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ABSTRACT

Zoning has been cited as a discriminatory policy tool by critics, who argue that ordinances are used to locate manufacturing activity in minority neighborhoods (environmental racism) and deter the entry of minority residents into good neighborhoods using density restrictions (exclusionary zoning). However, empirically documenting such discriminatory behavior is complicated by the fact that zoning and land use have been co-evolving for nearly a century in most American cities, rendering discrimination and sorting observationally equivalent. We employ a novel approach to overcome this challenge, studying the introduction of comprehensive zoning in Chicago. Using fine-scale spatial data on the location of African Americans and immigrants across the city along with maps of pre-existing land use, we find strong evidence of environmental racism. Both southern black and immigrant neighborhoods appear to have been targeted for increased levels of industrial use zoning. We also find evidence of a pre-cursor to modern day exclusionary zoning.

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I. Introduction

Few local policies are as controversial or as frequently linked to discrimination as zoning. Critics argue that zoning is used to steer industrial activity towards minority neighborhoods, leading to disproportionate toxic exposure and depressed land values (Maantay, 2001; Baden and Coursey, 2002; Wilson, Hutson, and Mujahid, 2008). "Environmental racism" associated with zoning could thus serve as a channel through which minorities remain disadvantaged and isolated.[2] Scholars and policy makers also argue that zoning is used as a tool to deter entry of poorer households into good neighborhoods, often through the imposition of minimum lot sizes.[3] This school of thought concludes that low-income minority households are trapped in poor neighborhoods as a result of "exclusionary" zoning (Schlay and Rossi, 1981; Rothwell and Massey, 2009; Rothwell, 2011). The empirical evidence on the environmental racism and exclusionary zoning hypotheses is mixed in part because of the difficulty associated with devising well-identified empirical tests. Zoning and land use have been co-evolving for nearly a century in most American cities, making it difficult to show that zoning ordinances are responsible for the adverse outcomes or segregation of particular racial and ethnic groups.

We assess whether land use regulation has discriminated against minorities by focusing on the introduction of comprehensive zoning in Chicago in 1923, one of the first policies of its kind in the U.S. Using a novel, geographically identified, demographic dataset in conjunction with a fine-scale digitized map of contemporary (1922) land uses, we ask how the racial and ethnic composition of neighborhoods influenced Chicago's initial zoning ordinance. We focus on both the initial sorting of demographic groups relative to the extant character of Chicago's

[2] The term "environmental racism" was coined by Reverend Benjamin Chavis during a press release regarding the influential report "Toxic Waste and Race in the United States: A National Report on the Racial and Socioeconomic Characteristics of Communities with Hazardous Waste Sites" (United Church of Christ, 1987).
[3] For reviews of the exclusionary zoning literature, see Ihlanfeldt (2004) and Pogodzinski (1991).

urban geography and the ways in which neighborhood demographics served to determine zoning outcomes. Our research thus evaluates the extent to which zoning could have provided a channel through which minority communities were exposed to a disproportionate share of environmental hazards and were excluded from the economic benefit of low density, purely residential zoning (McMillen and McDonald, 2002).

The key innovation of our approach is that we observe detailed measures of existing land use at the city block level *prior* to the introduction of comprehensive zoning. Our empirical strategy thus asks what impact minority populations had on zoning outcomes, conditional on the extant land use patterns at the time of initial zoning adoption. The ability to observe and control for ex ante minority proximity to undesirable land uses distinguishes our work from much of the previous literature, which has struggled to disentangle environmental racism in land use regulation from the observationally equivalent mechanism of poor minorities sorting into less expensive neighborhoods near polluting sites (Been and Gupta, 1997). Similarly, the ability to control for ex ante density allows us to distinguish between minority neighborhoods receiving higher density zoning and the tendency of minorities to settle in neighborhoods with denser development.

Another contribution of our study is the rich detail of the microdata assembled for the analysis. We observe place of birth and parents' place of birth for the universe of individuals living in Chicago in 1920, allowing us to precisely measure the size of both first- and second-generation immigrant populations. We are also able to distinguish northern-born black populations from enclaves of southern-born blacks who had migrated to Chicago, enabling us to ask whether these groups were treated differently in the zoning process. Our geographic unit of observation is an enumeration district, which was a small spatially delineated administrative unit

used internally by the census that contained fewer than 1,200 residents on average in Chicago in 1920. Our microdata includes the entire population of Chicago from the 1920 census, which represents a substantial improvement over existing sources of data.

We find that neighborhoods with a larger share of southern-born blacks or first-generation immigrants were more likely to be zoned for industrial uses than comparable neighborhoods with white natives. Specifically, a standard deviation increase in southern black share is associated with a 7 percentage point increase in the likelihood of an enumeration district being zoned to include manufacturing uses, and a one standard deviation increase in the first-generation immigrant share is associated with a 6 percentage point increase in the likelihood of an enumeration district being zoned for manufacturing uses. These are quantitatively important effects given that only 11 percent of enumeration districts were zoned for manufacturing uses. The inclusion of a rich set of controls for existing land uses and urban geography suggests that our results cannot be explained by minorities sorting into areas of the city that were most suited for manufacturing uses prior to the passage of the zoning ordinance.

Turning to density, we also find evidence of a form of exclusionary zoning. On the margin between the two lowest levels of volume zoning, where the greatest scope for exclusionary zoning through density restrictions would have existed, a one standard deviation increase in the southern black share of a neighborhood was associated with a 5.5 percentage point increase in the likelihood of the neighborhood being zoned primarily for high density building. For European immigrants, the relationship is reversed and is roughly twice the magnitude of the effect for southern blacks. Thus, at the margin, the zoning board appears to have endeavored to increase the building density in neighborhoods with high numbers of black

immigrants and decrease the density in neighborhoods with large numbers of European immigrants.[4]

We highlight that a striking feature of our results is the apparent singling out of blacks from the South for disadvantageous zoning. Although neighborhoods with a larger share of black residents were more likely to be zoned for industrial uses, we show that this effect is driven entirely by the presence of black migrants from the South. Our results cast doubt on the de jure racial blindness of comprehensive zoning ordinances, of which all but one (New York) were passed after the Supreme Court ruled explicitly racial zoning unconstitutional in the 1917 *Buchanan v. Warley* case. Furthermore, although our evidence is historical, the results demonstrate that racial discrimination in land use regulation can arise even when the policy tool is not as exclusionary in nature as minimum lot sizes and is restricted to regulating where industrial and commercial activity may take place. Shertzer, Twinam, and Walsh (2014) find that these ordinances have persistent effects on a city's economic geography, providing evidence that land use regulation could serve as a channel through which minorities remain poor over the long term.

II. Background on Zoning in Chicago

a. Brief History of Zoning in Chicago

The origins of comprehensive land use regulation in Chicago were rooted in public demand for "orderly" urban development, in particular the prevention of industrial and commercial encroachment on residential neighborhoods. Early twentieth century observers, including the influential Chicago Real Estate Board, expressed concern about the effect of

[4] The extant literature on exclusionary zoning emphasizes differences in zoning ordinances across various incorporated municipalities, not within a single city (for instance, *The Homevoter Hypothesis*, Fischel, 2001). However, to the extent that cities faced pressure to concentrate minorities in particular neighborhoods, we may expect to see higher density zoning in black and immigrant neighborhoods in our context.

unchecked expansion of commercial and industrial activity on property values (Schwieterman and Caspall, 2006). Others objected to the "canyon effect" created by unbroken rows of skyscrapers and the potential negative effects of the associated reduction in sunlight exposure and air flow on public health (Hall, 2002).

Chicago's city government had made previous attempts to control undesirable land uses, including an 1837 municipal code that prohibited any landowner or tenant from maintaining certain nuisances (such as dead animals, dung, putrid meat, or fish entrails) on their property. However, such piecemeal approaches proved insufficient for meeting public demand for controlled development, and in 1920 the newly created Chicago Zoning Commission began preparing a comprehensive zoning ordinance. The Commission, composed of eight aldermen and fourteen representatives from the Chicago community, spent eighteen months surveying existing land use in Chicago before issuing the initial statute.

Chicago's comprehensive zoning ordinance regulated land through both use districts and volume districts. Four distinct use districts were included: residential (single family housing), apartment, commercial, and manufacturing. These use districts were hierarchical, with apartment districts allowing residential uses, commercial districts allowing both apartments and single-family homes, and manufacturing districts allowing any use. Volume districts imposed restrictions on maximum lot coverage, aggregate volume, and height. The five volume districts in Chicago's ordinance were also hierarchical with district 5 allowing the tallest buildings.

Zoning statutes spread across the country in rapid order after Chicago's ordinance was passed, and by 1925 nearly 500 cities had adopted similar forms of comprehensive land use regulation (Mills, 1979). By this time, the question of whether zoning could explicitly address race and block black residents from certain neighborhoods had been settled: the U.S. Supreme

Court had ruled a Louisville, Kentucky racial zoning ordinance unconstitutional in *Buchanan v. Warley* in 1917. This case squashed an effort by the Chicago Real Estate Board to convince the city to adopt a similar racial zoning ordinance. The realtors, led by agents from the Hyde Park, Kenwood, and Oakland neighborhoods, had argued that the dispersion of African-Americans throughout the city could lead to more than $250 million (in 1922 dollars) in property value depreciations (Chicago Commission on Race Relations, 1922).

When the move for a racial zoning ordinance failed, demand for segregation and protection from black "encroachment" led to the proliferation of private alternatives such as restrictive covenants (Brooks, 2011; Brooks and Rose, 2013). White residents were concerned by the arrival of blacks from the South, seeing them as "ignorant and rough-mannered, entirely unfamiliar with the standards of conduct in northern cities" (Chicago Commission on Race Relations, 1922). White immigrants were also concerned about competition for jobs from newly arrived African Americans and viewed the prospect of Negro neighbors as a "catastrophe equal to the loss of their homes" (Grossman, 1989, p. 175). Even longtime black residents of Chicago were hostile to the new arrivals, worrying that they would lose what social privileges they had as a result of the influx of poor and uneducated southern blacks into the city (Kennedy, 1968, p. 222).

For their part, African Americans were suspicious of the movement for comprehensive zoning, particularly so soon after the racial zoning debate. They suspected that the new ordinance would treat their neighborhoods unfairly and facilitate the encroachment of polluting factories into black neighborhoods bordering industrial areas. The history of amendments to the 1923 ordinance also provides evidence of potential exclusionary motives: various local property owners associations rallied to block amendments that would allow apartment buildings in

residential areas, arguing that these changes would encourage the entry of African Americans who could not afford single family homes.[5] On the other hand, a prominent African American developer on the zoning board, Charles S. Duke, championed land use regulation to the black community and is credited by historians for having shielded the wealthiest black neighborhoods from mixed use zoning (NAACP, 1923).

b. Related Empirical Work on Zoning in Chicago

Although to our knowledge we are the first scholars to empirically ask how the spatial distribution of minority populations shaped initial zoning ordinances, comprehensive land use regulation is the subject of a large literature, and the case of Chicago has attracted particular interest. Previous work on Chicago's 1923 zoning ordinance used a sample of city blocks to determine the extent to which the ordinance followed existing uses, finding that zoning patterns were highly predictable given existing land uses, proximity to transportation networks, and distance to waterways (McMillen and McDonald, 1999). The same authors also asked how the 1923 zoning ordinance impacted land values (McMillen and McDonald, 2002). Using propensity score matching on the same sample of city blocks, they find that strictly residential zoning increased land values relative to commercial zoning.

III. Data

The dataset used in this paper has three components: 1920 census data at the enumeration district level, the comprehensive 1922 Chicago land use survey, and a map of the

[5] The historical background on the black reaction to zoning in this paragraph is from Barbara Flint's dissertation entitled "Zoning and Residential Segregation" (University of Chicago, 1977).

city's 1923 zoning ordinance. Summary statistics for key predictors and outcomes are provided in Table 1.

a. Census Enumeration District Data

We obtained counts of the number of blacks and white ethnic group members at the census enumeration district level for a 100 percent sample of the population using a digitized version of the original 1920 Census taken from the genealogy website Ancestry.com. Enumeration districts were small administrative units used internally by the Census to divide cities into small areas that could be surveyed by one person.[6] The spatial microdata compiled for this paper represents a significant improvement over existing sources, most of which are tabulations of the population at the ward level produced by the Census Bureau.[7] The average enumeration district in Chicago had 1,182 individuals in 1920, less than two percent of the population of the average ward.

In order to investigate the relationship between the composition of the population and zoning outcomes, we digitized the 1920 enumeration district map of Chicago. We first used written descriptions of the enumeration districts available on microfilm from the National Archives. The information from these microfilms has been digitized and made available on the web due to the work of Stephen P. Morse.[8] Second, we took digital photographs of the physical map of the 1920 census enumeration districts of Chicago from the National Archives. Working primarily with a geocoded (GIS) historic base street map developed by the Early Indicators

[6] The Census Bureau did not switch to a mail-based survey system until 1960.
[7] The IPUMS sample for 1920 (Ruggles et al, 2004) covers 1 percent of the population of Chicago and contain enumeration district identifiers; however, this small sample is insufficient for studying neighborhoods.
[8] Website: http://stevemorse.org/ed/ed.php.

Project, we generated a GIS representation of the Chicago enumeration district map that is consistent with the historic street grid.[9]

In our empirical work we focus on four categories of racial and ethnic minorities. Given the emphasis in the historical record on the lack of cohesiveness between northern and southern blacks, we separate these two groups in much of our empirical work. We define as southern blacks those individuals who report their race as black or mulatto and their place of birth as in the South.[10] We also include in the southern black category "second-generation" blacks, that is, individuals born in the North but with southern-born fathers in order to group all blacks of southern origin together. Northern blacks are defined as black or mulatto individuals who were both born outside the South with fathers born outside the South.

First-generation immigrants include all foreign-born individuals plus second-generation individuals under the age of 18, the latter of whom are presumably children residing in the same household as their foreign-born parents. Second-generation immigrants are defined as individuals who were born in the U.S. and who are at least 18 years old with foreign-born fathers. Using these definitions, we avoid the standard problem in the segregation literature of immigrant populations being diluted by the presence of their native-born children (see Cutler, Glaeser, and Vigdor, 2008). Third-generation whites are defined as white individuals who were born in the U.S. and whose fathers were born in the U.S. As is shown in Table 1, the population of our study area is composed of 1.5 percent northern blacks, 2.9 percent southern blacks, 52.0 percent first-generation immigrants, and 17.9 percent second-generation immigrants in 1920. The remainder are white third-generation and beyond natives.

[9] See "Historical health conditions in major US cities: The HUE dataset" (Villareal, Bettenhausen, Hanss, Hirsch) for details on the street file construction.

[10] We use an eleven state definition of the South, defining the region to include Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, and Virginia.

There are important compositional and economic differences between the first- and second-generation immigrant groups. Adult second-generation immigrants primarily traced their ancestry to Ireland and Germany and tended to be wealthier than recent arrivals. First-generation immigrants were more likely to have arrived from Poland, Italy, Russia, Bohemia (now the Czech Republic), and the other "new" sending countries of the late nineteenth and early twentieth century European immigration. The German and Irish communities also held political clout and most Aldermanships; the larger new immigrant groups had mobilized politically but counted few Aldermen among their number (Centennial List of Mayors, City Clerks, City Attorneys, City Treasurers, and Aldermen, 1937). We may thus expect first and second-generation immigrants to have been treated different by the zoning process.

The spatial distribution of the minority groups we study is displayed in Figure 1.[11] Panel A shows the concentration of southern-born blacks in the "Black Belt" south of downtown with a secondary population to the west. Northern-born blacks appear to be concentrated in the Black Belt as well, but with larger numbers living to the north and south of the most densely African American areas. Figure 2 graphically illustrates the variation in where northern and southern blacks lived in finer detail, with a close up view of the black neighborhoods to the south and west of downtown. Focusing exclusively on enumeration districts that were at least 5 percent black, the figure shows the spatial distribution in the percentage of each neighborhoods' black population that we classify as being southern black. As is clear from the figure, the southern black composition of these neighborhoods ranges from a low near 20 percent to a high in excess of 80 percent. We thus believe there is sufficient variation in where southern and northern blacks lived to examine their impact on zoning separately.

[11] The two blank areas are the result of missing data. We had to omit 84 enumeration districts (out of 1884) from our sample: 36 were missing from Ancestry.com's database and 48 had illegible or missing land use maps, leaving us with 1800 observations.

Turning to European immigrants, Panels C and D of Figure 1 show the distribution of first- and second-generation immigrants, respectively. Numerically much larger than the black population, first-generation immigrants were most concentrated in inland neighborhoods in the periphery of the central business district. Second-generation immigrants occupy the next ring of enumeration districts further out from the downtown, particularly in the northwest.

b. The 1922 Chicago Land Use Survey

The comprehensive land use survey we draw upon was conducted by the Chicago Zoning Commission in 1922 for the purposes of informing the drafting process for the zoning ordinance. Four teams, each equipped with an automobile, recorded the use of every building and lot in the city (Zoning Chicago 1922 Pamphlet). From these survey maps we obtain the location of every commercial and manufacturing use in the city; we also obtain the location and number of stories for every building with four or more stories. We geocoded the largest sample to date of this pre-zoning survey for our study. While previous work by McMillen and McDonald used a sample of 1000 blocks, we digitized nearly two-thirds of the city by land mass.[12] Our sample covers 79.4 percent of the 1920 population along with 97.8 percent of blacks and 80.8 percent of first-generation immigrants. Figure 3 provides a graphical illustration of the land mass covered by our sample.

Figure 4 provides a map image of several blocks from the survey. The Tilden Public School in the center of the image is surrounded by noxious facilities, indicated by "++N" on the map. The building heights of all structures over four stories can also be seen (surveyors occasionally indicated three-story buildings although not consistently). The letters on buildings correspond to specific uses, which we classified as residential, commercial, or manufacturing (further distinguished by subclass) using the same system as the Chicago Zoning Commission in

[12] Our sample covers 64 percent of the 1920 area of Chicago and 56 percent of the current (2013) city area.

1922. Of particular interest to our study are the various manufacturing classes: A and B include general manufacturing that does not cause a nuisance but may require yard storage, class S includes large-scale industrial facilities such as rail yards and granaries, class D covers storage of explosives and high pressure gases, and class C includes manufacturing facilities that emit noise, smoke, odors, or pose a fire risk. We consider the noxious facilities in classes C separately in much of our analysis (only one instance of Class D manufacturing exists in our sample). Commercial use is indicated using only one category and covers retail establishments, offices, and entertainment venues such as theaters.

c. Comprehensive Zoning Ordinance of 1923

We digitized the initial zoning ordinance for the same broad sample of Chicago as the land use survey, recording both use zoning and volume zoning. Use zoning delineated the city into four distinct districts: residential (single-family homes), apartment, commercial, and manufacturing. These use districts were hierarchical, with apartment districts allowing residential uses, commercial districts allowing both apartments and single-family homes, and manufacturing districts allowing any use.[13] The residential category was rarely used in the initial zoning ordinance; only three percent of the enumeration districts in our sample have any zoning of this type. Figure 5.A shows a section of a use zoning map from an area west of the downtown along the Chicago River. Zones for apartments, commercial activity, and manufacturing can all be seen.

The volume districts in the zoning ordinance are essentially rough concentric rings radiating out from the central business district. Figure 5.B shows the digitization of these

[13] There were additional gradations within the commercial and manufacturing districts, with certain objectionable commercial uses barred if they were within 125 feet of a residential or apartment district, while certain manufacturing uses were barred if they were within 100 to 2000 feet of a residential, apartment, or commercial district. Some commercial uses within 125 feet of residential or apartment districts also saw restrictions on the hours during which trucking activities could occur.

districts with each enumeration district assigned to the volume district most common within its borders. The volume district 1 maximum building height was effectively 33 feet, corresponding to roughly three stories.[14] For district 2, the maximum height was about six stories; district 3, eleven stories; and district 4, sixteen stories. District 5, which was restricted to the central business district, allowed a maximum building height about 22 stories. If a building satisfied requirements on additional setbacks from the street, the allowed height was greater. There were no density "minimums," only restrictions only the maximum volume, height, and lot coverage.

d. Empirical Approach

Our empirical approach relies on the ability to observe the same land use data employed by the Chicago Zoning Commission when they drafted the ordinance. We pose two questions in our empirical work. First, how were minorities sorted across the city and within neighborhoods with respect to existing land use and urban geography prior to the zoning ordinance? Second, accounting for geography and extant land use, what was the impact of various minority populations on zoning outcomes?

Crucial to the identification of the second question is that we sufficiently account for other causes of zoning that also influenced the demographic composition of enumeration districts. By conditioning on an extensive array of spatial, land use, and transportation variables, our empirical strategy attempts to block all "back-door" paths from our demographic variables to zoning outcomes (Pearl, 2009). In the language of Rosenbaum and Rubin (1983), we render the non-demographic causes of zoning "conditionally ignorable," and so the effect of demographic composition on zoning outcomes is identified. Recognizing the limits of our ability to block all

[14] We further discuss how the volume district ordinance was structured in Section V.

alternate mechanisms via controls, we attempt to further verify our main results using a series of robustness checks in Section VI.

The models we estimate are all single index models, i.e., functions of a linear combination $x'\beta$ of our covariates. To permit nonlinearities in responses, we frequently allow covariates to enter through indicators as well as polynomials. Specifically, spatial variables such as distance to the central business district, distance to Lake Michigan, and distance to the nearest river all enter as quartic polynomials, and we include indicators that equal one whenever an enumeration district is proximate to any of these features. We also include quartic polynomials for population density and the area of the enumeration districts. Indicators for overlapping a railroad or major street are included, as is a quartic polynomial for the distance to the nearest railroad.

To control for existing land use, we include variables measuring the density of commercial uses, warehouses, and each of the five different manufacturing use classes; these enter as both indicators and quadratic polynomials in the density of each type of use. To account for large industrial sites, we add an indicator equal to one if the enumeration district includes a contiguous area greater than 800,000 square feet (approximately four city blocks) populated by heavy industrial activity. We include separate indicators for enumeration districts that overlap the Union Stockyards and those that are within 1,000 feet of the Stockyards. To capture the industrial character of the area surrounding an enumeration district, we also include counts of different manufacturing uses in 500 and 1,000-foot rings around each district. To account for the existing distribution of building heights, we include the densities of four, five, six, seven, eight, nine, and ten story buildings. We also include the density of eleven through twenty-five story

buildings; disaggregating this category has little impact on the analysis due to the concentration of these buildings in the central business district.

To address the possibility that recent immigrants and black migrants located in cheaper areas of the city that were also suitable for manufacturing activity, we include as a control a measure of land values transcribed by Gabriel Ahlfeldt and Daniel McMillen from the 1913 edition of Olcott's Blue Books.[15] Specifically, this variable is the average land value per front foot based on 125 foot tracts (see McMillen, 2012). As a further control for wealth, we use the head of household variable in the census to develop an income measure based on live-in hired help. For each enumeration district, we count the number of household heads as well as the number of individuals who report being a maid, cook, servant, or laborer in relation to the head of house.[16] We then compute the ratio of live-in hired help to heads of household and include this value in our regressions. We also include ward fixed effects to account for differential political influence exerted by alderman. There are approximately 51 enumeration districts per ward in our sample. Finally, to measure home neighborhood motivations for the zoning board members, we added an indicator for whether a zoning board member lived in the enumeration district.[17]

[15] Land prices may have influenced zoning directly; for example, the zoning board may have considered areas with cheaper land to be more suited for large-scale industrial uses. Land prices may also proxy for unobservable neighborhood characteristics. Since both racial and ethnic composition and unobservable neighborhood characteristics can be expected to have had a causal effect on land prices, conditioning on land prices may induce a correlation between these variables even if they are unconditionally independent. This "collider-stratification" could bias the estimation of our coefficients of interest (Greenland 2003, Pearl 2009). However, despite the fact that land prices are strongly correlated with both our explanatory and outcome variables, their inclusion has a negligible effect on our coefficient estimates.

[16] We do not observe occupation in the Ancestry.com data, relation to head of house is our only opportunity to measure household employment status.

[17] Only one enumeration district with a board member received any industrial zoning. We explored a variety of political representation indicators in our analysis, including whether a ward's alderman served on the zoning board. We found small and insignificant results on manufacturing zoning for all variables relating to local representation on the board.

We measure zoning outcomes using both continuous and discrete variables as appropriate. For example, we assess the probability that an enumeration district contains any manufacturing zoning as well as the percentage of the enumeration district that is zoned for manufacturing uses. When the outcome is a binary indicator, we typically report results from both a linear probability model (LPM) and a probit model. When a successful outcome is sufficiently rare or the support of our sample is sufficiently thin, we report only probit results. Probit results are reported in terms of average marginal effects. We consider only discrete outcomes for density zoning because there are relatively few enumeration districts straddling the relevant density zone borders. Each enumeration district is assigned to the volume district in which most of its area falls.

When considering continuous outcomes, we typically report results from two different models. The first is standard ordinary least squares (OLS); however, this specification is not tailored to the fact that our continuous outcome variables are fractions and hence bounded between zero and one. In response to this concern, we also report results from a Tobit model, which assumes the existence of an underlying variable that equals the index $x'\beta$ plus a normally distributed error term. The observable value of the latent variable is equal to zero if the latent variable is below zero; similarly, it is equal to one if the latent variable exceeds one. This model accounts for the fact that EDs receiving boundary values may differ substantially in their suitability for different types of zoning. [18]

[18] In the Tobit model, β is the marginal effect of x on the underlying latent variable; the marginal effect over the uncensored range is obtained by multiplying this β by a shrinkage factor, which explains why it is generally larger than the estimates we obtain from the OLS specifications (McDonald and Moffit, 1980). An alternative estimation procedure involves fitting a beta distribution whose parameters are a function of our covariates. However, this is inappropriate since we observe many values at the boundary, and these values are discarded when estimating the parameters of the beta distribution because there is no support on the boundary. Papke and Wooldridge (1996) recommend the fractional logit estimation procedure in this context. The fractional logit estimator is a generalized linear model where the conditional expectation of the outcome variable is equal to the logit function evaluated at the index $x_i'\beta$. This ensures that the output from the model is always bounded between zero and one. As a robustness

Our baseline specification is thus

$$\%\ or\ indicator\ for\ zoningtype_i = x_i'\beta + ward_i + \epsilon_i \qquad (1)$$

where the zoning type is manufacturing or commercial and x_i includes the extensive list of spatial and land use controls described above as well as measures of the share of the enumeration district population composed of African Americans, the share composed of first-generation immigrants, and the share composed of second-generation immigrants. We use robust standard errors throughout the analysis (White, 1980).[19] We also decompose the black share into southern- and northern-born blacks in much of the analysis.

IV. Existing Patterns of Minority Residential Location

We begin by documenting the distribution of minority location across the city and within neighborhoods with respect to measures of urban density, proximity to commercial and manufacturing activity, and proximity to other demographic groups. We employ two approaches to measure pre-existing sorting associated with land use. First, we report the exposure to various uses experienced by the average member of each demographic group we study. Second, we regress a variety of land use variables on demographic composition along with basic spatial controls to understand the relationship between demographics and pre-existing land uses.

Table 2 reports the average exposure results. The first two columns of Panel A report the average number of four story and four to ten story buildings per acre experienced by the average member of each demographic group we study. Southern-born blacks had the highest exposure to both categories of tall structures, followed by northern blacks and then first-generation

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check, we also estimated all of the continuous dependent variable models reported here using the fractional logit specification. These results were qualitatively similar to those reported in the paper. For parsimony, we only report the OLS and Tobit results.

[19] Using the method of Conley (1999) to construct standard errors robust to spatial autocorrelation consistently resulted in smaller standard errors, which we do not report here.

immigrants. However, first-generation immigrants experienced the highest population density (column 3). The ordering is similar for commercial enterprises per acre, noxious facilities per acre (defined as the number of Manufacturing class C uses), and general manufacturing facilities per acre (defined as Manufacturing classes B, C, and S uses) with both black groups and first-generation immigrants having the highest exposure (columns 4-6). Although industrial facility exposure was essentially equal across groups, southern blacks and first-generation immigrants were exposed to more noxious industrial uses than other groups (.007 uses per acre compared with .006 for northern blacks and .0046 for second-generation immigrants).

Minority exposure to other demographic groups is shown in Panel B. As we would expect, both northern and southern blacks live in enumeration districts with larger shares of other blacks. However, the sum of share northern and share southern black faced by the average southern black is only .64. We interpret this result as evidence that blacks were not completely segregated by race; we also note that many black individuals served as live-in maids in white neighborhoods and would have been enumerated in their employers' houses. Immigrants and native whites had very low exposure to blacks (average share .02 and .03, respectively). Finally, we observe that southern blacks lived on the cheapest land relative to other groups, with first-generation immigrants just behind them. The difference in land values faced by the average black and average third-generation white is a striking $35 ($90.66 versus $125.67 in 1913 dollars) and underscores the importance of controlling for land values in our regressions.

As a second approach, we compare the sorting patterns of blacks and immigrants using a reverse regression analysis to identify the relationship between demographic groups and land uses while controlling for potentially confounding correlations with other demographic or spatial variables. We regress land use variables on our slate of demographic variables and (in some

cases) additional controls. Panel A of Table 3 includes no spatial or land use controls; the results can thus be thought of as the characteristics of areas in the cities where minority groups lived relative to third-generation whites (the omitted demographic group).[20] Panel B of Table 3 presents the results of the same specifications with the full set of spatial controls, including the area of the enumeration district, ward fixed effects, and distances to the central business district, major street, Lake Michigan, nearest river, and nearest railroad; these results can be thought of as the urban characteristics faced by minorities relative to third-generation whites conditional on the particular neighborhood of the city in which they lived.

The results from these regressions suggest relationships similar to those obtained from the average exposure exercise. Areas of the city with more second-generation immigrants and northern blacks had fewer tall structures compared with areas having more native whites. This finding is consistent with the pictorial evidence in Figure 1 showing that second-generation immigrants lived the furthest from the center city. Whether we look across the city (Panel A) or within neighborhoods (Panel B), first-generation immigrants lived in the densest, most commercial areas while southern blacks were exposed to more noxious and non-noxious manufacturing relative to third-generation whites (see columns 3 and 4 for first-generation immigrants and columns 5 and 6 for southern blacks). Furthermore, first-generation immigrants located in more industrial areas of the city (Panel A, columns 5 and 6).

These results underscore the need to control for existing sorting according to land use when asking how the spatial distribution of minorities shaped the zoning ordinance. We note, however, that the land use and demographic composition relationships identified in Panel B are in many instances at odds with the zoning findings we report in the next section, suggesting that

[20] We include only our proxy for income, maids per head of household, as a control.

our main results cannot driven solely by pre-existing relationships between land use and demography that later influenced the zoning ordinance.

V. The Impact of Minority Share on Zoning Outcomes

a. Manufacturing Zoning

We begin our analysis of the 1923 zoning ordinance by examining the relationship between the size of various minority groups and the likelihood of being zoned for manufacturing uses. Specifications control for confounding influences through the inclusion of the full vector of spatial and pre-existing land use controls as well as land prices and the wealth and political representation variables discussed in Section IV. To make the results readily comparable across groups, we report both coefficient estimates and standard errors in units of standard deviations for the relevant demographic variable (for instance, the coefficient on the variable "southern black" is reported in units of the standard deviation of southern black share). The standard deviations for each variable are reported in Table 1.

Turning first to the presence, or lack thereof, of any manufacturing zoning in the neighborhood, Columns 1 through 3 of Table 4 report coefficient estimates from versions of equation (1) where the dependent variable is an indicator for the presence of any manufacturing zoning in the neighborhood. In Column 1 we report results from a simple linear probability model where both southern and northern blacks are collapsed into a single category. The model estimates show a significant positive relationship between black population share and the likelihood of receiving at least some zoning for manufacturing uses. In Column 2 we replicate Model 1 with northern and southern blacks included separately. It is immediately clear from these results that the entire positive relationship between black share and the presence of manufacturing zoning is being driven by the southern black share. We are also interested in the

treatment of recent European immigrants. The coefficient estimates presented in Columns 1 and 2 indicate that enumeration districts with more first-generation immigrants were also more likely to be zoned for manufacturing uses. As a robustness check, Column 3 reports the predicted marginal effects from a replication of Model 2 where the linear probability specification is replaced by a probit model. The results remain qualitatively unchanged.

The magnitudes of these estimates are economically significant. The results in column 2 imply that a one standard deviation increase (roughly 13 percentage points) in southern black share is associated with a 7 percentage point increase in the likelihood of an enumeration district being zoned to include manufacturing uses. A standard deviation increase in the first-generation immigrant share (roughly 22 percentage points) is associated with a 6 percentage point increase in the likelihood of an enumeration district being zoned for manufacturing uses. These estimates are particularly large given that only 11 percent of enumeration districts in our sample received any manufacturing zoning.

So far, we have argued that manufacturing use zoning was unambiguously "bad" in the sense that minority communities thus zoned would face disproportionate environmental hazards and decreased future home values. However, it is also possible that poor minority groups benefited economically from living in close proximity to their places of employment due to lower transportation costs. While we do not believe this is a driving force in our results, it is possible that within this context a positive value for the indicator may reflect advantageously located manufacturing zoning at the neighborhood fringe. One response to this concern is to focus instead on the share of a neighborhood that is zoned for manufacturing uses. The motivation here is that a positive relationship between minority share and the *percentage* of

manufacturing zoning may be more consistent with the notion of encroachment of industry into black and immigrant neighborhoods and a finding that minorities were disadvantageously zoned.

Thus, we replicate our basic model using the continuous outcome measure, the percent of the enumeration district zoned for manufacturing. OLS and Tobit results are presented in columns 4 through 7 of Table 4. The dichotomy between the experience of northern and southern blacks is highlighted in these specifications. Overall, under the Tobit specification, a one standard deviation increase in southern black share is associated with a roughly 3 percent increase in the area of an enumeration district being zoned for manufacturing uses. This is an increase of 27 percent relative to the mean industrial zoning in this sample. Under the OLS specification, the overall impact of percent black is only a quarter of the estimated Tobit magnitude and the precision of the estimate drops to a p-value of 16 percent. However, as highlighted above, these aggregate estimates serve to mask the starkly different experiences of southern and northern blacks.

As is shown by the disaggregated coefficient estimates in columns 5 and 7, southern black share is strongly associated with increased levels of manufacturing zoning. Under the Tobit specification, a one standard deviation increase in southern black share is associated with a 10 percent increase in the area of an enumeration district being zoned for manufacturing uses. This is essentially a doubling of the overall enumeration district average exposure of 11 percent manufacturing zoning. Again, OLS estimates are attenuated relative to the Tobit estimates.

In contrast, holding southern black share constant, northern black share is negatively associated with the share of the enumeration district zoned for manufacturing. Two factors serve to explain this result. First, we note that the average northern black lived in a neighborhood that was comprised of 45 percent southern black. As a result, the overall impact of black share was

to increase exposure to manufacturing zoning. Our negative coefficient estimate on northern black share essentially indicates that more established black neighborhoods with large concentrations of northern blacks were able to effectively avoid being targeted for increased manufacturing zoning. Second, this finding is consistent with the anecdotal evidence regarding the status of northern blacks in the zoning process. Neighborhoods with larger populations of northern blacks were likely wealthier, more exclusive, and better represented by the Zoning Commission. In particular, contemporary reports suggest that Charles S. Duke, an African American on the Zoning Commission, actively worked to protecting northern black interests during the zoning process (Schwieterman and Caspall, 2006).

Turning to European immigrants, our estimates suggest that first-generation immigrants were also more likely to see a larger fraction of their neighborhood zoned for manufacturing; however, the estimated effect was about half as large as that for southern blacks. We also note that, while the Tobit estimates are quite statistically robust (p-value just over 1 percent), the precision of the OLS estimates drops to a p-value of just 11 percent. Finally, we do not see any evidence that second-generation immigrant neighborhoods were disadvantageously zoned relative to third-generation white neighborhoods. Thus, our primary finding on manufacturing zoning is that southern black and first-generation immigrant neighborhoods were more likely to be zoned for manufacturing uses and tended to receive a larger amount of such zoning.[21]

So far our identification strategy has relied on controlling for an extensive set of spatial and pre-existing land use variables in addition to land prices, political influence, and a wealth

[21] One potential area of interest is the fact that the first-generation immigrant group is itself composed of immigrants from many countries. In Appendix Table 1 we present the results from the indicator and continuous measures of industrial zoning with the first-generation immigrants further divided by sending country; these results are also presented in standard deviation terms. We observe that no group was as disadvantageously zoned for industrial uses as were southern blacks; furthermore, the coefficients on the share of the enumeration district population composed of the main ethnic groups (Polish, Russian, Italian, Irish, and German) are all quantitatively similar. Thus, it does not appear that any particular immigrant group was singled out for industrial zoning in the same way as southern blacks.

proxy. We may nonetheless be concerned that our findings are driven by unobserved sorting of blacks and immigrants into industrial areas in a manner that is not fully captured by our specification. To investigate the robustness of our approach, we rerun the specifications from Table 4 on samples of the city that would provide fewer opportunities for poor minority groups to sort into unobserved manufacturing areas. We begin by restricting our sample to enumeration districts with no existing large-scale or noxious manufacturing uses (manufacturing classes C and S). In doing so, we seek to mitigate the possibility that our results to biased due to sorting around areas with high potential for manufacturing. We then further restrict the sample to enumeration districts without heavy or noxious uses that are also at least 500 feet away from such uses. Finally, we restrict the sample to enumeration districts at least 1000 feet away from any heavy or noxious uses. The results from probit and Tobit analyses on these restricted samples are presented in Table 5. Columns 1 and 4 present results from the least restricted samples while columns 3 and 6 present results from the most restricted samples.[22] Results from each of the 3 different sample restrictions are consistent with the baseline results presented in Table 4.

b. Commercial Zoning

We next turn our attention to commercial zoning. While zoning for this use was undesirable for the wealthiest of neighborhoods that were exclusively residential, poor black and immigrant populations would likely have viewed close proximity to food stores, shops and entertainment venues as a benefit and clearly would have viewed proximity to commercial uses

[22] We only report probit and Tobit specifications in Table 5. However, OLS results are consistent with these results. For parsimony, we also don't report results for models with aggregated black shares. These models yield significant positive coefficients that are significant at the 5 percent level in all but one case. The exception is the discrete presence of zoning model for the most restrictive sample where a positive coefficient estimate has a p-value of .18.

as preferable to manufacturing uses.[23] Table 6 reports OLS and Tobit estimates of the relationship between demographics and the percentage of the enumeration district zoned for commercial uses.[24]

The OLS and Tobit estimates presented in columns 1 and 3 show that the relationship between total black share and percent commercial zoning is negative. Columns 2 and 4 disaggregate the black share into southern and northern blacks; once again, this shows that our results are driven by the presence of southern blacks. Similarly, we find that first-generation immigrant neighborhoods also received less commercial zoning. In contrast to the manufacturing zoning analysis, we see that second-generation European immigrants also received less commercial zoning than natives. We note that this effect may be driven by increasing levels of residential zoning for this higher-income demographic group instead of manufacturing zoning. We investigate the channels through which various groups received more manufacturing and commercial zoning in the next section.

c. Decomposing the Commercial Zoning vs. Manufacturing Zoning Tradeoff

To fully understand the mechanisms through which minority neighborhoods received more manufacturing and less commercial zoning, we split the sample by pre-existing levels of manufacturing and commercial activity and reproduce our baseline specifications in Table 7. Panel A presents results by quartile of pre-existing commercial use density, and Panel B by quartile of pre-existing manufacturing use density. For parsimony, we only present the

[23] An African American member of the Zoning Commission, Charles S. Duke, succeeded in removing two objectionable parts of the zoning ordinance covering the Black Belt, one of which would have extended a commercial district through Grand Boulevard where most of the "better colored homes" were situated (Schwieterman and Caspall, 2006, p. 29).

[24] Commercial zoning was much more prevalent than manufacturing zoning: 86 percent of enumeration districts received at least some commercial zoning, while only 11 percent received any manufacturing zoning. Thus, there is little reason to model commercial zoning outcomes using an indicator variable.

coefficient estimates for the enumeration district's percent southern black and percent foreign born, again scaled so that the coefficients reflect the estimated effect of a one standard deviation increase in the given demographic. The underlying regressions include the entire set of control and demographic variables that were incorporated in the baseline specification. To give a sense of scale and overall zoning patterns, we also present the average percentage of the neighborhoods in each quartile that were zoned for commercial or manufacturing uses. We also report by quartile the number of neighborhoods whose population is at least 10 percent southern black populations and greater than 40 percent first-generation immigrant.[25]

Focusing first on the commercial density decomposition, we note that there is a systematic relationship between pre-existing commercial density and the zoning of land for manufacturing and commercial uses. Moving from the first quartile to the fourth quartile in commercial density (from low levels of pre-existing commercial activity to high levels of pre-existing commercial activity), the average percentage of a neighborhood that received manufacturing zoning decreases monotonically from 16 to 4 percent. Furthermore, the average percentage of a neighborhood receiving commercial zoning increases monotonically from 9 to 36 percent. This decomposition reinforces McMillan and McDonald's (1999) finding that Chicago's initial zoning ordinance was significantly influenced by pre-existing land uses.

The regression results in Panel A also shed light on our finding that neighborhoods containing larger numbers of southern blacks or first-generation immigrants received larger shares of manufacturing zoning and smaller shares of commercial zoning, controlling for pre-existing land uses and geography. The largest concentration of neighborhoods comprised of at least 10 percent southern blacks occurs in the third quartile of the commercial density

[25] We use a 10 percent cutoff for southern blacks and a 40 percent cutoff for foreign immigrants to characterize the presence of "enclaves" because of the difference in their relative size in the overall population.

distribution. On average, these neighborhoods received a high level of commercial zoning and relatively low levels of manufacturing zoning. However, our regression results for these neighborhoods indicate that a one standard deviation increase in southern black share is associated with an almost 10 percentage point decrease in commercial zoning and a 3 percentage point increase in manufacturing zoning (relative to baseline averages of 25 percent and 7 percent, respectively). Thus, the presence of southern blacks appears to be associated with a significant shift away from potentially more desirable commercial zoning and towards manufacturing zoning in these neighborhoods. A similar, but smaller in magnitude, commercial zoning effect occurs in the fourth quartile, which contains the second-highest concentration of southern black neighborhoods.

A second component of the manufacturing effect is evident in the first quartile neighborhoods, which on average received high levels of manufacturing zoning. While these neighborhoods contain fewer southern blacks than those in any other quartile, when southern blacks are present, they are associated with a significant increase in the level of manufacturing zoning. A one standard deviation increase in southern black share is associated with a 5.7 percentage point increase, relative to a base of 16 percent. The first-generation immigrant results are generally similar to those for southern blacks with the exception that we do not see clear evidence of substitution between commercial and manufacturing in the third quartile of commercial density.

Panel B of Table 6 replicates the top panel with the sample decomposed based on pre-existing manufacturing density. Here, there are 577 enumeration districts with no pre-existing manufacturing uses. As a result, the first and second quartiles differ in their number of observations. Very little manufacturing zoning was applied in these first quartile neighborhoods,

all of which had no pre-existing manufacturing; on average, only 1.8 percent of these neighborhoods were zoned for manufacturing. The coefficient estimates from this quartile suggest that a large portion of the manufacturing zoning that did occur in these areas which had no extant manufacturing activity was concentrated in neighborhoods with large southern black and immigrant populations. The second quartile reveals a similar result for immigrants but not for southern blacks, although there were very few neighborhoods with a large number of southern blacks in this quartile.

Panel B also shows that higher levels of pre-existing manufacturing were generally associated with higher proportions of commercial zoning. The largest concentrations of southern blacks occurred in the third quartile of pre-existing manufacturing, while the largest concentrations of first-generation immigrants occurred in the fourth quartile. Both groups were associated with significantly lower levels of commercial zoning in these quartiles: a one standard deviation increase in southern black share in the third quartile led to 6.7 percentage points less commercial zoning, relative to an average of 23.4 percent, while a one standard deviation increase in first-generation immigrant share in the fourth quartile led to 6.2 percentage points less commercial zoning, relative to an average of 33.6 percent. We also note that for southern blacks, there is suggestive evidence that, in the third quartile, they are associated with substitution from commercial zoning to manufacturing zoning (the p-value on the positive manufacturing effect is .14). This last result mimics the finding from Panel A that the presence of southern blacks led to an overall shift out of commercial zoning and into manufacturing zoning in neighborhoods that could have received either type based on existing uses.

We close this section by summarizing our results related to use zoning. First, there is evidence that across neighborhood types, the presence of southern blacks and first-generation

immigrants led to lower levels of commercial zoning, particularly in types of neighborhoods that contained the highest numbers of these minorities. Second, the results suggest that for the types of neighborhoods typically populated by southern blacks, their presence led to a shift away from commercial zoning towards manufacturing zoning. Third, in those neighborhoods that had no pre-existing manufacturing and generally received very little manufacturing zoning, the presence of first-generation immigrants and southern blacks is associated with significantly increased probabilities of manufacturing zoning. Finally, in those neighborhoods that had very little pre-existing commercial uses and on average received high levels of manufacturing zoning, the presence of these minority groups led to significant increases in the level of manufacturing zoning.

d. Volume Zoning

Finally, we explore whether volume zoning may have been used as a tool for concentrating southern blacks in higher density neighborhoods, a potential precursor to modern day arguments regarding exclusionary zoning.[26] Analyzing volume zoning requires a slightly different empirical approach. Because the volume districts were essentially concentric rings radiating out from the central business district, the key tradeoff is between adjacent volume categories.

Under zoning for volume district 1, buildings were capped at 5 to 6 stories (66 feet maximum height) and could cover only 50 percent of an interior lot. In volume district 2, apartment buildings could reach 12 to 13 stories (132 feet maximum height) and cover 60

[26] A second potential vehicle through which the zoning ordinance could have been used to advance exclusionary motives would have been through the location of residential vs. apartment use zoning. However, in practice, residential zoning was restricted to outlying portions of the city in neighborhoods that were not proximate to significant numbers of black residents. Thus, there is little scope for an empirical analysis of tradeoffs along this margin.

percent of the lot. However, the effective difference in height and density limitations between these two districts was actually much greater due to restrictions on overall building volume. In volume district 1 a building's interior volume (excluding attic) was limited to not more than 10 feet (13 feet for corner lots) multiplied by the area of the lot on which the building was located. For instance, based on the volume restriction, a three story building with 8 foot ceilings would be limited to covering less than 45 percent of its lot. Thus, the volume restriction was likely a binding constraint in the context of Chicago's dense urban neighborhoods. In volume district 2, the volume restrictions were quadrupled. Interior volumes were limited to not more than 40 feet (50 feet for corner lots) multiplied by lot size. Thus, to the extent that these volume restrictions were binding, residential housing built in volume district 2 could effectively be 4 times as dense as that built in volume district 1. As a result, volume districts 1 and 2 effectively delineated the boundary between locations where 8 to 10 story tenements were allowed and locations where residential development was limited to structures of no more than 3 stories. This boundary represents the relevant margin for the proto-exclusionary zoning behavior we seek to analyze. We therefore focus our analysis on the border between volume districts 1 and 2.

To test for a potential exclusionary zoning motive in the location of these boundaries, in Table 8 we report the results from a probit analysis on the presence of volume district 2; the models we estimate include the full set of controls used in the previous analysis. We restrict the sample to locations that lie along the boundary between volume districts 1 and 2, and exclude neighborhoods that included any volume zoning other than districts 1 and 2.[27] Columns 1 and 2 report results when we restrict the sample to locations within 1000 feet of the border, while Columns 3 and 4 report results restricting to within 500 feet of the border. The results in columns 1 and 3 indicate that a larger black share is associated with a greater likelihood that an

[27] We also replicated this analysis using OLS (not reported) and obtained very similar results.

enumeration district will receive the higher density (district 2) zoning. Again, this effect is driven by southern blacks, as the results in columns 2 and 4 indicate. The latter effect is estimated with slightly lower levels of precision (p-values of 5.2 percent and 6.5 percent).

While in the case of manufacturing and commercial zoning, southern blacks and first-generation European immigrants were treated in a similar manner, with volume zoning we find the opposite. The presence of first-generation European immigrants is associated with a significantly lower likelihood of high density (district 2) zoning. Taken together, our estimates suggest that the combination of a one standard deviation increase in black share and a one standard deviation decrease in the first-generation immigrant share would be associated with a roughly 15 percentage point increase in the likelihood that an enumeration district received a majority of higher density zoning. These results are consistent with an exclusionary zoning strategy that, at the margin, sought to create low density neighborhoods for recent white immigrants while containing southern blacks in higher density areas.

This finding is unexpected because our reading of the history indicates that the overarching concern of the zoning board relating to density was to keep skyscrapers in the downtown area. These results also suggest that a pre-cursor to modern-day exclusionary zoning may be found in the implementation of Chicago's initial zoning law. At the time, both European immigrants and black migrants faced housing shortages. At the margin, the Chicago Zoning Board appeared to adopt a strategy designed to keep blacks in place through high density housing. The tendency towards lower density zoning in European immigrant neighborhoods suggests an expectation that these immigrants would spread out across the city. Given the existence at the time of public animus towards both recent European immigrants and blacks, one possibility is that this differential treatment reflected the 1921 passage of federal immigration

restrictions. With the border closing, the tide of European immigration was effectively stemmed, while the inflow of southern blacks was likely to continue unabated.

VI. Conclusion

This paper examines the introduction of zoning in Chicago and asks whether race blind comprehensive zoning ordinances discriminated against minorities, focusing in particular on whether African American and immigrant neighborhoods received more zoning for industrial uses. We found robust and quantitatively important evidence that otherwise comparable neighborhoods with larger populations of these minority groups were zoned disproportionately for manufacturing, suggesting environmental racism was present in the zoning process. We also found evidence that neighborhoods with more southern blacks were more likely to be zoned for higher density buildings, suggesting that volume restrictions were used as an early form of exclusionary zoning. Our results are robust to the inclusion of an extensive set of controls for geography, existing land use, land prices, and political factors; it is thus unlikely that sorting of minorities into neighborhoods suitable for industry can explain our results.

The findings of this paper cast doubt on the racial blindness of comprehensive zoning ordinances when they were introduced, particularly in major cities such as Chicago. Racism against African American migrants from the South emerged even though the policy was restricted to regulating where economic activity took place. The zoning board appears to have taken minority concentration into account when deciding where to locate future manufacturing uses through zoning: both neighborhoods with no extant industrial activity and those with a mix of uses that would otherwise have been zoned commercial received more manufacturing zoning when blacks and immigrants were present. In future work, we will explore the long-term

implications of the discretionary authority wielded by the zoning board in shaping the distribution of minorities and the spatial arrangement of economic activity across Chicago.

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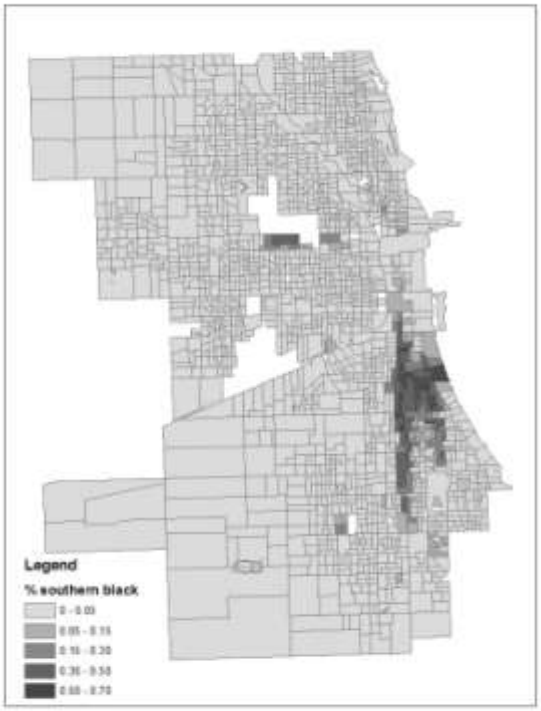
Figure 1. Distribution of Minorities across Chicago in 1920

Panel A. Distribution of Southern-born Blacks



Panel B. Distribution of Northern-born Blacks

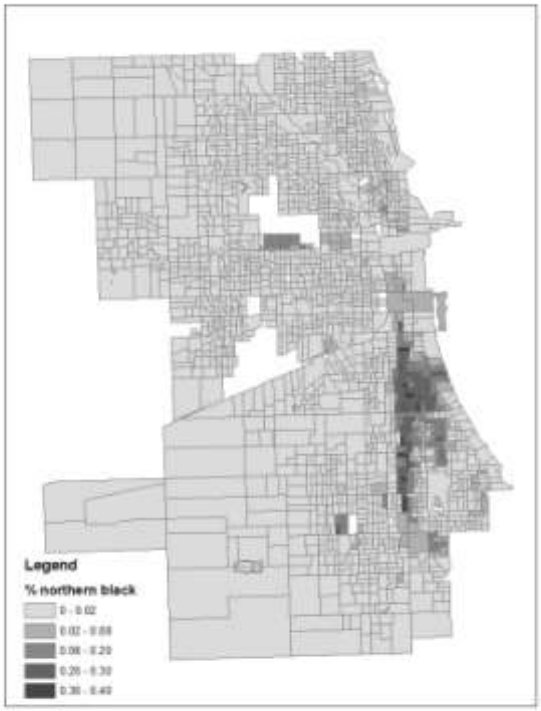
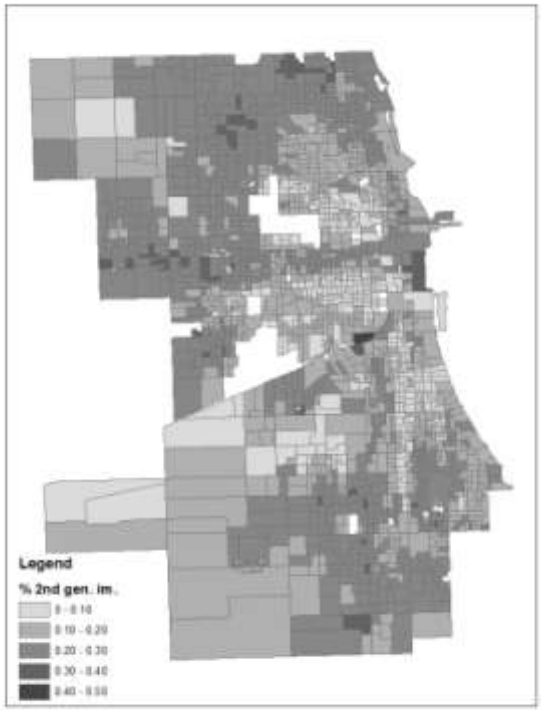


Figure 1. Distribution of Minorities across Chicago in 1920, continued

Panel C. Distribution of First-Generation Immigrants

Panel D. Distribution of Second-Generation Immigrants



Notes: The sample covers the 1800 enumeration districts for which we have digitized land use data and census data, as described in Section III. Missing areas in the center of the city are due to either missing data from Ancestry.com or illegible land use maps (84 out of 1884 enumeration districts in the sample were omitted. See Section III for definitions of southern black, northern black, first-generation immigrant, and second-generation immigrant.

Figure 2. Distribution of Southern Blacks as Percentage of All Blacks

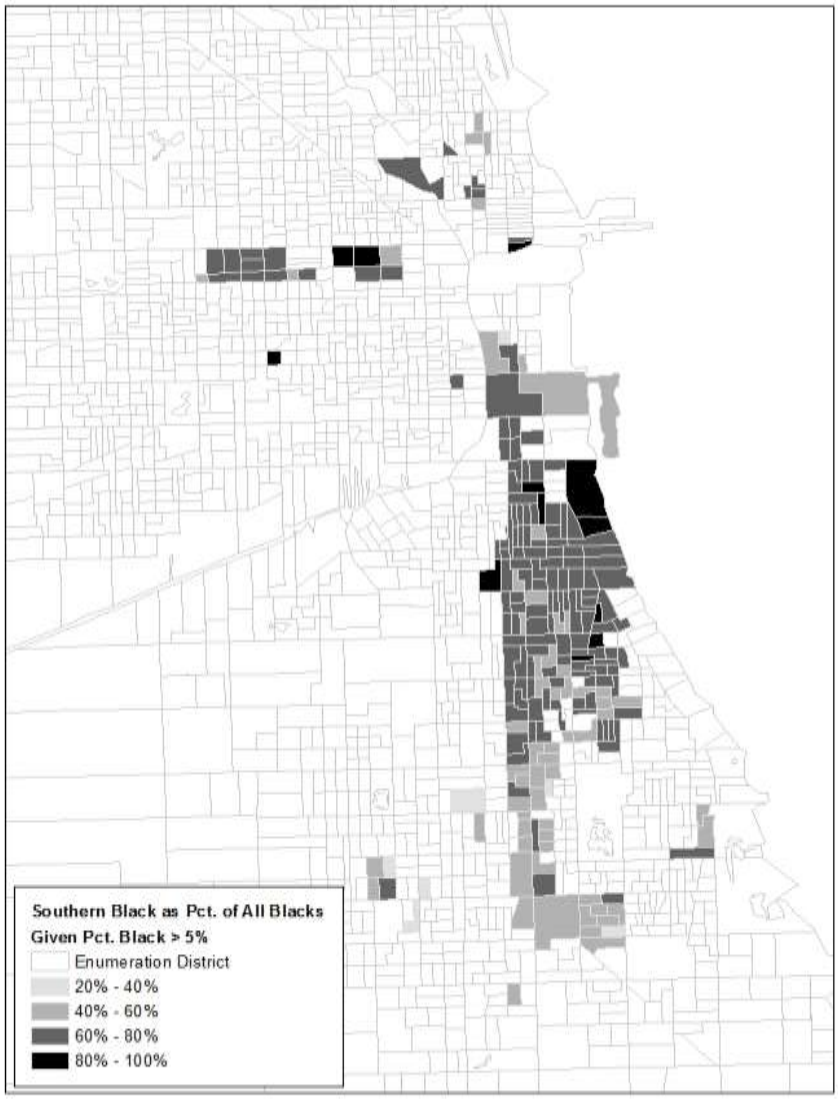
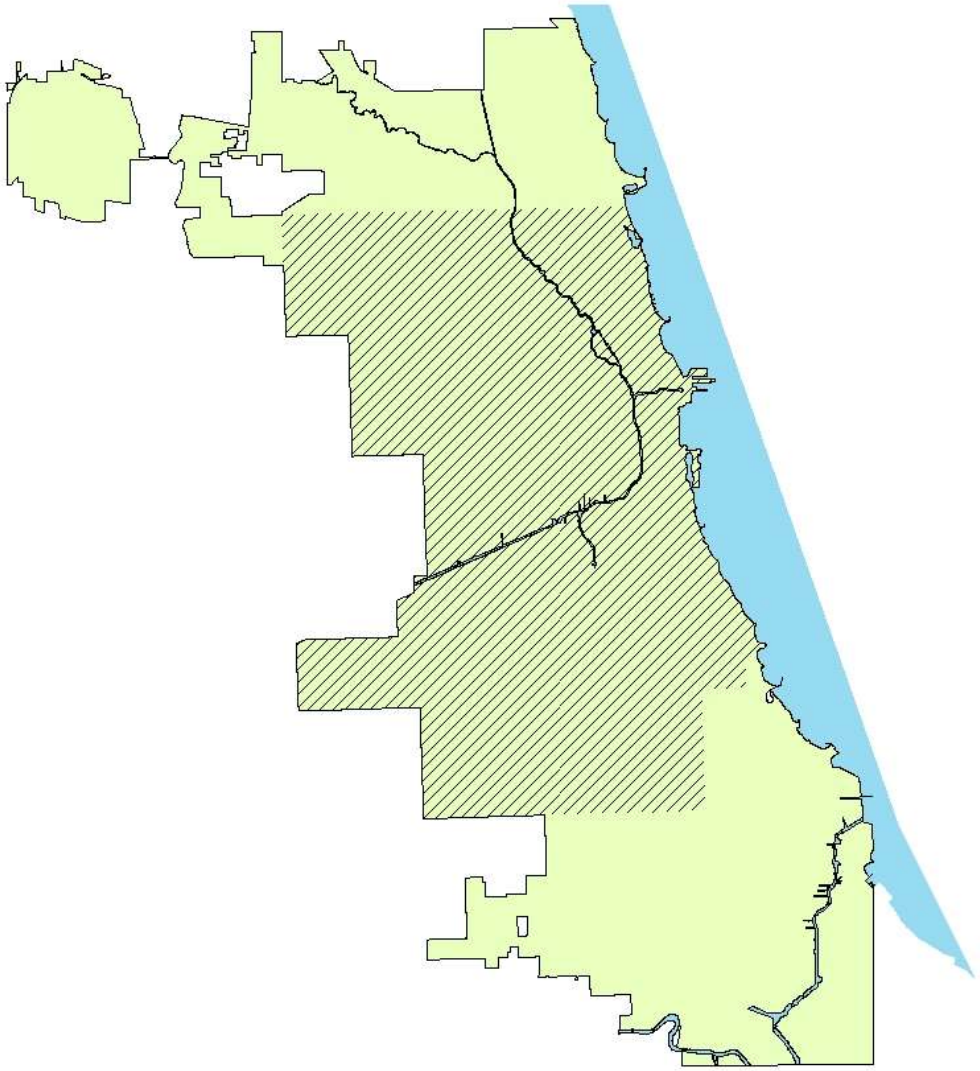
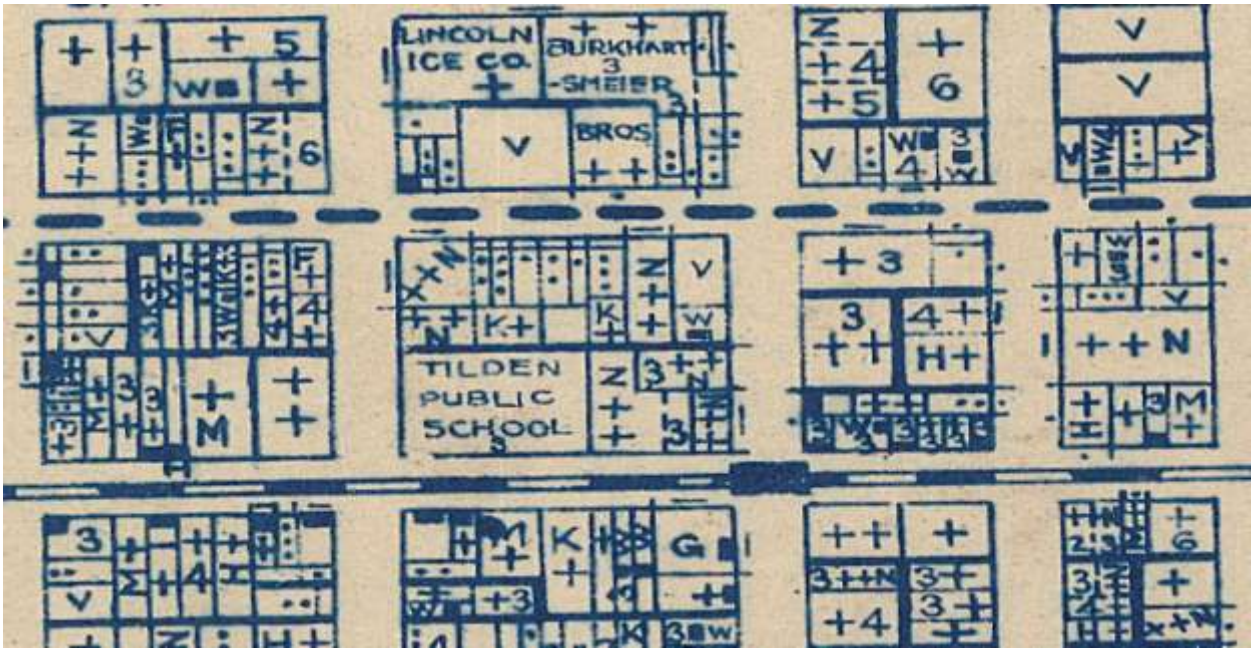


Figure 3. Sample Coverage



Notes: The image shows the current (2013) borders of Chicago. The hatched area is the section covered by our sample. Our sample covers 64 percent of the 1920 area of Chicago and 56 percent of the current city area.

Figure 4. Land Use Map Sample



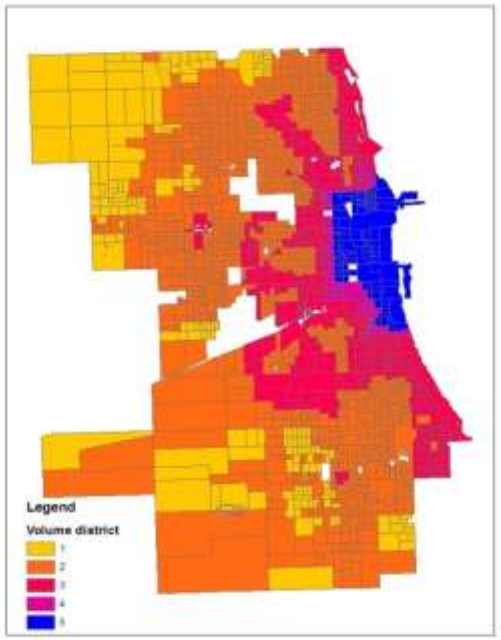
Notes: A portion of the 1922 land use survey map created by the Chicago Zoning Commission. These blocks are located just across the Chicago River to the west of the downtown.

Figure 5. Zoning Maps

Panel A: Use Zoning Map Sample

Notes: This image shows the area of Chicago west of the downtown along the Chicago River. Unhatched areas are zoned for apartments, hatched areas are zoned for commercial uses, and cross-hatched areas are zoned for manufacturing.

Panel B: Digitized Volume Zone Map



Notes: This map shows volume districts in the Chicago zoning ordinance with enumeration districts assigned to the volume district in which the majority of its area fell. District 5 permitted the tallest buildings, up to 22 stories. District 1 was the most restrictive, allowing only buildings with three or fewer stories.

Table 1. Descriptive Statistics

Percent manufacturing	0.097
	(0.196)
Percent manufacturing if greater than 5 percent	0.371
	(0.214)
Indicator for manufacturing zoning	0.262
	(0.440)
Percent commercial zoning	0.218
	(0.181)
Indicator for volume district 2 if within 500 feet of district 1 and 2	0.587
	(0.493)
Total blacks	0.057
	(0.181)
Southern blacks	0.039
	(0.126)
Northern blacks	0.018
	(0.057)
First-gen. immigrants	0.462
	(0.221)
Second-gen. immigrants	0.208
	(0.080)
1913 land values	103.368
	(386.982)

Notes: Full sample unless otherwise indicated.

Table 2. Exposure to Urban Features and other Demographic Groups

Panel A Group	Number 4+ story buildings (1)	Number 4-10 story buildings (2)	Population Density (3)	Commercial enterprises per acre (4)	Noxious facilities per acre (5)	Industrial facilities per acre (6)
Southern blacks	0.19	0.22	64.91	0.91	0.0072	0.02
Northern blacks	0.17	0.21	64.21	0.89	0.0060	0.02
First-gen. immigrants	0.12	0.15	70.09	1.01	0.0070	0.02
Second-gen. immigrants	0.08	0.11	58.01	0.72	0.0046	0.01
Third-gen. whites	0.10	0.14	55.00	0.64	0.0040	0.01
Sample Average	0.11	0.15	58.03	0.79	0.0071	0.02

Panel B Group	Share Southern Black (1)	Share Northern Black (2)	Share First Gen. Immigrant (3)	Share Sec. Gen. Immigrant (4)	Share White 3rd Gen. (5)	1913 Avg. Land Prices (6)
Southern blacks	0.45	0.19	0.16	0.08	0.14	90.66
Northern blacks	0.42	0.19	0.17	0.09	0.15	96.69
First-gen. immigrants	0.01	0.01	0.60	0.19	0.20	93.11
Second-gen. immigrants	0.01	0.01	0.45	0.23	0.29	92.15
Third-gen. whites	0.02	0.01	0.38	0.23	0.36	125.67
Sample Average	0.04	0.02	0.46	0.21	0.27	103.37
Sample Std. Dev.	0.13	0.06	0.22	0.08	0.16	386.98

Notes: The demographic data come from Ancestry.com and the land use counts were computed using the 1922 Land Use Survey created by the Chicago Zoning Commission. See Section III for definitions of the ethnic groups, details on the land use data, and sample restrictions.

Table 3. Pre-existing Sorting of Minority Groups across the City and Neighborhoods

Panel A (no controls)	Number 4+ story buildings (1)	Number 4-10 story buildings (2)	Population Density (3)	Commercial enterprises per acre (4)	Noxious facilities per acre (5)	Industrial facilities per acre (6)
Southern blacks	0.0167	-0.105	9.211	0.461	0.0553*	0.0750
	(0.125)	(0.162)	(18.55)	(0.393)	(0.0297)	(0.0464)
Northern blacks	-0.718***	-0.849**	11.42	0.355	-0.115**	-0.130
	(0.255)	(0.372)	(37.47)	(0.804)	(0.0551)	(0.0886)
First-gen. immigrants	-0.123***	-0.216***	38.85***	1.212***	0.0116***	0.0436***
	(0.0335)	(0.0466)	(5.800)	(0.106)	(0.00410)	(0.00865)
Second-gen. immigrants	-1.239***	-1.655***	-75.03***	-1.965***	-0.0307***	-0.0575**
	(0.0971)	(0.136)	(16.22)	(0.304)	(0.0119)	(0.0272)
R-squared	0.128	0.104	0.112	0.243	0.030	0.058
Panel B (with controls)						
Southern blacks	0.150	0.173	0.357	0.0187	0.0734**	0.0875*
	(0.121)	(0.133)	(16.17)	(0.366)	(0.0306)	(0.0471)
Northern blacks	-0.307	-0.287	-13.74	0.886	-0.121**	-0.132*
	(0.225)	(0.298)	(32.05)	(0.733)	(0.0470)	(0.0769)
First-gen. immigrants	-0.0592	-0.0446	24.39***	0.755***	0.00420	0.0106
	(0.0452)	(0.0606)	(7.188)	(0.141)	(0.00678)	(0.0135)
Second-gen. immigrants	-0.303***	-0.188	-52.20***	-0.907***	0.0105	0.0104
	(0.0991)	(0.138)	(17.02)	(0.325)	(0.0158)	(0.0353)
R-squared	0.576	0.641	0.541	0.547	0.187	0.273

Notes: N=1800 observations for all columns. Controls include the full set of spatial variables described in Section IV in addition to ward fixed effects. See Section III for definitions of each ethnic group and sample restrictions.

Table 4. Effect of Minority Share on Manufacturing Zoning

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	Ind. for Industrial Zoning in ED			Percent of ED Zoned Industrial			
	OLS	OLS	Probit	OLS	OLS	Tobit	Tobit
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Total blacks	0.0520***			0.00878		0.0326*	
	(0.0158)			(0.00629)		(0.0169)	
Southern blacks		0.0734***	0.0791***		0.0318***		0.102***
		(0.0229)	(0.0145)		(0.00934)		(0.0203)
Northern blacks		-0.0213	-0.0253**		-0.0231***		-0.0656***
		(0.0216)	(0.0114)		(0.00805)		(0.0172)
First-gen. immigrants	0.0634***	0.0625***	0.0488***	0.0120*	0.0114	0.0509**	0.0517**
	(0.02)	(0.0201)	(0.0154)	(0.00722)	(0.00722)	(0.0212)	(0.0210)
Second-gen. immigrants	0.0159	0.0158	0.0319**	-0.00483	-0.00560	-0.0216	-0.0223
	(0.0163)	(0.0165)	(0.0127)	(0.00654)	(0.00655)	(0.0178)	(0.0177)
1913 land values	0.0139	0.0154	0.0466**	-0.00958***	-0.00911**	0.00510	0.00960
	(0.0112)	(0.0111)	(0.0183)	(0.00366)	(0.00364)	(0.0118)	(0.0126)
Observations	1,800	1,800	1,789	1,800	1,800	1,800	1,800
R-squared	0.625	0.628		0.721	0.723		

Notes: All specifications include the full set of spatial and pre-existing land use controls described in Section IV in addition to ward fixed effects. See Section III for definitions of each ethnic group and sample restrictions.

Table 5. Effect of Minority Share on Manufacturing Zoning Robustness

	Ind. for Industrial Zoning in ED			Percent of ED Zoned Industrial		
	Probit	Probit	Probit	Tobit	Tobit	Tobit
	(1)	(2)	(3)	(4)	(5)	(6)
Southern blacks	0.0911***	0.0644***	0.0766***	0.137***	0.135***	0.137***
	(0.0162)	(0.0160)	(0.0249)	(0.0271)	(0.0292)	(0.0331)
Northern blacks	-0.0301**	-0.0279**	-0.0469**	-0.0638***	-0.0479**	-0.0379*
	(0.0127)	(0.0124)	(0.0215)	(0.0211)	(0.0221)	(0.0224)
First-gen. immigrants	0.0492***	0.0417**	0.0456**	0.0880***	0.105***	0.130***
	(0.0179)	(0.0186)	(0.0200)	(0.0249)	(0.0261)	(0.0334)
Second-gen. immigrants	0.0379***	0.0252	0.0148	0.0152	0.0353	0.0494*
	(0.0143)	(0.0159)	(0.0189)	(0.0218)	(0.0241)	(0.0296)
1913 land values	0.0453**	0.0301*	-0.150*	-0.0167	-0.00913	-0.135
	(0.0187)	(0.0160)	(0.0869)	(0.0146)	(0.0353)	(0.117)
Observations	1,481	1,147	765	1,560	1,294	1,064

Notes: All specifications include the full set of spatial and pre-existing land use controls described in Section IV in addition to ward fixed effects. See Section III for definitions of each ethnic group and sample restrictions. Columns (1) and (4) include only enumeration districts with no Class C or S manufacturing. Columns (2) and (5) include only enumeration districts with no Class C or S manufacturing that are at least 500 feet away from such uses. Columns (3) and (6) include only enumeration districts with no Class C or S manufacturing that are at least 1,000 feet away from such uses.

Table 6. Effect of Minority Share on Commercial Zoning

	Percent of ED Zoned Commercial			
	OLS	Tobit	OLS	Tobit
	(1)	(2)	(3)	(4)
Total black percent	-0.0165**	-0.0156*		
	(0.00821)	(0.00836)		
Southern blacks			-0.0495***	-0.0521***
			(0.0156)	(0.0166)
Northern blacks			0.0331**	0.0363***
			(0.0132)	(0.014)
First-gen. immigrants	-0.0437***	-0.0449***	-0.0427***	-0.0440***
	(0.00813)	(0.00846)	(0.00813)	(0.00846)
Second-gen. immigrants	-0.0166**	-0.0144**	-0.0154**	-0.0131*
	(0.00665)	(0.00709)	(0.00667)	(0.00711)
1913 land values	-0.00977*	-0.0111**	-0.0105*	-0.0119**
	(0.00551)	(0.00544)	(0.00553)	(0.00547)
Observations	1,800	1,800	1,800	1,800
R-squared	0.578		0.581	

Notes: All specifications include the full set of spatial and pre-existing land use controls described in Section IV in addition to ward fixed effects. See Section III for definitions of each ethnic group and sample restrictions.

Table 7. Main Result by Commercial and Manufacturing Activity Quartiles

Panel A: Commercial Density	1st Quart.	2nd Quart.	3rd Quart.	4th Quart.
Outcome: Pct. zoned industrial				
Avg. pct. zoned industrial	15.97%	12.16%	6.78%	4.05%
Southern black	0.0570***	0.0179	0.0339*	0.0179
	(0.0191)	(0.0187)	(0.0197)	(0.0178)
First-gen. immigrants	0.0535***	0.0024	0.0137	-0.0087
	(0.0176)	(0.0157)	(0.0161)	(0.0092)
Outcome: Pct. zoned commercial				
Avg. pct. zoned commercial	9.25%	16.52%	25.23%	36.11%
Southern black	0.0068	-0.0052	-0.0968***	-0.0468*
	(0.0369)	(0.0253)	(0.0333)	(0.0264)
First-gen. immigrants	0.0069	-0.0326*	-0.0531**	-0.0807***
	(0.0111)	(0.0171)	(0.0209)	(0.0197)
Observations	450	450	450	450
Observations w/ southern black > 10%	22	40	54	45
Observations w/ first-gen. > 40%	164	233	256	325

Panel B: Manufacturing Density	1st Quart.	2nd Quart.	3rd Quart.	4th Quart.
Outcome: Pct. zoned industrial				
Avg. pct. zoned industrial	1.76%	12.15%	12.97%	15.00%
Southern black	0.0175*	0.0026	0.0291	0.0114
	(0.0107)	(0.0504)	(0.0198)	(0.0183)
First-gen. immigrants	0.0143**	0.0437**	-0.0183	-0.0117
	(0.0063)	(0.0212)	(0.0160)	(0.0175)
Outcome: Pct. zoned commercial				
Avg. pct. zoned commercial	13.88%	17.21%	23.37%	33.59%
Southern black	0.0233	-0.1625***	-0.0674**	-0.0298
	(0.0260)	(0.0607)	(0.0299)	(0.0282)
First-gen. immigrants	-0.0142	-0.0018	-0.0265	-0.0619***
	(0.0123)	(0.0205)	(0.0171)	(0.0239)
Observations	577	323	450	450
Observations w/ southern black > 10%	38	11	61	51
Observations w/ first-gen. > 40%	233	206	239	300

Notes: Outcome variables in panel A are the percent of the enumeration district zoned industrial and commercial (as indicated), with regressions run on subsamples defined by quartile of commercial density. Outcome variables in panel B are the percent of the enumeration district zoned industrial and commercial (as indicated), with regressions run on subsamples defined by the quartile of manufacturing (A, B, C, D and S) density. All specifications include the full set of spatial and pre-existing land use controls described in Section IV in addition to ward fixed effects. See Section III for definitions of each ethnic group and sample restrictions.

Table 8. Effect of Minority Share on Volume Zoning

	Indicator for Volume District 2			
	Probit	Probit	Probit	Probit
	(1)	(2)	(3)	(4)
Total black percent	0.0418***		0.0357**	
	(0.0147)		(0.0154)	
Southern blacks		0.0546*		0.0587*
		(0.0281)		(0.0318)
Northern blacks		-0.0132		-0.0230
		(0.0271)		(0.0281)
First-gen. immigrants	-0.105**	-0.104**	-0.108**	-0.108**
	(0.0481)	(0.0480)	(0.0482)	(0.0480)
Second-gen. immigrants	0.0331	0.0324	0.00204	0.00155
	(0.0352)	(0.0352)	(0.0380)	(0.0379)
1913 land values	0.301***	0.301***	0.289***	0.289***
	(0.0638)	(0.0640)	(0.0659)	(0.0661)
Observations	380	380	333	333

Notes: For columns (1)-(2), the sample is restricted to EDs within 1000ft of the border between density districts 1 and 2. For columns (3)-(4), the sample is restricted to EDs within 500ft of the border between density districts 2 and 3. All specifications include the full set of spatial and pre-existing land use controls described in Section III in addition to ward fixed effects.

Appendix Table 1. Immigrant Breakdown for Manufacturing Zoning

	Percent of ED Zoned Industrial		Ind. for Industrial Zoning in ED	
	OLS	Tobit	OLS	Probit
	(1)	(2)	(3)	(4)
Southern black	0.0316***	0.104***	0.0746***	0.0790***
	(0.00936)	(0.0205)	(0.0230)	(0.0147)
Northern black	-0.0222***	-0.0607***	-0.0219	-0.0259**
	(0.00801)	(0.0172)	(0.0217)	(0.0115)
Polish	0.00481	0.0310**	0.0298*	0.0197
	(0.00641)	(0.0157)	(0.0165)	(0.0120)
Russian	0.00640	0.0146	0.0366***	0.0221**
	(0.00510)	(0.0136)	(0.0140)	(0.0112)
Italy	0.00857*	0.0287*	0.0425***	0.0277**
	(0.00508)	(0.0148)	(0.01380)	(0.0110)
Irish	0.00783*	0.0327***	0.0110	0.0155**
	(0.00407)	(0.00939)	(0.0105)	(0.00688)
German	0.00612	0.0289**	0.0218**	0.0272***
	(0.00468)	(0.0113)	(0.0104)	(0.00936)
Other immigrant	0.00573	0.0320**	0.0392***	0.0260**
	(0.00521)	(0.0155)	(0.0139)	(0.0119)
Second generation	-0.00776	-0.0407**	0.0164	0.0184
	(0.00668)	(0.0182)	(0.0170)	(0.0137)
1913 land values	-0.00870**	0.0122	0.0163	0.0463**
	(0.00364)	(0.0120)	(0.0112)	(0.0183)
Observations	1,800	1,800	1,800	1,789

Notes: All specifications include the full set of spatial and pre-existing land use controls described in Section IV in addition to ward fixed effects. See Section III for definitions of each ethnic group and sample restrictions.