildings having different ownership structures. This suggests caution in interpreting the condominium results.

In general, these imputations will lead to understated results if the size of apartment buildings within categories is correlated with the prevalence of buildings across categories, as is likely to be the case. For instance, if larger apartment buildings tend to be built on blocks where more apartment buildings are built, the imputation will understate the impact of zoning regulations on the number of apartment units. Nonetheless, these regressions can be informative about the underlying trends in building type connecting zoning regulation to racial shares.

Table 7 shows the coefficients from border fixed effects regressions of total units and structure type on permitting multifamily housing in the sample of blocks that lie on a border between single-family and multifamily zones. I break multifamily zoning into two categories—low-density (three to eight units per acre) and medium-density to high-density (nine units per acre and above)—as the results in the earlier models suggested different impacts for each. Columns 1 and 2 show the impact on the overall number of dwelling units per acre and the number of rental units per acre from census data. Going from permitting single-family housing to permitting low-density multifamily housing leads to 4.3 additional dwelling units per acre and an increase of 3.7 additional rental units per acre. Permitting high-density multifamily housing increases the number of dwelling units by 8.4 units per acre and the number of rental units by 6.6 per acre.

Table 7. Permitted Use and Types of Housing Units Available on Border Blocks

	Dwell. Units per Acre (1a)	Rental Units per Acre (2a)	1-Family Units per Acre (3a)	2-Family Units per Acre (4a)	3-Family Units per Acre (5a)	Small Apt. Units per Acre (6a)	Large Apt. Units per Acre (7a)	Condo Units per Acre (8a)
Zoned for Single-Family	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
Zoned for Low-Density	4.3395**	3.6965**	–1.2493**	1.1995	0.4263*	0.8148*	0.7025	0.8098
Multifamily Housing	[1.1765]	[1.0419]	[0.4473]	[0.6341]	[0.1648]	[0.3113]	[0.6036]	[0.4436]
Zoned Med./High-Density	8.3706**	6.5756**	–1.3173**	–0.6234	0.8452*	0.4043	4.7508*	4.0760*
Multifamily Housing	[1.7245]	[0.9851]	[0.3130]	[0.4795]	[0.3353]	[0.2322]	[1.9247]	[1.7230]
Border Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Observations	1,959	1,959	850	850	850	850	850	850
Blocks Included in Regression	Single/ Multifamily Borders	Single/ Multifamily Borders	Single/ Multifamily Borders	Single/ Multifamily Borders	Single/ Multifamily Borders	Single/ Multifamily Borders	Single/ Multifamily Borders	Single/ Multifamily Borders
	(1b)	(2b)	(3b)	(4b)	(5b)	(6b)	(7b)	(8b)
Zoned for Low-Density Single-Family Housing	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
Zoned for Med.-Density	0.6382*	0.1647	0.7186**	0.0697	0.0068	0.0266	0.0525	–0.9286
Single-Family Housing	[0.2470]	[0.1573]	[0.1045]	[0.0664]	[0.0207]	[0.0298]	[0.0549]	[1.1327]
Zoned for High-Density	2.4894**	0.9077**	1.1315**	0.6870**	0.2161**	0.1623**	0.223	–0.6184
Single-Family Housing	[0.3797]	[0.2855]	[0.2247]	[0.1766]	[0.0695]	[0.0548]	[0.1162]	[0.9719]
Border Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Observations	4,314	4,314	2,491	2,491	2,491	2,491	2,491	2,491
Blocks Included in Regression	Single-Family Borders	Single-Family Borders	Single-Family Borders	Single-Family Borders	Single-Family Borders	Single-Family Borders	Single-Family Borders	Single-Family Borders

Note: The unit of observation in all regressions is the block. Blocks are included if they are in a metropolitan area, have a positive population, are zoned for residential use, have zero people living in group quarters or public housing, are less than 160 acres in land area, and have less than 10 percent of their area covered by water. A block is part of the border sample if it intersects a band of 50 meters around a zoning border where residential land use changes. Borders that coincide with bodies of water, highways, or railroads are omitted from the border sample. Standard errors are clustered at the town level.
*significant at 5 percent; **significant at 1 percent.

Moving to columns 3 through 8, the sample drops as assessment data are available only for a portion of the sample. Permitting low-density multifamily housing leads to a significant negative impact of more than one single-family residence per acre, and significant positive impacts on three-family and small apartment units. The impacts of permitting medium-density and high-density multifamily housing show up particularly strongly for large multifamily apartment units and condominium units, with small increases in three-family houses and small apartment buildings and decreases in one-family and two-family housing.

The bottom panel of table 7 repeats the same regressions, but for different densities of single-family zoning, using the single-family housing border sample. Permitting dense (less than 3/8 acre lot sizes) single-family housing leads to 2.5 additional dwelling units per acre and 0.9 additional rental units compared to blocks with lot sizes of one acre or larger. Moving from lot sizes over an acre to those between 3/8 and one acre yields an extra 0.6 total dwelling units, but a trivial amount of new rental housing. Not surprisingly, these impacts are concentrated in increases in single-family units and, in the case of high-density single-family zoning, two-family residential units.

To connect this back to racial shares, in table 8, I regress the number of housing units for each race on the types of housing on the block. Column 1 shows the results of a regression of total units on housing types, including border fixed effects for all blocks on borders. The results are as expected, though the number of additional units from adding three-family houses looks closer to two in this sample, suggesting some misclassification between two-family and three-family houses in the data. Turning to column 2, the results for black households show that nearly all the gains come from the presence of large apartment buildings. This sheds light on the results from earlier tables showing that medium-density and high-density multifamily permitting are the only regulations that have significant impacts on the share of the block householders that are black.

Table 8. Impact of Building Type on Housing Units and Households by Race

	Housing Units per Acre (1)	Black Households per Acre (2)	Hispanic Households per Acre (3)	White Households per Acre (4)	Housing Units per Acre (5)	Black Households per Acre (6)	Hispanic Households per Acre (7)	White Households per Acre (8)
Region Included	Boston Metro	Boston Metro	Boston Metro	Boston Metro	Route 128	Route 128	Route 128	Route 128
Single-Family Houses per Acre	0.9615** [0.0170]	0.0066 [0.0042]	0.0092* [0.0041]	0.8726** [0.0160]	1.0092** [0.0202]	0.0140** [0.0028]	0.0104** [0.0020]	0.8815** [0.0157]
Two-Family Houses per Acre	2.0819** [0.1664]	0.1845* [0.0827]	0.1635* [0.0694]	1.3799** [0.1763]	2.7143** [0.3428]	0.0758** [0.0292]	0.0691** [0.0236]	2.2404** [0.2369]
Three-Family Houses per Acre	1.8268** [0.5270]	0.0831 [0.1064]	0.6786* [0.2978]	0.855 [0.5363]	–1.0813 [3.3421]	–0.332 [0.2880]	0.368 [0.2912]	0.0051 [1.8357]
Small Apartment Buildings per Acre	6.0667** [1.1647]	0.1669 [0.0868]	0.4171 [0.2485]	4.3858** [1.2067]	7.8432* [3.6293]	0.4703 [0.3295]	0.7101* [0.3066]	4.7903* [2.2212]
Large Apartment Buildings per Acre	34.1206** [5.7976]	3.8864** [1.2541]	2.7969** [0.6009]	20.7355** [3.7459]	63.5854** [19.1119]	3.8849** [1.4718]	2.6577** [0.9883]	40.2098** [11.0048]
Condominium Units per Acre	0.8880** [0.1097]	0.0180* [0.0074]	0.0232* [0.0111]	0.6979** [0.1067]	0.7269** [0.2408]	0.0284** [0.0102]	0.0343** [0.0126]	0.4560** [0.1523]
Border Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Observations	3,421	3,421	3,421	3,421	929	929	929	929
Blocks Included in Regression	All Border Blocks	All Border Blocks	All Border Blocks	All Border Blocks	All Border Blocks	All Border Blocks	All Border Blocks	All Border Blocks

Note: The unit of observation in all regressions is the block. Blocks are included if they are in a metropolitan area, have a positive population, are zoned for residential use, have zero people living in group quarters or public housing, are less than 160 acres in land area, and have less than 10 percent of their area covered by water. A block is part of the border sample if it intersects a band of 50 meters around a zoning border where residential land use changes. Borders that coincide with bodies of water, highways, or railroads are omitted from the border sample. See appendix for sub-metro area definitions. Standard errors are clustered at the town level.
*significant at 5 percent; **significant at 1 percent.

For Hispanic households in column 3, the coefficients on three-family and small apartment buildings are also sizable, though the standard error for small apartments is too large to draw firm conclusions. Nonetheless, this is consistent with the results mentioned previously indicating that low-density multifamily housing has strong impacts for the Hispanic population that are not seen for black residents. Column 4 provides the numbers for non-Hispanic whites as a contrast. Additional units of all types increase the white population. This is not surprising since whites make up 70 percent of the population in the area, but the relative impacts for white households are much stronger in the single-family and condominium categories than for apartment units.

To confirm that these impacts of structure type on the size of black and Hispanic populations are not being driven by only the urban core portion of the sample, I rerun the same regressions in columns 5 through 8 for just the Route 128 corridor. Column 5 shows that the gains in units for each category are roughly equal, but columns 6 and 7 show somewhat smaller increases for black and Hispanic households than the ones in columns 2 and 3. Nonetheless, additional large apartment buildings increase the black population, as do additional small and large apartments for the Hispanic population. The impact of additional three-family houses, while still positive for Hispanic residents, is smaller and not distinguishable from zero. These results suggest that building more multifamily housing in the suburbs, especially large apartment buildings, would increase minority populations.

6. Discussion

While the border design helps to reduce omitted variable bias, endogeneity may continue to be a concern. It may be that places that had small black populations to begin with were precisely the places where more restrictive zoning laws were put in place, as historians cited previously have argued. Any model that looks within towns, whether using town fixed effects or the more restrictive border design, will mitigate this concern as the town is the level of government writing zoning restrictions. In addition, some motives for enacting zoning legislation, such as excluding those of lower incomes to avoid a drain on local public finances, act at the town level rather than the neighborhood level. However, concerns remain that the residents of certain neighborhoods might lobby their local governments to preserve those neighborhoods with zoning restrictions while allowing members of other races to move into other parts of the jurisdiction that already have more minorities.

Given the narrow spatial focus here, in order to violate the assumptions of the design there would need to be some reason why, in the absence of zoning regulation, block-level racial shares would not converge toward those of directly adjacent blocks over time. Certainly, when major roads, railroad lines, or streams mark the border between zones, there is cause for concern that such boundaries would demarcate racially segregated neighborhoods on their own. But given that I am dropping these borders from the analysis, the concern is somewhat lessened.

Also reassuring is that historical zoning maps for communities in the area such as Arlington, Newton, Quincy, and Sudbury show remarkable consistency over time. In Newton, though the rules governing land use within each zone have changed over time, the borders themselves are nearly identical to those that appear on a 1921 zoning map. Similarly, the boundaries of Sudbury's residential zones remain unchanged since they were originally drawn in 1955. In Quincy, the list of zone changes since 1976 numbers in the hundreds. However, in nearly all cases, these are not changes from one residential classification to another but rather changes in zoning for commercial and conservation purposes, which are not part of this analysis.

Though a more rigorous historical examination is surely a worthy endeavor, the relative stability of these regulations over long time periods in the subset of towns for which data are readily available lends credibility to the approach taken here. The fact that I observe few changes in regulations in Massachusetts towns is unsurprising in light of the state law that required a two-thirds supermajority for local zoning boards to amend zoning rules. This law was changed to a simple majority as part of the Housing Choice legislation that passed only at the beginning of 2021.

There are some caveats about the local average treatment effects estimated using this border design model. Much of the current literature explores the impact of residents' racial preferences on housing market equilibria (see, for example, Schelling 1971; Cutler, Glaeser, and Vigdor 1999; Card, Mas, and Rothstein 2008). If zoning changes impact a neighborhood's racial composition, this may induce further changes in neighborhood composition; that is, people might choose housing based on personal preferences about their potential neighbors. To interpret the results, it is crucial to determine how much of that sorting takes place within narrowly defined geographies like the block and how much takes place across larger neighborhoods that span both sides of the zoning boundary. If racial composition changes within the narrow geography, it is captured as part of the effect I measure. If it spans the boundary, then it is missed by my border fixed effects design.

These two types of sorting may bias the results in opposite directions when interpreting the results in the context of removing variation in zoning regulations. If sorting based on neighbors' race, income, or education at the block level is substantial, then, in the absence of salient zoning boundaries, it could be that residents would gradually resegregate along other lines. This would lessen the impact of removing zoning boundaries that one might expect based on the reduced form results here. On the other hand, if the impact of zoning on neighborhood composition is spilling across the boundary through sorting effects at the broader neighborhood level, then it could be that the effects measured here underestimate the full impact of removing variation in zoning.

One could return to a larger unit of geography, such as the metro area, where the unit of observation is sufficiently large as to rule out spillovers beyond its bounds, though at the risk of retaining the confounding factors discussed in the review of prior literature. Alternatively, with richer block-level data, such as the restricted-access census data used by Bayer, Ferreira, and McMillan (2007), one could attempt to explicitly model these spillover effects in the context of zoning. Kulka (2019) is able to make progress in this direction when modeling the impact of lot size restrictions on income sorting. Her strategy, which relies on fine-grained spatial data on home sales and loan applicants from Home Mortgage Disclosure Act (HMDA) data, would be difficult to execute here where so much of the impact is being driven by multifamily rental housing for which fine-grained spatial data are less available.

Furthermore, as with any local average treatment effect, caution should be taken in extrapolating these results to other contexts. Boston in particular has some of the strictest land use regulations in the country as measured by both Pendall (2000) and the Wharton Residential Land Use Survey, and it would be interesting to see how the micro-level estimates compare in regions with a less extreme distribution of zoning.

Another unique feature in Massachusetts is Regulation 40B, a statewide statute that allows developers to seek state authorization to override local zoning authority in communities where less than 10 percent of housing is deemed affordable in exchange for maintaining at least 20 percent of the new units as affordable (Fisher 2008). The threat of this law has also motivated some municipalities to enact their own inclusionary zoning laws to achieve the same outcomes with more local control. However, according to an examination by Schuetz, Meltzer, and Been (2011), these laws had led to only modest levels of production of affordable housing before the 2010 data measured here, with only about a fifth of communities reporting any new housing built under their inclusionary zoning laws at the time of their study. If communities made widespread use of these regulations, the evidence I find from zoning borders might be attenuated compared to what would be found in places without such regulations. But Schuetz, Meltzer, and Been's work suggests that perhaps the lost revenue from having to set aside affordable units mutes the impact of these laws.

Even within Massachusetts, the estimates here are only informative about places that look like those falling along zoning borders. Allowing construction of multifamily apartments may have very different effects in a rural area zoned for an agricultural and residential mix than it would in places bordering extant multifamily zones. The heterogeneity analysis showing strong impacts even in suburban areas such as the Route 128 corridor is reassuring here. But that may mask variability within that region between places close to and far away from multifamily districts. Fortunately, the margins most relevant for policy are those along which the impacts are being identified in the data. This is because communities are likely to enact small policy changes by moving one or two lot size categories or by shifting from higher-density single-family to multifamily housing.

Proceeding with caution, given these caveats, I conclude the analysis by seeing what the results imply about the impact of zoning on area-level segregation measures. One way of assessing this is to take the estimates of the impact of zoning on block-level population shares by race and simulate the impact of equalizing zoning regulation across the area. This should not be thought of as a policy simulation as I am not suggesting that the areas toward the city center should substantially reduce zoned density to meet the suburbs at the halfway point. Rather, this is an attempt to estimate segregation in the absence of zoning variation while holding the area's overall minority populations constant.

I measure metro-area-level segregation using the dissimilarity index at the tract level. For two racial groups, the dissimilarity index measures the percentage of one group that would have to move in order for that group's tract-level share of the population to be equal across the area. This is a common measure in the sociology and economics literature on segregation and is the measure used by Rothwell and Massey (2009) in their papers on the impact of zoning regulation.

In the 2010 census, with a dissimilarity index of 0.576, Boston ranked 27th out of the 88 metro areas with populations over 600,000, while Springfield ranked 35th at 0.557, and Worcester ranked 55th at 0.473. Because I only include the Massachusetts portion of the Boston metro area, I measure a slightly smaller value of 0.564 for Boston's dissimilarity index. This value moves Boston one place on the list, falling to 28th below the Denver metro area.

To simulate the removal of zoning regulation, I move all blocks toward the center of the distribution of the linear zoning measure for the metro area, using the distribution of marginal effects from the first fractional logit specification shown in table 2 to estimate the change in the black share that would result from loosening or tightening zoning regulation. I move each metro area to the level of density observed in areas zoned for low-density multifamily housing in that metro area: 10.4 units per acre in Boston and 6.2 units per acre in Springfield and Worcester. This results in the dissimilarity index for Boston falling to 0.507, with Springfield only modestly affected at 0.531 and Worcester declining sharply to 0.400, which would put Worcester 69th out of the 88 metro areas included.

The change for Boston is substantial; the 0.057 point decrease is roughly half a standard deviation of the national distribution across large metro areas. The simulated value would take Boston from 28th to 44th ranked metro area in dissimilarity, a movement from the 30th to the 50th percentile of the 88 metro areas measured. Some of its neighbors in that section of the national distribution—Dallas, Houston, and Oklahoma City—are among the least regulated metro areas in the country according to the average Wharton Residential Land Use Regulation Index, whereas Boston is ranked second most regulated. Though the impact is substantial, the estimate is much smaller than that of Rothwell and Massey, whose results suggest that moving from the most to least restrictive zoning regime could have an impact on the dissimilarity index as large as 0.23 points.

7. Conclusion

Do strict density regulations have an exclusionary impact on minority populations? The results I present here for Massachusetts suggest that they do. For each additional unit allowed per acre, the black share of the population increases by 0.16 percentage points and the Hispanic share by 0.26 percentage points. The impact of permitting multifamily housing is particularly strong, with the black share increasing by 3.39 percentage points and the Hispanic share by 5.54 percentage points. By estimating the impacts using only areas along zoning borders, I am able to control for potentially omitted town and neighborhood effects, isolating the variation coming from moving from a block on one side of a zoning boundary to another.

Future work is necessary to confirm the validity of these results in contexts beyond Massachusetts and to disentangle the mechanisms driving the results. Of particular interest is the intersection between race and socioeconomic status. Lens and Monkkonen (2016) document a relationship between land use restrictions and economic segregation using the Wharton Land Use Regulation Index at the metro area level. As block-level census data are available by race but not income, the strategy employed in this paper cannot be extended to income segregation or to estimate what share of the impacts on race found here are driven by income or wealth, rather than other race-specific factors.

The impact of restrictive land use regulation on racial and economic segregation continues to be highly relevant to policy conversations across the country. The city of Minneapolis and the state of Oregon passed laws to end single-family exclusive zoning in 2019, and state legislatures across the country from Massachusetts to Connecticut to California have taken up debates on bills that would require cities and towns to zone areas for multifamily housing. In July 2015, the Department of Housing and Urban Development issued new regulations to carry out the "Affirmatively Furthering Fair Housing" requirement of the Fair Housing Act, though implementation of these new regulations was subsequently postponed. As zoning regulations in the United States continue into their second century, the study of their exclusionary impacts remains of urgent policy interest.

Appendix: Subregions of Greater Boston

I define four geographic subregions based on proximity to the city center of Boston and to Route 128:

1. *The urban core:* I define the urban core as the city of Boston and any city that falls within five miles of the city's political and economic center in northeast Boston. In practice, nearly all these cities fall to the north and are generally a set of racially integrated suburbs. This area includes 10 municipalities: Boston, Brookline, Cambridge, Chelsea, Everett, Malden, Medford, Revere, Somerville, and Winthrop.
2. *The Route 128 corridor:* Route 128, which runs concurrently with Interstate 95 in the Boston metro area, is the inner of the two circumferential highways, circling the city center at a distance between 10 and 15 miles. It runs through or near many of Boston's wealthiest suburbs and is a hub of high-tech employment. I use suburbs that fall inside or outside the road from its origin just south of the city to the edge of Essex County. This set of 27 towns includes Arlington, Bedford, Belmont, Burlington, Concord, Lexington, Lincoln, Melrose, Natick, Newton, North Reading, Reading, Sudbury, Stoneham, Waltham, Wakefield,

Watertown, Wayland, Weston, Wilmington, Woburn, Winchester in Middlesex County, Dedham, Dover, Needham, Wellesley, and Westwood in Norfolk County.

3. *The northern suburbs:* I define the northern suburbs as encompassing all of Essex County, with the exception of the far northern coastal communities. The 22 towns in this group are Andover, Beverly, Boxford, Danvers, Georgetown, Groveland, Hamilton, Haverhill, Lawrence, Lynn, Lynnfield, Marblehead, Methuen, Middleton, Nahant, North Andover, Peabody, Salem, Saugus, Swampscott, Topsfield, and Wenham.
4. *The southern suburbs:* The southern suburbs extend south from the city limits to Brockton. The 18 towns included are Abington, Avon, Braintree, Bridgewater, Brockton, Canton, East Bridgewater, Easton, Holbrook, Milton, Norwood, Quincy, Randolph, Sharon, Stoughton, West Bridgewater, Weymouth, and Whitman.

References

Aaronson, Daniel, Daniel Hartley, and Bhashkar Mazumder. 2021. "The Effects of the 1930s HOLC 'Redlining' Maps." *American Economic Journal: Economic Policy* 13(4): 355–92.

Ananat, Elizabeth Oltmans. 2011. "The Wrong Side(s) of the Tracks: The Causal Effects of Racial Segregation on Urban Poverty and Inequality." *American Economic Journal: Applied Economics* 3(2): 34–66.

Bajari, Patrick, and Matthew E. Kahn. 2005. "Estimating Housing Demand with an Application to Explaining Racial Segregation in Cities." *Journal of Business and Economic Statistics* 23(1): 20–33.

Baum, Christopher F. 2008. "Stata Tip 63: Modeling Proportions." *Stata Journal* 8(2): 299–303.

Bayer, Patrick, Fernando Ferreira, and Robert McMillan. 2007. "A Unified Framework for Measuring Preferences for Schools and Neighborhoods." *Journal of Political Economy* 115(4): 588–638.

Black, Sandra E. 1999. "Do Better Schools Matter? Parental Valuation of Elementary Education." *Quarterly Journal of Economics* 114(2): 577–99.

Boustan, Leah Platt. 2010. "Was Postwar Suburbanization 'White Flight'? Evidence from the Black Migration." *Quarterly Journal of Economics* 125(1): 417–42.

Bronin, Sara. 2021. "Zoning by a Thousand Cuts." *Cornell Journal of Law and Public Policy*, 2022, https://ssrn.com/abstract=3792544.

Card, David, Alexandre Mas, and Jesse Rothstein. 2008. "Tipping and the Dynamics of Segregation." *Quarterly Journal of Economics* 123(1): 177–218.

Cutler, David M., Edward L. Glaeser, and Jacob L. Vigdor. 1999. "The Rise and Decline of the American Ghetto." *Journal of Political Economy* 107(3): 455–506.

Dain, Amy. 2019. *The State of Zoning for Multifamily Housing in Greater Boston.* Boston: Massachusetts Smart Growth Alliance.

Danielson, Michael N. 1976. *The Politics of Exclusion*. New York: Columbia University Press.

Downs, Anthony. 1973. *Opening Up the Suburbs: An Urban Strategy for America*. New Haven: Yale University Press.

Fischel, William A. 1985. *The Economics of Zoning Laws: A Property Rights Approach to American Land Use Controls*. Baltimore: Johns Hopkins University Press.

Fisher, Lynn. 2008. "Reviewing Chapter 40B: What Gets Proposed, What Gets Approved, What Gets Appealed, What Gets Built?" Policy brief, Rappaport Institute for Greater Boston, Cambridge, MA.

Glaeser, Edward. L., and Jacob. L. Vigdor. 2012. *The End of the Segregated Century: Racial Separation in America's Neighborhoods, 1890–2010.* Civic Report No. 66, Manhattan Institute, New York, NY.

Glaeser, Edward. L., and Bryce A. Ward. 2009. "The Causes and Consequences of Land Use Regulation: Evidence from Greater Boston." *Journal of Urban Economics* 65(3): 265–78.

Gyourko, Joseph, Albert Saiz, and Anita Summers. 2008. "A New Measure of the Local Regulatory Environment for Housing Markets." *Urban Studies* 45(3): 693–729.

Kulka, Amrita. 2019. "Sorting into Neighborhoods: The Role of Minimum Lot Sizes." Conference paper, APPAM 41st Annual Fall Research Conference, Denver, CO, November 7–9, 2019.

Lens, Michael C., and Paavo Monkkonen. 2016. "Do Strict Land Use Regulations Make Metropolitan Areas More Segregated by Income?" *Journal of the American Planning Association* 82(1): 6–21.

Menendian, Stephen, Samir Gambhir, Karina French, and Arthur Gailes. 2020. *Single-Family Zoning in the San Francisco Bay Area*. Othering and Belonging Institute, University of California, Berkeley, CA.

Morse, Patricia A. 1975. "Route 128: Boston's Road to Segregation." Joint Report of the Advisory Committee to the US Commission on Civil Rights and the Massachusetts Commission Against Discrimination.

Office of Geographic Information. 2013. Commonwealth of Massachusetts, Information Technology Division. MassGIS Zoning Datalayer.

Papke, Leslie E., and Jeffrey M. Wooldridge. 1996. "Econometric Methods for Fractional Response Variables with an Application to 401(K) Plan Participation Rates." *Journal of Applied Econometrics* 11(6): 619–32.

Pendall, Rolf. 2000. "Local Land Use Regulation and the Chain of Exclusion." *Journal of the American Planning Association* 66(2): 125–42.

Pendall, Rolf, Robert Puentes, and Jonathan Martin. 2006. *From Traditional to Reformed: A Review of the Land Use Regulations in the Nation's 50 Largest Metropolitan Areas*. Washington, DC: Brookings Institution.

Reardon, Tim, Jesse Partridge Guerrero, and Lily Perkins-High. 2020. *Introduction to the Zoning Atlas*. Technical report, Metropolitan Area Planning Council, Boston, MA.

Rothstein, Richard. 2017. *The Color of Law*. New York: Liveright Publishing Corporation.

Rothwell, Jonathan T., and Douglas S. Massey. 2009. "The Effect of Density Zoning on Racial Segregation in US Urban Areas." *Urban Affairs Review* 44(6): 779–806.

Schelling, Thomas C. 1971. "Dynamic Models of Segregation." *Journal of Mathematical Sociology* 1(2): 143–86.

Schuetz, Jenny, Rachel Meltzer, and Vicki Been. 2011. "Silver Bullet or Trojan Horse? The Effects of Inclusionary Zoning on Local Housing Markets in the United States." *Urban Studies* 48(2): 297–329.

Shertzer, Allison, Tate Twinam, and Randall P. Walsh. 2016. "Race, Ethnicity, and Discriminatory Zoning." *American Economic Journal: Applied Economics* 8(3): 217–46.

Shertzer, Allison, and Randall P. Walsh. 2019. "Racial Sorting and the Emergence of Segregation in American Cities." *Review of Economics and Statistics* 101(3): 415–27.

Sood, Aradhya, William Speagle, and Kevin Ehrman-Solberg. 2019. "Long Shadow of Racial Discrimination: Evidence from Housing Covenants of Minneapolis." Working paper, University of Minnesota, Minneapolis, MN, September 30, https://ssrn.com/abstract=3468520.

US Census Bureau. 2011. 2010 Census Summary File 1—Massachusetts.

Weise, Andrew. 2004. *Places of Their Own: African American Suburbanization in the Twentieth Century*. Chicago: University of Chicago Press.

Wheaton, William C., and Bengte Evenson. 2003. "Local Variation in Land Use Regulations." *Brookings-Wharton Papers on Urban Affairs* 4:221–60.

Wooldridge, Jeffrey. 2001. *Econometric Analysis of Cross Section and Panel Data*. Cambridge, MA: MIT Press, 661–64.

Zabel, Jeffrey, and Maurice Dalton. 2011. "The Impact of Minimum Lot Size Regulations on House Prices in Eastern Massachusetts." *Regional Science and Urban Economics* 41(6): 571–83.