The Impact of Land Use Regulation on Racial Segregation: Evidence from Massachusetts Zoning Borders

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Abstract

Local zoning regulations such as minimum lot size requirements and restrictions on the permitting of multi-family housing may exacerbate racial segregation by reducing in some neighborhoods the construction of units that appeal to 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 multi-family structures, in explaining disparate racial location patterns. Blocks zoned for multi-family housing have black population shares 3.36 percentage points higher and Hispanic population shares 5.77 percentage points higher than single-family zoned blocks directly across a border from them. Using the results to simulate an equalization of zoning regulation across the metro area suggests that over half the difference between levels of segregation in the stringently zoned Boston and lightly zoned Houston metro areas can be explained by zoning regulation alone.

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 as 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. Local zoning regulations have played a key role in keeping lot sizes large and multi-family housing rare in many jurisdictions. As the prevalence of restrictive zoning regulations increased in the 1960s and 1970s, the question arose among economists and other urban scholars whether such laws were causing increased racial segregation. While the letter of the law was exclusionary only towards certain classes of residential land use, many hypothesized that the true impact extended towards exclusion of classes and races of people. In some cases historians have documented that such outcomes were in fact the intent of the laws, pointing towards jurisdictions enacting such regulation 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).

Regardless of 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 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 particularly detailed spatial data made available to the public by the Massachusetts Office of Geographic Information (MassGIS) I am able here to assess the impact of zoning restrictions on minority population shares at the block level within jurisdictions in the major metropolitan areas of Massachusetts. The geographic detail of the data allows me to 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 allows me to circumvent 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 be influenced by historical settlement patterns that developed in the aftermath of the great black migration of the early 20th century and subsequent white suburbanization, by access to public transportation, differing willingness and ability to pay for local amenities and public goods, housing discrimination or decentralized racism. To the extent 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 zeroing in on differences in racial population shares along narrow bands on either side of within jurisdiction zoning borders I am able to minimize the impact of these other city and neighborhood factors that should vary more continuously across the boundary. 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 my ability to restrict 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. Increasing the allowable density by ten dwelling units per acre, roughly the standard deviation in the Massachusetts metropolitan areas, increases the block's black share by 3.8 percentage points and the Hispanic share by 5 percentage points, roughly doubling the base share for both groups. The impact of by right allowance of multi-family housing is particularly strong for both groups, and this is as true in the suburbs as the urban core. Permitting multi-family housing leads to a 3.36 percentage point higher black share and a 5.77 percentage point increase in the Hispanic share.

The impact, particularly for Hispanics, has grown stronger over the last 20 years and land use regulation is strongly predictive of growth in block-level minority shares between 1990 and 2010. I conclude by extrapolating these findings to the metro area level, finding that equalizing zoning across the Boston Metro Area could more than halve the gap between heavily zoned Boston and lightly zoned Houston on a common segregation measure. These results strongly confirm the hypothesis that zoning negatively impacts racial integration, while suggesting caution in interpreting the even larger impacts found in cross-MSA studies.

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

2 Literature Review

The hypothesis that restrictive zoning may lead to decreased minority residence in more prohibitive areas and greater overall segregation has long been present in the economics literature (e.g. Downs (1973); Fischel (1985)). Rigorous empirical examination of the hypothesis has only been undertaken more recently. Pendall (2000) compiled a dataset with the intent of examining this question, gathering survey responses from planning directors in 1168 jurisdictions across the 25 largest US metropolitan areas. He estimates that jurisdictions allowing only what he defined as low-density housing (no more than 8 units per acre) had less than half the black populations of those without such controls and only 60 percent as large a Hispanic populations in 1980. 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. They find that increasing the maximum allowable density by one standard deviation increases the dissimilarity index in a metro area, a measure of what percentage of a population would need to move to ensure a uniform share of that group across the area, by between four and seven percentage points in the 1990 and 2000 cross-sections, depending on the OLS specification. Their point estimate implies that moving from one end of the distribution to the other would lower the dissimilarity index by 25 percentage points. Instrumental variables show a slightly larger effect, with a point estimate of 8 percentage points for a standard deviation change. They also show that a standard deviation higher level of maximum density is associated with an 8 percentage point higher (less negative) change in the dissimilarity index between 1980 and 2000 with most of the effect concentrated in the earlier part of the period, and this is fairly similar between the OLS and the IV regressions.

These findings lend credence to the hypothesis that restrictive zoning might have quite large effects on racial segregation, but some caution is warranted. While both sets of authors are well aware 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, one might worry that the instrument of year of statehood, which is nearly collinear with region effects, might be acting on segregation through any number of mechanisms beyond density zoning. In fact the regional patterns in the dissimilarity index are striking - for instance, the top 9 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 of blacks from the South in the early 20th century (see, for instance, Boustan (2010)). While Rothwell and Massey argue that the density result holds within regions when they run the regressions separately, isolating the effect of zoning across metro areas remains challenging.

3 Data

The data for this project come from the State of Massachusetts's Office of Geographic Information (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 study focuses primarily on the zoning data, which was 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. As town zoning bylaws can differ substantially in intent and wording between jurisdictions, compiling uniform spatial data with this level of detail and geographic scope is quite rare - in fact I know of no other state that makes such data available. The data is described extensively and explored by Wheaton and Evenson (2003) and has been used by Zabel and Dalton (2011) to examine the effect of zoning on housing prices.

The main variables used in this study are derived from the "primary use" variable, which classifies zones to one of 21 categories including 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 residential, the primary focus here, three multi-family housing categories separate land zoned for multi-family structures with densities of 3 to 8 dwelling units, 9 to 20 units and greater than 20 units per acre. The remaining six 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 (3 to 8 units per acre) to the largest category of 80,000 square feet and above (at least 2 acres per lot) as well as a category for mixed low density agricultural and residential. 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 allowances, but this coding allows an exploration of the effect of zoning laws as written, rather than as they're being interpreted contemporaneously, a variable more likely to be exogenous to current local conditions.

The main dependent variables come from race data at the block level taken from 2010 US Census 100 percent sample (Summary File 1) geocoded using the Census Tiger shapefiles. Census blocks are the smallest unit of geography available to the public and data are available at this level for only a small set of variables: populations by age, sex, race, Hispanic origin, household type and whether the housing unit is owned or rented. Blocks are delineated by roads or geographic features, and vary in size depending on population density. Urban blocks tend to encompass literal blocks, surrounded on all four sides by adjacent roads, whereas rural blocks can be substantially larger. Not all blocks are populated - some, for instance, are entirely covered by water. These unpopulated blocks are dropped from the analysis. Of those with non-zero populations, the blocks in Massachusetts metropolitan areas used here range from 1 to 4025 people with a median of 44 people and correspond to land areas between 0.02 and 5157 acres, with a median of 5.62 acres.

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 up to 99 percent and the results are broadly similar. The threshold presents a tradeoff - a lower threshold introduces measurement error biasing the results downwards, 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, with 70 percent falling into one of the nine residential categories and the remaining seven percent having either commercial, industrial, institutional or conservation uses.

The first column of Table 1 shows summary statistics for populated blocks in Massachusetts metropolitan areas. The majority (63.13 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. The population is 6.96 percent percent black, 10.08 percent Hispanic, and 75.05 percent non-Hispanic white.[1] The three races have strikingly different rates of renting versus owning, with blacks (66.53 percent) and Hispanics (75.44 percent) renting at over twice the rate of whites (31.67 percent).

In terms of land use, 6.52 percent of blocks are zoned for multi-family residential

[1]Black here is defined as black alone, not in combination with other races, and includes Black Hispanics. This is the subgroup for which the most data is available on Census Summary File 1.

use with most of that being denser than 8 units per acre. The 63.25 percent of land zoned for single family use is spilt roughly evenly between what I define as low (lot sizes over an acre), medium, and high (less than 3/8 of an acre lot sizes) density uses. I construct a linear measure of zoning by taking the 9 categorical measures of residential zoning and assigning each the average dwelling units per acre observed in the data for that category. This measure varies from 0.5 to 22 units per acre with a mean of 4.21 and a median of 4.73.

To ensure comparability between blocks in my sample, I employ several selection criteria. Starting with 82,071 blocks, I drop those with non-residential or split land use (23,079 blocks), with anyone housed in group quarters population (2,724 blocks), with any public housing (687 blocks), with land areas greater than 160 acres, equivalent to a square quarter mile (3,074 blocks) and where more than ten 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) for an exploration of the role of historical railroad lines in demarcating racial neighborhood boundaries.)

As an example, Figure 1 shows zoning regulation for Cambridge, Massachusetts and blocks identified as being on zoning borders. Like most inner suburban areas, Cambridge residential land use is split between multi-family 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 multi-family housing and commercial while the north and west have mostly single-family zoning. Given that differences may exist between the two regions of the city, such as historic settlement patterns, access to popular commercial areas, parks and universities, and proximity to heavier industry, we would not expect differences in composition between the two to be driven entirely by land use regulation. However, focusing on the outlined blocks, it is more plausible that the differences in block composition one sees when crossing one of the dark black borders is a result of the differential land use on either side.[2]

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

Returning to Table 1, three main border samples are used in the analysis. Column 2 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, though somewhat more black (10.05 percent), more concentrated in the Boston metro area and more likely to be zoned for multi-family housing.

The third and fourth columns look at two important subsets of the border sample. Column 3 shows blocks on either side of boundaries where land use changes between single-family residential and multi-family residential. These blocks have considerably larger minority populations, both for blacks (15.37 percent) and Hispanics (13.56 percent). They are also more densely populated, have more rental units per acre, are smaller in land area, closer to major city centers and particularly concentrated in Boston's urban core, defined here as Boston and the 9 suburban communities that lie within 5 miles of the city center.[3] The fourth column gives statistics for the sample

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

[3]See Appendix A for the set of towns located in each sub-region of Greater Boston.

comprised of blocks that lie on borders between single-family residential zones with different minimum lot sizes. These blocks have very small minority populations (1.93 percent black and 3.24 percent Hispanic), lower population densities, few rental units, and are more likely to be located along the Route 128 corridor in suburban Boston than in the urban core.

Along with the 2010 Census data, I also use past census block data to examine changes in racial composition over time. Because the spatial scope of census blocks is not consistent across decades, I geographically match blocks using the Census's Tiger Shapefiles. The need for this match limits the analysis to the time period of 1990 to 2010 as spatial data at the block level is not available before 1990. I keep blocks where I can find a set of 1990 blocks that are completely contained within a 2010 block and comprise more than 75 percent percent of the land area of that block, or meet the same criteria fitting 2010 blocks into 1990 blocks. This yields a match rate of about 60 percent for populated blocks.

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, where data is not available.

4 Model

Consider the housing market in the Boston metro area (or analogously, the Springfield or Worcester metro areas.) 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:

$$V_i(H_j) = f\left(P_j^*\left(X_j, Z_n\right), X_j, Z_n\right) \tag{1}$$

where 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, and Z_n is a vector of neighborhood characteristics such as local amenities and public goods, neighbors and the neighborhood's built environment. Though the functional form of this relationship will not be crucial for the estimation in this paper, to fix ideas I will assume this takes the linear form:

$$V_i(H_j) = -\alpha_i P_j^* \left(X_j, Z_n\right) + X_j \beta_i + Z_n \omega_i + \epsilon_{ij} \tag{2}$$

where the coefficients are allowed to differ across individuals. If housing within a block is relatively comparable, we could think of the j subscripts as referencing blocks rather than housing units, and think of this as a function describing people's preferences over consuming a unit of housing on a given block in the Boston area. The land use density restrictions that are of interest here 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 in the equation by introducing a small perturbation in density zoning:

$$\begin{aligned} V_i(H_j) = &-\alpha_i \left(\widetilde{P}_j^* + \left(\tfrac{\partial P_j}{\partial D_j} + \tfrac{\partial P_j}{\partial X_j}\tfrac{\partial X_j}{\partial D_j} + \tfrac{\partial P_j}{\partial Z_j}\tfrac{\partial Z_j}{\partial D_j}\right) dD_j\right) \\ &+ \left(\widetilde{X}_j + \tfrac{\partial X_j}{\partial D_j} dD_j\right)' \beta_i + \left(\widetilde{Z}_n + \tfrac{\partial Z_n}{\partial D_j} dD_j\right)' \omega_i + \epsilon_{ij} \end{aligned} \tag{3}$$

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

$$\begin{aligned} V_i(H_j) = &\left(-\alpha_i \delta_{pd} + \delta_{xd}\left(\beta_i - \alpha_i \delta_{px}\right)\right) D_j \\ &+ \delta_{zd}\left(\omega_i - \alpha_i \delta_{pz}\right) D_j - \alpha_i \widetilde{P}_j^* + \widetilde{X}_j \beta_i + \widetilde{Z}_n \omega_i + \epsilon_{ij} \end{aligned} \tag{4}$$

One could in principal use a structural approach to modeling these preference parameters by race based on observed racial location patterns (see Bajari and Kahn (2005) for a strategy in this spirit in the context of racial residential preferences) but this would require data from multiple markets with zoning data, or individual level housing data that allowed geographic identification at the zone level. Instead, 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 at the border. The neighborhood characteristics and residual attributes and price of the housing stock should remain fixed. Under this assumption, the indirect utility function simplifies to:

$$V_i(H_j) = \left(-\alpha_i \delta_{pd} + \delta_{xd}\left(\beta_i - \alpha_i \delta_{px}\right)\right) D_j + \theta_b + \epsilon_{ij} \tag{5}$$

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 me to convert this into an equation about the observed data, which are racial shares at the block level. Since I'm less interested in the specific preference parameters than I am in the aggregate impact of density zoning, I estimate the simple linear specification:

$$S_{rj} = \gamma D_j + \theta_b + \mu_j \tag{6}$$

where S_{rj} is the share of block j that is of race r, γ will be some function of the differences by race in the distributions of the preference parameters α_i and β_i and the zoning impacts on price and housing attributes δ_{pd}, δ_{xd}, and δ_{px}, θ_b represents a zone border fixed effect and μ_j is a mean zero error term that I will allow to be correlated within town but is assumed to be independent across towns.

Although the preference parameters within the γ 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 the direct impact of zoning on price holding other housing and neighborhood characteristics fixed multiplied by a measure of individual price sensitivity that could differ on average across races. In theory this direct impact should be small if units are highly substitutable across blocks, though estimates of the direct price impact of zoning vary in the literature ((Glaeser and Ward, 2009; Zabel and Dalton, 2011)).

The second term, $\delta_{xd}(\beta_i - \alpha_i \delta_{px})$ shows the two channels through which changes in the housing stock that result from zoning regulations affect racial shares. Races might have different preferences β_i, on average, for attributes of housing such as structure type, tenure or lot size. Alternatively, it might be that the types of housing built on the strictly zoned block differ in price from those on the surrounding more less strictly zoned blocks, and that races might be differentially sensitive to that change. Given the differences in average income and wealth across racial groups, it seems 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 land below the minimum threshold.

A third term, $\delta_{zd}(\omega - \alpha_i \delta_{pz})$ 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 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. Crucially here, any neighborhood changes induced by zoning on one block are assumed to be felt on neighboring blocks regardless of on which side of the zoning border they fall. Therefore, the border design will not identify this mechanism as part of the effect of density zoning regulation. A much studied dimension on which blacks and whites might differ is preferences for the racial makeup of the neighborhood itself. 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 downwards compared to the true long run impact of zoning regulation. I will return to a discussion of this issue in the section 6.

5 Results

Table 2 shows the results of regressions of the black share of the block population on permitted density, as measure by dwelling units per acre. Column 1 provides the estimate of equation 6 above, a linear regression of the share of the population that is black on dwelling units per acre with border fixed effects included in the regression, run on the sample of blocks that fall on a zoning border. Standard errors are clustered at the town level, as they are in all subsequent regressions unless noted. The coefficient, significant at the 1 percent level, indicates that an extra unit of density, measured in units permitted per acre, increases the black share on the block by 0.38 percentage points, where the baseline average black share is 7 percent in the overall population and 10 percent in the border sample. This suggests quite large effects of shifts in zoning of plausible magnitudes. For instance, lowering lot sizes from half acre lots to 8000-square foot lots (similar to the average in the densest single family zoning category) would increase the black share by 1.14 percentage points. Permitting of high-density multi-family housing, with densities of over 20 units per acre, would be expected to have extremely large impacts.

In column two I add controls for distance in miles to the metro area's main city center (Boston, Worcester or Springfield) 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 show up as significant predictors of the black share, suggesting that the sample is reasonably well-balanced on these dimensions.

My theory gives me little guidance as to the shape of the relationship between race and zoning, so I next fit a logarithmic model to the data. Unfortunately the black population at the block level is frequently zero, so I divide this into two regressions - one to predict the zeros and the other a regression in logs on the non-zero data.

Column 3 reports the marginal effects from a probit model of the impact of density zoning on the having no black population. Not surprisingly, more densely zoned places are less likely to have zero black population than less densely zoned blocks across the border from them, though the coefficient of 2.35 percentage points is small when compared to the fact that over 60 percent of blocks in the sample have no black population.

Given this prevalence of zeros, the number of observations in column 4 shrinks considerably. The coefficient I get from regressing the log of the black share on the log of the density measure implies that doubling zoned density increases the black population by 17.46 percent on blocks with positive black populations. This may be a better fit for the data than the linear measure, though interpretation is complicated by the large number of dropped blocks. Zeroing in on the impact at certain points in the distribution is likely to be more illuminating, as I will explore in the next table.

Before turning to that, in columns 5 and 6, I illustrate the impact of the use of the border design by running ordinary least squares in the full sample of Massachusetts metro areas with and without town fixed effects to benchmark the results. The coefficient in standard OLS is over twice the size of the border estimate from column 1, emphasizing that these blocks differ in more than just how they are zoned. Not surprisingly, much of the variation in the share black of the block population can be explained by the tendency of blacks to live disproportionately in jurisdictions clustered in highly urbanized areas with lax density restrictions, as we see by moving to the town fixed effect regression.

However, it is surprising that the town fixed effects estimator shrinks the effect to half the size of the border fixed effects estimator and that this effect is insignificant at conventional levels. This is driven largely by the city of Boston, where the black population is highly concentrated in the south and west of the city which are zoned mostly for low density multi-family and high density single-family housing, whereas the whiter areas closer to the city center are zoned for denser multi-unit high rises. After dropping Boston in column 7 the town fixed effects estimate looks similar to the one from the border design.

Taking Boston on its own in columns 8 and 9, using Huber-White robust standard errors and running OLS in the full sample shows a strong and significant negative coefficient, but the border regressions shows a small and insignificant positive effect. This illustrates the need to focus on narrow variation within neighborhoods rather than within town variation that may be confounded by omitted neighborhood level variables. The confidence interval for the border regression in Boston alone is certainly too large to rule out that the effect may be equal to that of the full sample, though the smaller effect would be consistent with the hypothesis that upzoning in the urban cores of expensive cities may have negative rather than positive effects on the size of minority populations. With only one major city center, I lack the data to say anything about this hypothesis.

In Table 3 I decompose the effect of the linear zoning measure by focusing specifically on the effect of allowing the construction of multi-family housing by right on the share of black residents on the block. Limiting the sample to borders across which use changes from single to multi-family dwellings leaves 1959 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 satellite cities such as Brockton, Fall River, Lowell and in inner ring suburbs like Cambridge, Brookline and Quincy. The land use regulation on the single-family blocks is predominately in the highest density category.

Column 1 shows the estimated coefficient of a border fixed effects regression which finds an impact of 3.36 percentage points that is significant at the 1 percent level. This is just over a fifth of the average black population for blocks in this sample. We can break down multi-family housing into low density (up to 8 units per acre), medium density (9 to 20 units per acre) and high density (20 and above.) Column 2 shows that the point estimate is much larger when crossing from single family housing to medium and especially high density multi-family housing compared to low density multi-family, though Wald tests can only reject equality of the high and low density coefficients at the 10 percent level. Column 3 instead uses the sample of borders between different classes of multi-family zoned housing and finds that moving from low density multi-family housing (the omitted category) to medium and high density multi-family housing yields sizable positive coefficients, though only the difference between low and high density is significant. These results suggest that the largest differences in racial composition exist not between single and multi-family blocks of similar densities, but rather between low-density multi-family blocks of triple-decker houses and those with medium and high density apartment buildings.

Columns 4 and 5 turn to single family housing borders. A regression of the black share on allowing single family housing in the highest density category (lot size under 15,000 square feet) yields an insignificant coefficient, as does a regression of the black share on the linear density per acre measure used above taken only in the single-family border sample. The confidence interval allows me to rule out an effect in excess of 1.3 percentage points from permitting the densest form of multi-family housing versus lot sizes of over an acre, though given the small average black population in this sample of blocks (1.93 percent) that is not a very restrictive upper bound. Running a regression of the log share on log density in only the single-family sample also yields an insignificant coefficient, though the point estimate of 0.16 log points is very similar to the one found in the full sample. Though I cannot rule out substantial percentage gains as a result of changes in density regulation, given the small initial share of blacks in the sample, even at the upper end of the confidence interval, large changes in minimum lot size regulations are likely to have at most modest impacts on the overall segregation of the black population.

Tables 4 repeats the same set of regressions from table 1 for Hispanics rather than blacks. The patterns are largely similar, though the effects are slightly larger. An increase in allowable density of one unit per acre corresponds to a 0.5 percent percentage point increase in the Hispanic share of the block population, which averages 10 percent in the population and 9.2 percent in the border sample. This is unaffected by the inclusion of controls for distance to the city and presence of bodies of water. Turning to a logarithmic specification again requires dropping a large portion of the sample because 46.5 percent of border blocks lack any Hispanic population, but within the set of blocks that do have positive population, a 10 percent increase in zoned units per acre leads to a 2.1 percent increase in the Hispanic share on the block. These effects are roughly half the size of the effect of running OLS in the full sample without border fixed effects, and smaller than town fixed effects estimates as well, again emphasizing the importance of narrowly focusing on variation less confounded by town and neighborhood differences.

In Table 5 I decompose these effects between multi-family and single-family zones, and find again that multi-family housing is driving the bulk of the impact. In the sample of borders where zoned use changes between single-family and multi-family use, crossing the border to the multi-family side yields a 5.77 percentage point impact in the Hispanic share, which is 43 percent of the 13.56 percent mean Hispanic population in this sample of blocks. That is roughly twice the size of the impact measured for the black share in Table 3. Column 2 decomposes the effect into three classes of multi-family housing and finds a significant effect of moving from single-family housing to any of the three categories. The impacts are larger in all categories than the effects seen for the black share, but particularly striking is the comparative size of the low-density multi-family impact. For the black population this effect was indistinguishable from zero, and the point estimate was below 1 percentage point, whereas for Hispanics the effect is 3.4 percentage points and significant at the 5 percent level.

The coefficients for medium and high density multi-family housing are higher, though a Wald test cannot reject equality between any pair of coefficients. Column 3 shows that at borders where multi-family use changes I can detect an impact of moving from low-density to high-density multi-family housing. Again, these results suggest that permitting medium and high density multi-family housing leads to particularly large increases in the Hispanic share, but for the Hispanic population, in contrast to blacks, zoning for low-density multi-family neighborhoods, which in Massachusetts generally means triple-decker three-family housing, also leads to significant increases in the share.

Turning to single-family housing, Column 4 shows the impact of moving from low-density (lot sizes one acre or larger) single-family zoning to medium and high-density (lot size less than 3/8 of an acre) single-family housing. The coefficient for high-density single-family is approaching significance at the 5 percent level (p-value of .064) and the point estimate suggests an impact of 1.37 percentage points where the average Hispanic share in this sample of blocks is 3.24 percent. Again, comparing the magnitude to the impacts seen for the black population, the size of the Hispanic coefficients suggest that changes in land use regulation can have impacts on the Hispanic share at lower density levels than would be expected for the black population. Nonetheless, given the small initial Hispanic populations on blocks bordering low-density single-family zoning, it seems unlikely that changes in minimum lot size regulations would have large impacts on the overall levels of segregation in Massachusetts metro 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). Of course it could be that even in the absence of restrictive land use regulation these towns would have low minority populations. To investigate, I break the Boston portion of my sample down into four sub-regions, one Boston and 9 inner ring suburbs comprising the urban core, one for the Route 128 Corridor covering the west and northwest suburbs, and one each for suburbs north and south of the city excluding some of the more distant shoreline communities that share little in common with the neighboring jurisdictions. For a list of the cities included and a brief discussion of the construction of each region see Appendix 1.

Figures 3 and 4 show how the black and Hispanic populations are spread across the four regions. Along with a heavy concentration in the urban core, many of the southern suburbs reaching down from the city limits to the smaller city of Brockton have high densities of black residents. Hispanic populations are more heavily concentrated in the northern suburbs with Lawrence, Massachusetts, an old mill town near the New Hampshire border having a population that is 70 percent Hispanic.

In Table 6 I break down the impact of zoning on segregation between these 4 regions. The upper half of the table shows the impact of permitting multi-family housing on minority populations in the sample of borders where land use changes from single to multi-family 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 regions differs substantially, and suggests that permitting multi-family 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 population differs more between the four regions. Not surprisingly it is largest in the North suburbs where concentrations of Hispanics are already high.

The bottom half of the table shows the impact of different classifications of single family housing. As would be expected from the earlier tables, the impacts are small and generally indistinguishable from 0, though impacts look slightly larger for both minority groups in the northern suburbs than elsewhere. Surprisingly the impact of dense single family housing on the Hispanic share in the Route 128 Corridor approaches significance at the 5 percent level (p-value of .052). The results for any given subgroup are imprecise, but as a whole they are suggestive that the estimates from the main regressions apply not only to areas close to the city center, but to whiter and more affluent suburban areas as well.

To better understand how land use regulation affects block racial composition, tables 7 through 9 explore the impact of zoning on the types of residential structures on the block in the Boston metro area, omitting Boston where data is not available. Though block-level census data is only informative about the total number of dwelling units and whether they are owned or rented, parcel level assessment data subdivides the residential structures into six categories: single-family, two-family, three-family detached housing, small (4 to 8 unit) and large (9 or more unit) 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 on counts of each of the six building types at the block level in the full block sample. Reassuringly, the coefficients for 1, 2, and 3 family houses from this regression are almost exactly 1, 2 and 3 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 impact on total units and structure type of permitting multi-family housing in the sample of blocks that lie on a border between single-family and multi-family zones. I break multi-family zoning into two categories - low-density (3 to 8 units per acre) and medium to high-density (9 units per acre and above) as the regressions in the earlier tables suggested different impacts for these two categories. Columns one and two 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 multi-family housing leads to 2.8 additional dwelling units per acre, and an increase of 2.1 additional rental units per acre. Permitting high density multi-family housing increases the number of dwelling units by 7.4 units per acre and the number of rental units by 6.1 per acre.

Moving to columns 3 through 8 the sample drops as assessment data is only available for a portion of the sample. Permitting low-density multi-family housing leads to a significant negative impact of over one single-family residence per acre, and a significant positive impact of about 1 condo unit per acre. While not significant due to the limited sample size, the magnitudes of the changes in other structure types are fairly large. Almost a full unit of two-family housing is gained, and increases are also seen in the three other multi-family dwelling types. The impacts for permitting multi-family housing show up particularly strongly for large multi-family apartment units and condominium units, with small increases in three-family houses and small apartment buildings, and decreases in one and two-family housing.

Table 8 repeats the same regressions, but this time 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 1.92 additional dwelling units per acre, and 0.58 additional rental units compared to blocks with lot sizes of 1 acre or larger. Moving from lot sizes over an acre to those between 3/8 and 1 acre yields an extra 0.56 total dwelling units, but a trivial amount of new rental housing. Not surprisingly these impacts are concentrated in increases in single, and in the case of high density single-family zoning, two-family residential units.

To connect this back to racial shares, in table 9 I regress the number of units for each race on the types of housing on the block. Column 1 regresses total units on housing types including border fixed effects for all blocks on borders. The results are what would be expected, though the number of additional units from adding three-family houses looks closer to 2 in this sample, suggesting some misclassification between 2 and 3 family houses in the data. Turning to column 2, the results for blacks show that nearly all of the gains in black households that come from crossing from one side of a border to another come from the presence of large apartment buildings. This sheds light on the results from earlier tables showing that medium and high density multi-family zoning are the only regulations that have significant impacts on the share of the block population that is black.

For Hispanics 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 above indicating that low-density multi-family housing has strong impacts for the Hispanic population that are not seen for blacks. Column 4 provides the numbers for non-Hispanic whites to contrast them. Additional units of all types increase the white population, not surprisingly since they make up 70 percent of the population, but the relative impacts for whites versus minorities are much stronger in the single-family and condominium categories than for apartment units.

We might again worry that these impacts of structure type on the size of minority populations are driven by only the urban portion of the sample, and that building multi-family units might have smaller impacts in more suburban locations. 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 minority groups 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 Hispanics. The impact of additional three-family houses, while still positive for Hispanics is smaller and not distinguishable from zero with the power I have in this sample. Nonetheless, these results suggest that building more multi-family housing, especially large apartment buildings, in the suburbs does increase minority populations.

Finally, I turn to data from the 1990 census to assess the impact of zoning regulations on block-level racial composition changes over this period. Because I am using a single cross-section of zoning regulations that are presumed to stay constant over the period it is not clear we should expect much change in the impact of zoning on racial residential location patterns. However, there are a few reasons to expect that there might be differences. First, it could be that even if zoning regulations were put in place years earlier, that the composition of neighborhoods adjusts slowly and that even by 1990 blocks had not reached their steady state equilibria. In this case the primary interest would be in the 2010 level estimates, and the 1990 estimates would merely serve to illustrate how slowly the process unfolds. Alternatively, it could be that as housing demand by race changes over the period that the adjustment process differs between more and less stringently zoned blocks. For instance, consider an influx of minorities to the area. It could be that less stringently zoned neighborhoods are able to rapidly expand the stock of housing to accommodate new migrants, whereas more restrictive blocks have a largely static population of longer tenured residents.

First I examine the impact of zoning regulation on the share of the population that is black at the block level for 1990. Even though the geographic definition of blocks does not stay constant over the period I can perform the same match for 1990 blocks to land use zones as I did for 2010. Using the sample of border blocks in 1990 I attain an identical coefficient, 0.38 percentage points, for the impact of zoned units per acre on the share of the population that is black as I did in the 2010 data. Column 3 shows that, among blocks with positive black populations this represents a somewhat higher percentage increase, 25.9 percent versus 17.5 percent found in 1990. Columns 4 through 6 repeat regressions from table 3 looking at the impact of multi-family and single-family zoning independently for the 1990 sample. The 2.57 percentage point impact of permitting any type of multi-family housing is similar, though slightly smaller than the 2010 coefficient, and the difference seems particularly apparent in the impact of high-density multi-family housing in column 5. The impact of different minimum lot size restrictions among single-family zones is negligible.

Repeating the same set of regressions for the Hispanic population in Table 11, I find that, while the differences between Tables 4 and 11 imply that the impact of the linear density measure has only grown modestly between 1990 and 2010, the impact of permitting multi-family housing has doubled over the two decades. Comparing Table 5 to 11, the coefficient on allowing multi-family housing jumps from 2.8 percentage points in 1990 (column 11.4) to 5.77 percentage points in 2010 (column 5.1). The coefficients for all three density classes of multi-family housing see similar growth. The impacts of changing the density of single-family housing is small and insignificant in 1990, though the confidence intervals are large enough compared to the effect that little can be said about any changes in the impact over time.

Along with comparing the magnitudes of the coefficients estimated separately for the two censuses, I can estimate the impacts of density on block-level changes over the period for the sample of blocks I am able to match across censuses. Column 1 shows a regression of the 2010 log share of the block's population that is black on logged zoned units per acre and the logged 1990 black population share with border fixed effects in the border sample. A log point increase in zoned units per acre increases the black share by 0.169 log points, with a p-value of 0.053, even controlling for the logged 1990 black share. This suggests that for blocks with black populations in 1990, less restrictive land use regulation predicted somewhat quicker growth in the black share of the population going forward.

The coefficient of 0.425 on the 1990 black share itself suggests that a 10 percent higher black share in 1990 led to a little over a 4 percent higher black share in 2010. The fact that this coefficient is not closer to one likely reflects two things. First, given that both sides of the border are similar along many neighborhood dimensions we would not necessarily expect the concentration of blacks on one side of the border in 1990 to be a strong predictor of the concentration of blacks 20 years later, controlling for the impact of land use regulation. Second, since the geographic block match leads to some measurement error we would expect this coefficient to be attenuated compared to the true impact. Reassuringly, running a simple regression of the logged 2010 black share on the 1990 black share without controls in the full matched block sample yields a coefficient close to one, suggesting that measurement error is not the only contributing factor.

Turning to columns 2 through 4, I find no significant impact of dummies for either permitting of multi-family housing or higher densities of single family housing. There is not enough power to distinguish what is driving the increase seen in column 1.

Turning to columns 5 through 8, the impacts of land use restrictions on the growth in the Hispanic share at the block level between 1990 and 2010 are much larger. Column 5 shows that a 10 percent increase in zoned units per acre leads to a 3.15 percent increase in the Hispanic share, conditional on the logged 1990 Hispanic share. This coefficient is actually higher than the coefficient on the logged 1990 Hispanic share itself, suggesting that there was substantial movement of the Hispanic population across blocks on the same border. This is not surprising given the substantial growth in the overall Hispanic population over the period. Even if incumbent Hispanic residents stayed relatively immobile, if new residents' location decisions are driven more by attributes of the housing stock on either side of the border than the block-level Hispanic share, then this is the pattern of coefficients we would expect.

Breaking down this impact, permitting of multi-family housing has a large and significant impact, and the impacts of different density class of single family housing a large, but too imprecisely estimated to be significant. Using the log zoned units per acre measure in the sample of single-family borders approaches significance at the 5 percent level (p-value 0.061), suggesting that zoning regulation along the entire spectrum of densities had some effect on Hispanic housing choices.

Finally, in Column 9 I test whether blocks with less stringent zoning were able to add more housing than more stringently zoned blocks across the border. Regressing the log of dwelling units per acre in 2010 on log zoned units per acre and log dwelling units per acre in 1990, I find that a 10 percent increase in allowed units per acre led to a 1.5 percent increase in dwelling units per acre over the time period. This lends some support to the hypothesis that if minority populations are growing in the area as a whole, more densely zoned blocks may be able to build new housing more quickly to attract new minority residents. Probing this hypothesis further would require individual level migration data.

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 above have argued. Any model that looks within towns, whether using town fixed effects or the more restrictive border design, will mitigate this concern since the town is the level of government writing zoning restrictions. In addition, some models motivating zoning legislation, such as excluding those of lower incomes to avoid drain on local public finances, act at the town rather than the neighborhood level. However, the concern might 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 had more minorities. However, 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 towards 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. 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 has 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. The list of zone changes since 1976 in Quincy numbers in the hundreds, but in nearly all cases these are not changes from one residential classification to another, but rather changes in zoning for commercial and conservation purposes that 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 is readily available lends credibility to the approach taken here.

Along with the strengths of the border design come a couple of caveats about the local average treatment effects estimated using this model. A long 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 the impact of changing zoning regimes is to change the racial composition of the neighborhood, then that change may itself beget further changes in neighborhood composition through the interaction of preferences for neighbors in the housing market. Since the underlying assumption of the border fixed effects design is that neighborhood attributes stay constant across the zoning borders, this effect, by assumption, should be equal on either side and will therefore be absorbed by the border fixed effects. In light of this, the estimates here are best seen as lower bounds for the overall impact that changes in zoning regulations will have over time. What is being isolated here is the variation that acts through the mechanisms discussed earlier; that is, through changing housing types and proportion of ownership, price changes that result directly from zoning and the stasis effect of slowing down new construction. Incorporating the spillover effect to the neighborhood could be achieved by adding more structure to the model such as is done in Bayer, Ferreira, and McMillan (2007) and Kasy (2012), but doing so requires individual level data that is unavailable here. Alternatively, 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 inviting back in the confounding factors discussed above.

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 both by 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 of these policies by Schuetz, Meltzer, and Been (2009) these laws have led to only modest levels of production of affordable housing, with only about a fifth of communities reporting any new housing built under their inclusionary zoning laws. If communities made widespread use of these regulations the evidence I find from zoning borders might be attenuated estimates compared to those that would be found in places with such regulations, but Schuetz'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 are only informative about places that look like those that fall along zoning borders. Allowing construction of multi-family apartment buildings may have quite different effects if enacted in a rural area zoned entirely for an agricultural and residential mix than it does in places that border currently extent multi-family 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 multi-family districts. Fortunately, the margins likely to be relevant for policy are precisely those along which the impacts are being identified in the data as communities are most likely to enact small policy changes by moving one or two lot size categories or from higher density single family to permitting of multi-family housing.

Proceeding with caution given these caveats, I conclude the analysis by seeing what my results imply about the impact of zoning on area level segregation measures. One way of assessing this is to take my estimates of the impact of zoning on block level log population growth by race and simulate the impact of equalizing zoning regulation across the area. This should not be thought of as a policy simulation, since nobody is suggesting that the areas towards the city center are going to substantially reduce zoning density to meet the suburbs at the halfway point. Rather this is an attempt to estimate segregation in the absence of zoning variation while keeping 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.

Table 12 shows the dissimilarity index for blacks and non-blacks across the largest 88 metropolitan areas with populations over 600,000 in the 2010 census as calculated by Glaeser and Vigdor (2012). Boston ranks 27th with a dissimilarity index of 57.6, while Springfield is 35th at 55.7 and Worcester is 55th at 47.3. Because my data only includes the Massachusetts portion of the Boston metro area I measure a slightly smaller value of 56.4 for Boston's dissimilarity index. I also use the updated 2013 redefinition of the Springfield metro area which removes the largely rural Franklin County and modestly lowers the dissimilarity index to 54.5. Neither of these changes affects the relative ranking of the cities by more than 1 place on the list.

To simulate the removal of zoning regulation I calculate the average zoned units per acre at the metro and tract level using the block level data. The average densities for the Springfield, Worcester and Boston areas are 4.63, 5.03 and 7.22 respectively, roughly the average number of units observed for dense single family housing. Using my coefficient from the first column of table 2, I multiply the difference between the tract average and the metro area average by .0038 percentage points and add that to the original black population. This results in a dissimilarity index for Boston of 49.9, with Springfield only modestly affected at 52.7 and Worcester plummeting to 32.9, which would be among the lowest values observed in the data. The change for Boston is substantial; the simulated value would take Boston from being the 27th ranked to the 48th ranked metro area in dissimilarity. Its neighbors in that region of the table, 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. The simulation suggests that as much as three quarters of the Boston to Houston gap could be accounted for by land use regulation alone. On the other hand, the estimate is much smaller than that of Rothwell and Massey, whose results suggested 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 in stringently zoned neighborhoods? 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 0.38 percentage points and the Hispanic share increases by 0.5 percentage points. The impact of permitting multi-family housing is particularly strong, with the black share increasing by 3.38 percentage points and the Hispanic share by 5.77 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. This paper is the first in this literature to isolate such narrow spatial variation.

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. While block level census data are available by race, no income measures are available making it difficult to separate income from the other channels by which land use regulation might influence racial location. Given that much of the impact is mediated through changes in the types of structures built, and that the proportion of minorities owning homes lags whites even within income categories, it is unlikely the entire result can be explained by income alone. Nonetheless, income surely plays a substantial role. Even aside from any racial interaction, the effect of zoning on segregation by income and educational attainment are worthy of study in their own right.

While changes in the dissimilarity index tend not to fit themselves neatly into canonical social welfare functions, these results may be of interest to policymakers who see lower (or higher) levels of racial segregation as a desirable outcome. The Department of Housing and Urban Development issued new guidelines in July 2013 with the goal of "Affirmatively Furthering Fair Housing" and has threatened to withhold block grant money from New York's Westchester County, among others, due to "restrictive practices" such as limits on density and building type it sees as racially and ethnically exclusionary. Angered by what he sees as federal overreach, a Westchester County Executive penned a Wall Street Journal Op-Ed (Astorino, 2013) asking residents whether they "think it is a good idea to give the Department of Housing and Urban Development unchecked authority to put an apartment building in your neighborhood." While the results here cannot tell us about the desirability of such a federal policy, they do imply that it would likely result in a substantial decrease in racial segregation.

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A Defining Sub-Regions of Greater Boston

In defining four regions to analyze heterogeneity in the treatment effect across different types of jurisdictions, I aimed to create four regions that were relatively internally consistent in their composition but that provided contrasts with each other. While I largely followed pre-defined county and New England City and Town Area (NECTA) division lines, I exerted some judgment given knowledge of the area to come up with the specific lists of cities. Figures 3 through 5 show visual representations of the four regions.

1) The Urban Core - I define the urban core as the city of Boston and any city that falls within 5 miles of the city's political and economic center in Northeast Boston. In practice nearly all of these cities fall to the north, and are generally a set of racially integrated suburbs. This set of 10 municipalities includes Brookline, Boston, Cambridge, Chelsea, Everett, Malden, Medford, Somerville, Winthrop, and Revere.

2) The Route 128 Corridor - Route 128, which runs concurrently with Interstate 95 in the Boston metro area, is the inner of the 2 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 just 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 and Winchester in Middlesex County and Dedham, Dover, Needham, Wellesley, and Westwood in Norfolk County.

3) I define the Northern Suburbs as encompassing all of Essex County with the exception of the far northern coastal communities that have little in common demographically and economically with their neighbors. The 22 towns in this group are Andover, Beverly, Boxford, Danvers, Georgetown, Groveland, Hamilton, Haver-

hill, Lawrence, Lynn, Lynnfield, Marblehead, Methuen, Middleton, Nahant, North Andover, Peabody, Salem, Saugus, Swampscott, Topsfield, and Wenham.

4) The Southern Suburbs extend south from the city limits to Brockton, Massachusetts. 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.

Table 1: Summary Stats

	All Blocks in Massachusetts Metro Areas			Blocks in Zoning Border Sample			Borders Between Multi-Family & Single-Family Zones			Borders Where Single-Family Density Zoning Changes		
	Total		Share	Total		Share	Total		Share	Total		Share
Person Level:												
Population	6,102,443			505,402			175,298			255,892		
Black	424,769		0.0696	50,804		0.1005	26,936		0.1537	4,941		0.0193
Hispanic	614,846		0.1008	46,441		0.0919	23,772		0.1356	8,286		0.0324
White (Non-Hispanic)	4,580,102		0.7505	360,784		0.7139	103,964		0.5931	227,028		0.8872
Dwelling Units	2,515,393			210,238			76,494			101,538		
Rental Units	906,254		0.3603	75,976		0.3614	36,671		0.4794	18,244		0.1797
Black Rental (of Black Total)	98,231		0.6653	11,247		0.6281	5,532		0.5916	716		0.4295
Hispanic Rental (of Hisp Tot)	136,049		0.7544	10,087		0.7323	5,336		0.7460	1,052		0.4804
White Rental (of White Total)	594,898		0.3167	47,754		0.3137	22,244		0.4557	15,464		0.1748
Block Level:												
Blocks	82,071			6,835			1,959			4,314		
Boundaries				1,328			414			796		
No Black Population	51,663		0.6295	4,154		0.6078	766		0.3910	3,308		0.7668
No Hispanic Population	40,379		0.4920	3,178		0.4650	575		0.2935	2,566		0.5948
Has Body of Water	6,375		0.0777	353		0.0516	25		0.0128	329		0.0763
Zoned for Multi-Family	5,354		0.0652	1,520		0.2224	932		0.4758	0		
Multi-Family High Density	4,438		0.0541	1,160		0.1697	638		0.3257	0		
Multi-Family Low Density	916		0.0112	360		0.0527	294		0.1501	0		
Zoned for Single-Family	51,907		0.6325	5,315		0.7776	1,027		0.5242	4,314		1.0000
Single-Family High Density	19,248		0.2345	2,007		0.2936	867		0.4426	1,153		0.2673
Single-Family Med. Density	15,570		0.1897	2,222		0.3251	112		0.0572	2,118		0.4910
Single-Family Low Density	17,089		0.2082	1,086		0.1589	48		0.0245	1,043		0.2418
Boston Metro Area	51,811		0.6313	4,917		0.7194	1,387		0.7080	3,012		0.6982
Urban Boston	10,632		0.1295	1,416		0.2072	839		0.4283	147		0.0341
Route 128	10,712		0.1305	1,086		0.1589	77		0.0393	1,012		0.2346
	Mean	**Median**	**St. Dev.**	**Mean**	**Median**	**St. Dev.**	**Mean**	**Median**	**St. Dev.**	**Mean**	**Median**	**St. Dev.**
Population	74.36	44	103.85	73.94	51	77.28	89.48	67	87.25	59.32	40	63.33
People Per Acre	12.77	6.43	27.95	13.97	7.34	19.84	22.84	18.45	23.82	6.09	4.49	9.28
Dwelling Units Per Acre	5.61	2.64	15.65	6.12	2.92	10.16	10.24	7.84	12.38	2.57	1.76	5.41
Rental Units Per Acre	2.69	0.19	10.37	2.91	0.27	7.53	5.30	2.69	10.31	0.62	0.06	2.59
Zoned Units Per Acre	4.21	4.73	4.02	5.69	4.73	5.84	9.00	4.73	6.24	2.66	1.94	1.44
Land (acres)	39.71	5.62	131.13	16.52	5.51	27.64	6.68	3.61	12.51	22.85	8.54	32.21
Dist to City Center (miles)	17.34	15.19	12.42	15.52	13.41	10.95	12.55	7.43	12.11	17.60	15.94	9.60

Notes: Population data are calculated using the 2010 US Census Summary File 1, an 100% sample of the US population. Geographic and zoning data are constructed using GIS shapefiles available from MassGIS.

Table 2: Black Share of Block Population and Zoned Density in Massachusetts Metro Areas

	(1) Black Share of Block Pop.	(2) Black Share of Block Pop.	(3) No Blacks on Block	(4) Logged Black Share	(5) Black Share of Block Pop.	(6) Black Share of Block Pop.	(7) Black Share of Block Pop.	(8) Black Share of Block Pop.
Zoned Dwelling	0.0038**	0.0036**	-0.0235**		0.0084**	0.0018	0.0036**	0.0017
Units per Acre	[0.0009]	[0.0007]	[0.0037]		[0.0020]	[0.0016]	[0.0008]	[0.0017]
Logged Zoned				0.1746**				
Units per Acre				[0.0465]				
Distance to Major		-0.0039						
City Center		[0.0029]						
Block Contains		0.004						
Body of Water		[0.0045]						
Border Fixed Effects	YES	YES	YES	YES	NO	NO	NO	YES
Town Fixed Effects	NO	NO	NO	NO	NO	YES	YES	NO
Observations	6835	6835	6835	2681	52359	52359	49772	754
R-squared	0.8	0.8	0.19	0.77	0.09	0.31	0.3	0.84
Blocks Included in Regression	All Border Blocks	All Borders Blocks	All Borders Blocks	Borders with Black Pop > 0	All Blocks	All Blocks	Non-Boston Blocks	Boston Border Blocks
Black Share of Sample	0.1005	0.1005	0.1005	0.1658	0.0696	0.0696	0.0465	0.3244

Notes: The unit of obersvation 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 except column 8 which uses Huber-White robust standard errors. * significant at 5%; ** significant at 1%

Table 3: Black Share of Block Population and Zoning Categories in Massachusetts Metro Areas

	(1) Black Share of Block Pop.	(2) Black Share of Block Pop.	(3) Black Share of Block Pop.	(4) Black Share of Block Pop.	(5) Black Share of Block Pop.	(6) No Blacks on Block	(7) Logged Black Share
Multi-Family	0.0336**						
Housing Permitted	[0.0074]						
Multi-Family Low Density		0.0087	(omitted)				
(3-8 units per acre)		[0.0133]					
Multi-Family Medium Density		0.0369**	0.0388				
(9-20 units per acre)		[0.0118]	[0.0221]				
Multi-Family High Density		0.0565**	0.0497*				
(20+ units per acre)		[0.0179]	[0.0171]				
Single-Family Low Density				(omitted)			
(lot size > 1 acre)							
Single-Family Medium Density				0.0004			
(lot sizes btw 3/8 and 1 acre)				[0.0045]			
Single-Family High Density				0.003			
(lot sizes < 3/8 acre)				[0.0051]			
Zoned Dwelling					0.0007	-0.0165	
Units per Acre					[0.0012]	[0.0135019]	
Logged Zoned							0.1648
Units per Acre							[0.1359]
Border Fixed Effects	YES	YES	YES	YES	YES	YES	YES
Observations	1959	1959	663	4314	4314	4314	1006
R-squared	0.8	0.8	0.84	0.36	0.36	0.12	0.64
Blocks Included in Regression	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Multi-Family Borders	Single-Fam. Borders	Single-Fam. Borders	Single-Fam. Borders	SF Bord. Black Pop > 0
Black Share of Sample Pop.	0.1537	0.1537	0.2701	0.0193	0.0193	0.0193	0.0484

Notes: The unit of obersvation in all regressions is the block. See notes from Table 2 for block and border selection criteria. Columns 1 and 2 use blocks that fall on a border between a single-family zone and one zoned for multi-family units. Column 3 shows blocks on borders of multi-family zones of different densities. Columns 4 through 7 use blocks on borders between single-family zones of different densities. Standard Errors are clustered at the town level. * significant at 5%; ** significant at 1%

Table 4: Hispanic Share of Block Population and Zoned Density in Massachusetts Metro Areas

	(1) Hispanic Share of Block Pop.	(2) Hispanic Share of Block Pop.	(3) No Hispanics on Block	(4) Logged Hispanic Share	(5) Hispanic Share of Block Pop.	(6) Hispanic Share of Block Pop.
Zoned Dwelling	0.0050**	0.0049**	-0.0195**		0.0098**	0.0078**
Units per Acre	[0.0009]	[0.0009]	[0.0040]		[0.0016]	[0.0017]
Logged Zoned				0.2077**		
Units per Acre				[0.0514]		
Distance to Major		-0.001				
City Center		[0.0009]				
Block Contains		0.0004				
Body of Water		[0.0032]				
Border Fixed Effects	YES	YES	YES	YES	NO	NO
Town Fixed Effects	NO	NO	NO	NO	NO	YES
Observations	6835	6835	6835	3657	52359	52359
R-squared	0.64	0.64	0.16	0.62	0.12	0.42
Blocks Included in Regression	All Border Blocks	All Borders Blocks	All Borders Blocks	Borders with Hisp Pop > 0	All Blocks	All Blocks
Hispanic Share of Sample	0.0919	0.0919	0.0919	0.1213	0.1008	0.1008

Notes: The unit of obersvation in all regressions is the block. See notes from Table 2 for block and border selection criteria. Standard Errors are clustered at the town level. * significant at 5%; ** significant at 1%

Table 5: Hispanic Share of Block Population and Zoning Categories in Massachusetts Metro Areas

	(1) Hispanic Share of Block Pop.	(2) Hispanic Share of Block Pop.	(3) Hispanic Share of Block Pop.	(4) Hispanic Share of Block Pop.	(5) Hispanic Share of Block Pop.	(6) No Hispanics on Block	(7) Logged Hispanic Share
Multi-Family	0.0577**						
Housing Permitted	[0.0122]						
Multi-Family Low Density		0.0344*	(omitted)				
(3-8 units per acre)		[0.0146]					
Multi-Family Medium Density		0.0630**	0.0324				
(9-20 units per acre)		[0.0192]	[0.0250]				
Multi-Family High Density		0.0753**	0.0596*				
(20+ units per acre)		[0.0229]	[0.0186]				
Single-family Low Density				(omitted)			
(lot size > 1 acre)							
Single-Family Medium Density				0.0031			
(lot sizes btw 3/8 and 1 acre)				[0.0028]			
Single-Family High Density				0.0137			
(lot sizes < 3/8 acre)				[0.0074]			
Zoned Dwelling					0.0033	-0.0485**	
Units per Acre					[0.0018]	[0.0135]	
Logged Zoned							0.0475
Units per Acre							[0.0937]
Border Fixed Effects	YES	YES	YES	YES	YES	YES	YES
Observations	1959	1959	663	4314	4314	4314	1748
R-squared	0.63	0.64	0.64	0.3	0.29	0.11	0.46
Blocks Included in Regression	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Multi-Family Borders	Single-Fam. Borders	Single-Fam. Borders	Single-Fam. Borders	SF Bord. Hisp. Pop > 0
Hispanic Share of Sample Pop.	0.1356	0.1356	0.1859	0.0324	0.0324	0.0324	0.0521

Notes: The unit of obersvation in all regressions is the block. See notes from Table 2 for block and border selection criteria. Columns 1 and 2 use blocks that fall on a border between a single-family zone and one zoned for multi-family units. Column 3 shows blocks on borders of multi-family zones of different densities. Columns 4 through 7 use blocks on borders between single-family zones of different densities. Standard Errors are clustered at the town level. * significant at 5%; ** significant at 1%

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

	(1a) Black Share of Block Pop.	(2a) Black Share of Block Pop.	(3a) Black Share of Block Pop.	(4a) Black Share of Block Pop.	(5a) Hisp. Share of Block Pop.	(6a) Hisp. Share of Block Pop.	(7a) Hisp. Share of Block Pop.	(8a) Hisp. Share of Block Pop.
Boston Sub-Metro Area	Urban Core	Route 128 Corridor	North Suburbs	South Suburbs	Urban Core	Route 128 Corridor	North Suburbs	South Suburbs
Multi-Family Housing Permitted	0.0434*	0.0443	0.0317*	0.048	0.0293*	0.0428	0.0763*	0.0147
	[0.0138]	[0.0345]	[0.0081]	[0.0237]	[0.0112]	[0.0257]	[0.0268]	[0.0121]
Border Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Observations	696	105	191	326	696	105	191	326
R-squared	0.82	0.55	0.63	0.75	0.47	0.52	0.71	0.37
Blocks Included in Regression	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Single/Multi Fam. Borders
	(1b) Black Share of Block Pop.	(2b) Black Share of Block Pop.	(3b) Black Share of Block Pop.	(4b) Black Share of Block Pop.	(5b) Hisp. Share of Block Pop.	(6b) Hisp. Share of Block Pop.	(7b) Hisp. Share of Block Pop.	(8b) Hisp. Share of Block Pop.
Boston Sub-Metro Area	Urban Core	Route 128 Corridor	North Suburbs	South Suburbs	Urban Core	Route 128 Corridor	North Suburbs	South Suburbs
Single-Family Low Density (lot size > 1 acre)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
Single-Fam. Med. Density (lots btw 3/8 and 1 acre)	0.0188	0.0008	0.0051	-0.0014	-0.0721	0.0069	0.0196	0.0107
	[0.0328]	[0.0043]	[0.0039]	[0.0208]	[0.0642]	[0.0064]	[0.0139]	[0.0113]
Single-Family High Density (lot sizes < 3/8 acre)	-0.0018	0.002	0.0195**	0.0141	-0.1029	0.0124	0.0685*	0.0156
	[0.0322]	[0.0051]	[0.0058]	[0.0230]	[0.0712]	[0.0064]	[0.0237]	[0.0099]
Border Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Observations	51	1037	530	361	51	1037	530	361
R-squared	0.33	0.2	0.25	0.48	0.32	0.18	0.35	0.24
Blocks Included in Regression	Single-Fam. Borders	Single-Fam. Borders	Single-Fam. Borders	Single-Fam. Borders	Single-Fam. Borders	Single-Fam. Borders	Single-Fam. Borders	Single-Fam. Borders

Notes: The unit of obersvation in all regressions is the block. See notes from Table 2 for block and border selection criteria. Regressions are clustered at the town level except for 1b and 5b which use robust Huber-White errors. * significant at 5%; ** significant at 1%

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

	(1a) Dwell. Units per Acre	(2a) Rental Units per Acre	(3a) 1-Fam Units per Acre	(4a) 2-Fam Units per Acre	(5a) 3-Fam Units per Acre	(6a) Small Apt Units per Ac.	(7a) Large Apt Units per Ac.	(8a) Condo Units per Acre
Zoned for Single Family	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
Zoned for Low-Density	2.8220**	2.0896**	-1.2635**	0.9064	0.3631	0.6113	0.765	1.0575*
Multi Family Housing	[0.7369]	[0.6779]	[0.2904]	[0.6218]	[0.2300]	[0.3471]	[0.5372]	[0.4646]
Zoned for M/H Dens.	7.3760**	6.0796**	-1.2992**	-0.4816	0.9226*	0.4180*	4.0228**	2.5451*
Multi Family Housing	[1.1367]	[0.6923]	[0.2776]	[0.4686]	[0.3893]	[0.1968]	[1.2898]	[1.1820]
Border Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Observations	1924	1924	848	848	848	848	848	848
R-squared	0.67	0.6	0.61	0.62	0.58	0.38	0.42	0.4
Blocks Included in Regression	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Single/Multi Fam. Borders
	(1b) Dwell. Units per Acre	(2b) Rental Units per Acre	(3b) 1-Fam Units per Acre	(4b) 2-Fam Units per Acre	(5b) 3-Fam Units per Acre	(6b) Small Apt Units per Ac.	(7b) Large Apt Units per Ac.	(8b) Condo Units per Acre
Zoned for Low Dens. SF	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
Zoned for Med. Density	0.5596**	0.0615	0.5782**	0.049	0.0074	0.03	0.0259	0.018
Single Family Housing	[0.1084]	[0.0662]	[0.0947]	[0.0441]	[0.0114]	[0.0312]	[0.0332]	[0.0624]
Zoned for High Density	1.9179**	0.5843**	1.1861**	0.3886**	0.0991**	0.0850*	0.1072*	0.1838
Single Family Housing	[0.2120]	[0.1290]	[0.2029]	[0.1175]	[0.0368]	[0.0328]	[0.0507]	[0.0925]
Border Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Observations	4033	4033	2374	2374	2374	2374	2374	2374
R-squared	0.42	0.28	0.62	0.49	0.34	0.22	0.15	0.38
Blocks Included in Regression	Single-Fam. Borders	Single-Fam. Borders	Single-Fam. Borders	Single-Fam. Borders	Single-Fam. Borders	Single-Fam. Borders	Single-Fam. Borders	Single-Fam. Borders

Notes: The unit of obersvation in all regressions is the block. See notes from Table 2 for block and border selection criteria. Standard Errors are clustered at the town level. * significant at 5%; ** significant at 1%

Table 8: Impact of Building Type on Total Units by Race

	(1) Dwelling Units Per Acre	(2) Black Units Per Acre	(3) Hispanic Units Per Acre	(4) White Units Per Acre	(5) Dwelling Units Per Acre	(6) Black Units Per Acre	(7) Hispanic Units Per Acre	(8) White Units Per Acre
Region Included	Boston Metro	Boston Metro	Boston Metro	Boston Metro	Route 128	Route 128	Route 128	Route 128
Single Family	0.9459**	0.0046	0.0079	0.8624**	0.9651**	0.0101*	0.0079**	0.8687**
Houses Per Acre	[0.0226]	[0.0054]	[0.0049]	[0.0195]	[0.0373]	[0.0044]	[0.0025]	[0.0242]
Two Family	2.0583**	0.1862*	0.1649*	1.3628**	2.4225**	0.0723**	0.0748**	2.0296**
Houses Per Acre	[0.1552]	[0.0836]	[0.0708]	[0.1715]	[0.2047]	[0.0247]	[0.0239]	[0.1739]
Three Family	2.0959**	0.0933	0.6764*	1.0423	1.9579	-0.0377	0.2776	1.4717
Houses Per Acre	[0.4513]	[0.1066]	[0.2945]	[0.5308]	[1.1921]	[0.0778]	[0.1531]	[1.0596]
Small Apartment	5.5703**	0.157	0.4921	3.8017**	3.7904*	0.3206	0.6838**	2.1009
Buildings per Acre	[0.8885]	[0.1056]	[0.3336]	[0.9909]	[1.7183]	[0.2047]	[0.2464]	[1.4079]
Large Apartment	30.4185**	3.6922**	2.6512**	18.8323**	34.4371**	2.1892**	1.6105**	23.6051**
Buildings per Acre	[3.8219]	[1.2957]	[0.5916]	[3.0556]	[10.0945]	[0.8276]	[0.6084]	[7.6139]
Condominium	0.8384**	0.0149*	0.0214	0.6692**	0.6386*	0.0195*	0.0288*	0.4143*
Units Per Acre	[0.0857]	[0.0065]	[0.0113]	[0.1000]	[0.2585]	[0.0087]	[0.0133]	[0.1635]
Border Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Observations	3302	3345	3345	3345	1045	1045	1045	1045
R-squared	0.79	0.51	0.63	0.81	0.76	0.49	0.55	0.83
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

Table 9: Black Share of Block Population and Zoning -- 1990 Census

	(1) Black Share of Block Pop.	(2) No Blacks on Block	(3) Logged Black Share	(4) Black Share of Block Pop.	(5) Black Share of Block Pop.	(6) Black Share of Block Pop.	(7) Black Share of Block Pop.
Zoned Dwelling	0.0038*	-0.0261**					-0.0002
Units per Acre	[0.0018]	[0.0033]					[0.0008]
Logged Zoned			0.2587*				
Units per Acre			[0.1108]				
Multi-Family				0.0257**			
Housing Permitted				[0.0084]			
Multi-Family Low Density					0.0065*		
(3-8 units per acre)					[0.0032]		
Multi-Family Medium Density					0.0372**		
(9-20 units per acre)					[0.0112]		
Multi-Family High Density					0.0366		
(20+ units per acre)					[0.0230]		
Single-family Low Density (lot size > 1 acre)						(omitted)	
Single-Family Medium Density						0.0025	
(lot sizes btw 3/8 and 1 acre)						[0.0018]	
Single-Family High Density						0.0011	
(lot sizes < 3/8 acre)						[0.0028]	
Border Fixed Effects	YES	YES	YES	YES	YES	YES	YES
Observations	4299	4299	1271	1222	1222	2788	2788
R-squared	0.82	0.19	0.77	0.8	0.8	0.27	0.27
Blocks Included in Regression	All Borders	All Borders	Borders w/ Black Pop > 0	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Single-Fam. Borders	Single-Fam. Borders

Table 10: Hispanic Share of Block Population and Zoning -- 1990 Census

	(1) Hispanic Share of Block Pop.	(2) No Hispanics on Block	(3) Logged Hispanic Share	(4) Hispanic Share of Block Pop.	(5) Hispanic Share of Block Pop.	(6) Hispanic Share of Block Pop.	(7) Hispanic Share of Block Pop.
Zoned Dwelling	0.0040**	-0.0245**					0.0008
Units per Acre	[0.0008]	[0.0039]					[0.0010]
Logged Zoned			0.2919**				
Units per Acre			[0.0712]				
Multi-Family				0.0280**			
Housing Permitted				[0.0064]			
Multi-Family Low Density					0.0181*		
(3-8 units per acre)					[0.0087]		
Multi-Family Medium Density					0.0257*		
(9-20 units per acre)					[0.0095]		
Multi-Family High Density					0.0414**		
(20+ units per acre)					[0.0138]		
Single-family Low Density (lot size > 1 acre)						(omitted)	
Single-Family Medium Density						-0.0018	
(lot sizes btw 3/8 and 1 acre)						[0.0036]	
Single-Family High Density						0.0015	
(lot sizes < 3/8 acre)						[0.0041]	
Border Fixed Effects	YES	YES	YES	YES	YES	YES	YES
Observations	4299	4299	1503	1222	1222	2788	2788
R-squared	0.47	0.12	0.56	0.45	0.45	0.21	0.21
Blocks Included in Regression	All Borders	All Borders	Borders w/ Hispanic Pop >	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Single-Fam. Borders	Single-Fam. Borders

Table 11: Zoned Density and Changes in Block Attributes between 1990 and 2010

	(1) Log Black Share, 2010	(2) Log Black Share, 2010	(3) Log Black Share, 2010	(4) Log Black Share, 2010	(5) Log Hisp. Share, 2010	(6) Log Hisp. Share, 2010	(7) Log Hisp. Share, 2010	(8) Log Hisp. Share, 2010	(9) Log Units per Ac. 2010
Logged Black Share, 1990	0.4283**	0.3845**	0.4857**	0.4858**					
	[0.0757]	[0.1093]	[0.1285]	[0.1263]					
Logged Hispanic Share, 1990					0.2094**	0.1692	0.2841**	0.2688**	
					[0.0477]	[0.0919]	[0.0988]	[0.0988]	
Log Dwell. Units per Acre, 1990									0.8273**
									[0.0221]
Log Zoned Units per Acre	0.1703			0.15	0.3215**			0.3877	0.1490**
	[0.0865]			[0.2623]	[0.0858]			[0.2016]	[0.0379]
Multi-Family Housing Permitted		0.1838				0.3113**			
		[0.1255]				[0.1029]			
Single-Family Low-Density			(omitted)				(omitted)		
Single-Family Medium-Density			0.0195				0.2446		
			[0.4192]				[0.2891]		
Single-Family High-Density			0.1345				0.4085		
			[0.4435]				[0.3094]		
Border Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	963	350	338	338	1284	448	542	542	3427
R-squared	0.92	0.89	0.88	0.88	0.79	0.72	0.71	0.71	0.97
Blocks Included in Regression	Matched Borders	Matched Multi/Sing	Merged Single Fam	Merged Single Fam	Matched Borders	Matched Multi/Sing	Merged Single Fam	Merged Single Fam	Matched Borders

Table 12: Segregation Across US Metro Areas, 2010 (Page 1 or 2)

Rank	Metropolitan Area	Dissimilarity Index	Population
1	Milwaukee-Waukesha-West Allis, WI	0.777	1,555,908
2	Detroit-Warren-Dearborn, MI	0.735	4,296,250
3	Chicago-Naperville-Elgin, IL-IN-WI	0.719	9,461,105
4	Cleveland-Elyria, OH	0.715	2,077,240
5	St. Louis, MO-IL	0.71	2,787,701
6	Buffalo-Cheektowaga-Niagara Falls, NY	0.699	1,135,509
7	Cincinnati, OH-KY-IN	0.68	2,114,580
8	Dayton, OH	0.656	799,232
9	Pittsburgh, PA	0.649	2,356,285
10	New York-Newark-Jersey City, NY-NJ-PA	0.647	19,567,410
11	Syracuse, NY	0.646	662,577
12	Birmingham-Hoover, AL	0.643	1,128,047
13	Toledo, OH	0.63	610,001
13	Indianapolis-Carmel-Anderson, IN	0.63	1,887,877
15	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	0.626	5,965,343
16	Baltimore-Columbia-Towson, MD	0.622	2,710,489
17	Rochester, NY	0.616	1,079,671
18	Columbus, OH	0.603	1,901,974
19	New Orleans-Metairie, LA	0.597	1,189,866
20	Memphis, TN-MS-AR	0.591	1,324,829
20	Grand Rapids-Wyoming, MI	0.591	988,938
22	Omaha-Council Bluffs, NE-IA	0.588	865,350
23	Albany-Schenectady-Troy, NY	0.585	870,716
24	Akron, OH	0.583	703,200
25	Miami-Fort Lauderdale-West Palm Beach, FL	0.581	5,564,635
26	Kansas City, MO-KS	0.577	2,009,342
27	**Boston-Cambridge-Newton, MA-NH**	**0.576**	**4,552,402**
28	Denver-Aurora-Lakewood, CO	0.567	2,543,482
29	Hartford-West Hartford-East Hartford, CT	0.563	1,212,381
30	Louisville/Jefferson County, KY-IN	0.562	1,235,708
30	Bridgeport-Stamford-Norwalk, CT	0.562	916,829
32	Washington-Arlington-Alexandria, DC-VA-MD-WV	0.561	5,636,232
33	Little Rock-North Little Rock-Conway, AR	0.56	699,757
34	Baton Rouge, LA	0.559	802,484
35	**Springfield, MA**	**0.557**	**621,570**
36	Cape Coral-Fort Myers, FL	0.545	618,754
36	Los Angeles-Long Beach-Anaheim, CA	0.545	12,828,837
38	New Haven-Milford, CT	0.544	862,477
39	Atlanta-Sandy Springs-Roswell, GA	0.541	5,286,728
40	Knoxville, TN	0.529	837,571
41	Wichita, KS	0.528	630,919
42	Nashville-Davidson--Murfreesboro--Franklin, TN	0.525	1,670,890
43	Tulsa, OK	0.517	937,478
44	Winston-Salem, NC	0.512	640,595

Notes: Data are from Edward Glaeser and Jacob Vigdor's “The End of the Segregated Century: Racial Separation in America’s Neighborhoods, 1890-2010.” Mannhattan Institute Civic Report, January 2012.

Table 12: Segregation Across US Metro Areas, 2010 (Page 2 of 2)

Rank	Metropolitan Area	Dissimilarity Index	Population
45	San Francisco-Oakland-Hayward, CA	0.505	4,335,391
46	Jacksonville, FL	0.504	1,345,596
46	Tampa-St. Petersburg-Clearwater, FL	0.504	2,783,243
48	North Port-Sarasota-Bradenton, FL	0.503	702,281
49	Greensboro-High Point, NC	0.498	723,801
50	Richmond, VA	0.496	1,208,101
51	Oklahoma City, OK	0.487	1,252,987
52	Minneapolis-St. Paul-Bloomington, MN-WI	0.48	3,348,859
53	Houston-The Woodlands-Sugar Land, TX	0.478	5,920,416
54	Dallas-Fort Worth-Arlington, TX	0.475	6,426,214
55	**Worcester, MA-CT**	**0.473**	**916,980**
56	Providence-Warwick, RI-MA	0.472	1,600,852
57	Charlotte-Concord-Gastonia, NC-SC	0.471	2,217,012
58	Columbia, SC	0.464	767,598
59	Madison, WI	0.461	605,435
60	Honolulu, HI	0.451	953,207
61	Virginia Beach-Norfolk-Newport News, VA-NC	0.449	1,676,822
62	Sacramento--Roseville--Arden-Arcade, CA	0.445	2,149,127
63	Orlando-Kissimmee-Sanford, FL	0.435	2,134,411
64	Seattle-Tacoma-Bellevue, WA	0.43	3,439,809
65	Portland-Vancouver-Hillsboro, OR-WA	0.423	2,226,009
66	San Antonio-New Braunfels, TX	0.421	2,142,508
67	Allentown-Bethlehem-Easton, PA-NJ	0.418	821,173
68	Greenville-Anderson-Mauldin, SC	0.415	824,112
69	Bakersfield, CA	0.401	839,631
70	Lakeland-Winter Haven, FL	0.397	602,095
71	Fresno, CA	0.391	930,450
72	Charleston-North Charleston, SC	0.39	664,607
73	Raleigh, NC	0.386	1,130,490
73	San Diego-Carlsbad, CA	0.386	3,095,313
75	El Paso, TX	0.385	804,123
76	Austin-Round Rock, TX	0.382	1,716,289
77	McAllen-Edinburg-Mission, TX	0.341	774,769
78	Colorado Springs, CO	0.34	645,613
79	Riverside-San Bernardino-Ontario, CA	0.326	4,224,851
80	Salt Lake City, UT	0.322	1,087,873
81	Stockton-Lodi, CA	0.314	685,306
82	Phoenix-Mesa-Scottsdale, AZ	0.312	4,192,887
83	Tucson, AZ	0.293	980,263
84	Boise City, ID	0.284	616,561
85	Las Vegas-Henderson-Paradise, NV	0.281	1,951,269
86	San Jose-Sunnyvale-Santa Clara, CA	0.253	1,836,911
87	Oxnard-Thousand Oaks-Ventura, CA	0.244	823,318
88	Albuquerque, NM	0.243	887,077

Notes: Data are from Edward Glaeser and Jacob Vigdor's "The End of the Segregated Century: Racial Separation in America's Neighborhoods, 1890-2010." Manhattan Institute Civic Report, January 2012.

Figure 1: Zoning Regulation in Cambridge, MA

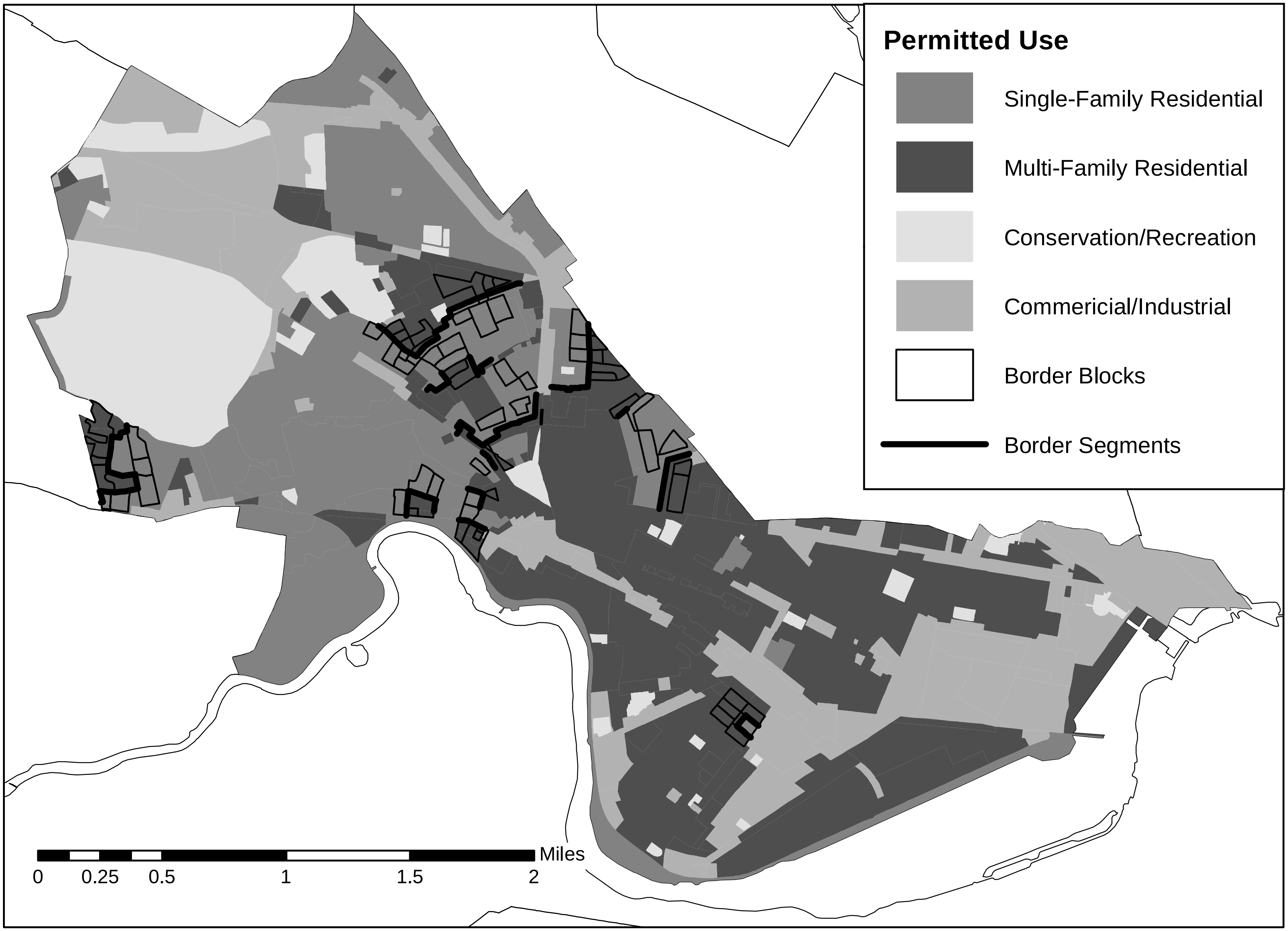

Figure 2: Percent Black by Census Block in Cambridge, MA

Figure 3: Black Population in the Boston Area

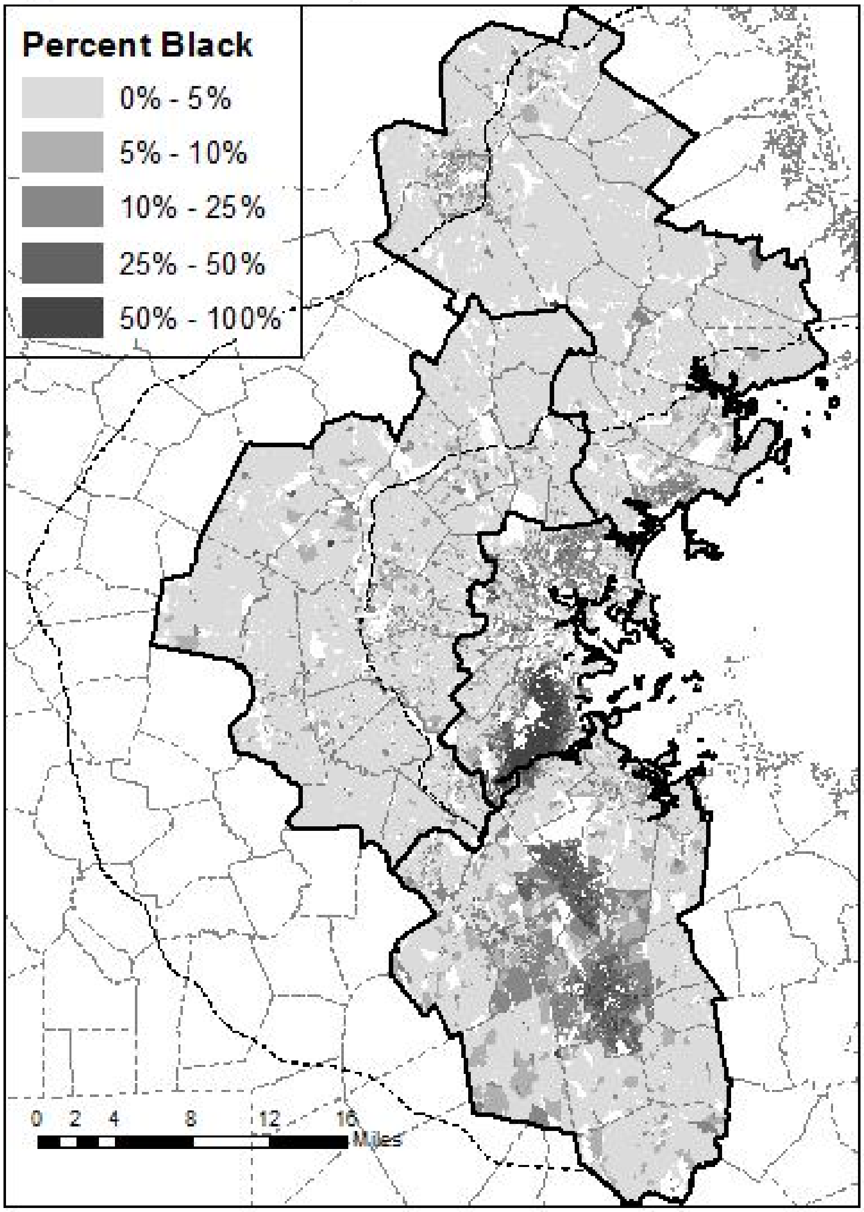

Figure 4: Hispanic Population in the Boston Area

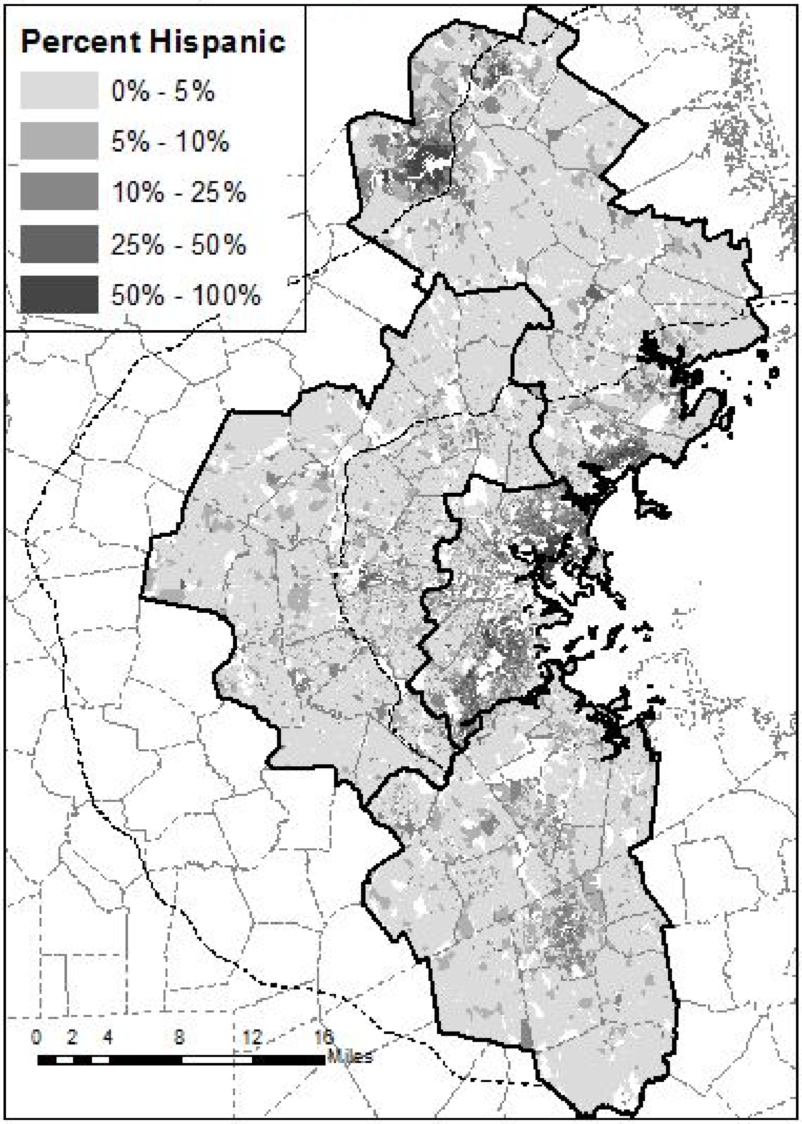

Figure 5: Zoning Regulation in the Boston Area