Zoning and the American Suburb*

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Abstract

American suburbs are generally characterized by single-family neighborhoods featuring large lots, with few businesses or apartments. To understand the origins of this development, we construct the first panel dataset of suburban zoning maps and bylaws for a major American metropolitan area and ask how comprehensive land use regulation shaped the form of the suburbs of Chicago today. Our strategy identifies the impact of zoning using land that was undeveloped before such regulations were adopted. The typical post-zoning suburb sets aside about 80% of land for single family homes, but having adopted the most diverse zoning we observe reduces the single family share by half, with most of this land having been redistributed to businesses and apartments in equal measure. Supply restrictions were also binding earlier than widely believed, and prewar minimum lot size regulations were associated with lots that were 19% larger than those that emerged from unregulated markets. Comprehensive land use regulation thus substantially increased the prevalence of single-family residential neighborhoods relative to the suburban form that would have prevailed without zoning, which would have featured more mixed uses and smaller lots.

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JEL codes: K11, N92, R14, R31, R52.

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1 Introduction

American suburbs are notable for their residential uniformity and extreme separation of uses. Jane Jacobs wrote of suburban developments of the 1950s – composed almost exclusively of detached single-family homes – as exhibiting a remarkable degree of "monotony, sterility, and vulgarity" (Jacobs, 1961, p. 7). Why did compact neighborhoods with a mix of residential and commercial uses stop being built in American metropolitan areas? And why are so many American suburbs filled with single-family homes on large lots that are inaccessible except by car and unwalkable even to the nearest store? While critics and fans alike have pointed to land use regulation as the explanation for the distinctive form of American suburbs, we know surprisingly little about what these regulations looked like historically, or how they influenced the development of neighborhoods. Even in the early 20th century, upwardly mobile Americans increasingly sought homes in planned neighborhoods and viewed apartment buildings as "parasitic" nuisances to be avoided.[1] These preferences for neighborhoods complicate efforts to understand the role of zoning during the 1920–1980 period when a significant share of the U.S. housing stock was constructed.

The central challenge in understanding the long-run impact of zoning on the suburbs is in observing the regulatory environment when these places were originally developed. Historical zoning maps and regulations can be very difficult to locate, as they have nearly all been superseded and relegated to municipal archives and libraries. Accordingly, ambitious efforts to map the nation's zoning laws such at the National Zoning Atlas (Xu et al., 2023) do not provide information on historical regulations, nor do widely used zoning surveys such as the Wharton Regulatory Land Use Regulation Index (Gyourko et al., 2008). The lack of information on historic zoning laws has limited efforts to understand the impact of zoning over the long run, particularly because current regulations have likely been shaped by many of the economic forces social scientists wish to study (Davidoff et al., 2016; Molloy, 2020; Trounstine, 2020).

In this paper, we construct the first panel dataset of the complete zoning regulations for a major U.S. metropolitan area using the original maps and bylaws from suburban municipalities around Chicago. The Cook County Longitudinal Database covers regulations from 1921, when suburban

[1] The original case legalizing comprehensive land use regulation Euclid v. Ambler (1926) contained the following description of apartments in suburban neighborhoods: "very often the apartment house is a mere parasite, constructed in order to take advantage of the open spaces and attractive surroundings created by the residential character of the district."

zoning first appeared, up to 1980. We combine these historical zoning regulations with unusually detailed spatial data that we obtained through a public records request to Cook County. This data includes a map with the date of subdivision for parcels and the date of construction of existing houses. This information is important because parcels were often subdivided decades before houses were built on them; this limits the usefulness of national datasets (like those provided by Cotality, which only includes structure built dates) for studying lot sizes.[2] Cook County contains over 120 municipalities that developed at different times and under various regulatory environments, yielding a broad variety of contemporary suburban forms.

We use this dataset to establish several new facts about early suburban zoning ordinances and residential development. Even the earliest suburban ordinances set aside a striking amount of land for single-family residential uses. Our data shows that approximately 60% of zoned inner-ring suburban land was set aside for single-family housing in the 1920s. The corresponding share was just 4% in the zoning ordinance adopted by Chicago in 1923. This suburban bias towards low-density housing appears to have only risen with time. While the share of zoned suburban land limited to single-family uses reached 65% by the 1970s, the share devoted to multi-family apartment uses declined considerably from 18% in the 1920s to only 6% around 1970. Patterns favoring low-density suburban housing are also apparent in the evolution of minimum lot size required per household. Minimum lot sizes were ubiquitous early on and grew substantially larger over time, from a median of 5,000 square feet required per household in the 1920s to 7,500 square feet in the 1970s. Because we can observe the date of plat for every parcel in the county, we can assess whether development occurred under regulation or before it was adopted. We find that unzoned development dominated in the 1920s, trailed off after World War II, and disappeared almost completely by 1970. This timeline motivates the empirical work we undertake in the paper.

To date, most work in economics on historical zoning laws has focused on density restrictions. However, our descriptive work suggests that the most important impact of suburban zoning may have been to shift the overall distribution of land use, principally towards single-family homes and away from virtually everything else. To address this question, we use the Cook County Longitudinal Database and the Public Land Use Survey System (PLSS) grid, which was created as part of the

[2]For example, more than half of the homes built in suburban Cook County in the early 1950s were built on parcels that were subdivided in the 1920s or before.

Land Ordinance of 1785, to measure the impact of zoning on land that was undeveloped (i.e., neither built up nor subdivided) at the time regulations were adopted. Using such "greenfield" development minimizes the chance that zoning followed existing land use. In addition, we can control for a rich set of attributes of the land in each grid square, including its estimated value, its proximity to different areas of Chicago, important geographic features, and historic transportation networks.

We show that areas that were developed before zoning was in place had on average 55% of their land set aside for single-family homes and 15% for each of apartments and commercial uses (with the remainder largely for industry). But under zoning, this distribution shifted to 80% single-family homes and 5% for each of apartments and commercial uses. Is this shift the result of zoning? Using simple entropy indexes to measure the diversity of zoning and contemporary land use, we ask how zoning restrictiveness at the time of development affected the overall distribution of land use. Adopting the most flexible zoning we observe reduces the single family share by 41 percentage points and increases commercial and apartment shares by 27 percentage points, with the effect evenly split across these two use categories. We also show that these estimates are essentially invariant to the inclusion of controls for other factors that could drive these differences, including the location and value of land. These results together suggest that zoning regulations themselves shifted the allocation of land in the suburbs. We conclude that the suburbs would have contained substantially more mixed-use development had comprehensive land use regulation not been allowed by *Euclid v. Ambler Realty Co.* in 1926.

We also contribute to the literature on minimal lot sizes by providing well-identified estimates of the effects of these regulations on residential neighborhoods. We find that, conditional on location within the county and year of development, new single-family residential neighborhoods were becoming less walkable and further from apartments and stores in both regulated and unregulated municipalities. In the prewar era, the existence of a zoning ordinance explains little of the differences across residential neighborhoods. The one exception is in fact minimum lot size (MLS) regulations. Although the prevailing wisdom suggests that density restrictions were not important in the United States until the 1970s (for instance, see discussions in Fischel, 2005; Krimmel, 2021), we find that minimum lot sizes were binding as early as the 1920s. Zoning was associated with a 1,494 square foot increase in lot size (19% of the mean) in residential development from 1921 to

1945. In the postwar era (1945-1980), we compare developments under different regulatory restrictiveness, finding an elasticity of lot sizes with respect to MLS of .47. The robustness of these effects strongly suggests that zoning shifted the lot sizes of residential neighborhoods beyond what the private market would have delivered. These larger-lot developments also mechanically increased the distance of single-family homes from other use types.

The data work in this paper required a years-long archival effort and the existence of an unusually well-equipped county GIS office. It would be thus be extraordinarily difficult to replicate this approach for a broader sample of metro areas. We close by considering what we can learn from our setting, in which nearly everything is observed, to guide interpretation of more indirect approaches. A growing number of recent papers have developed creative methods to impute past minimum lot size requirements from contemporary real estate data (Cui, 2024; Macek, 2024; Song, 2025; Zabel & Dalton, 2011). These approaches are undoubtedly important, as zoning has become a crucial part of the national debate on housing. Yet our findings suggest the need for caution in interpreting today's lot size distribution as a measure of past regulation. We find that suburban developers chose lot sizes clustered around similar round numbers whether zoning was in place or not. Zoning ordinances also largely followed existing subdivision, so the distribution of lot sizes from unregulated development was crystallized into future minimum lot size regulations. The observed lot size distribution today is thus informative of past minimum lot size regulations both because these regulations shaped development, and because existing development shaped future regulations. The dataset we have assembled for this paper provides the ground truth for one metro area, which will provide a new means of validating approaches with broader geographic coverage.

This paper contributes to a literature in economics that seeks to understand the causal impacts of land use regulation. Economists have studied the short-run impact of zoning on undeveloped areas (Turner et al., 2014) and on existing urban development, both in recent years (Anagol et al., 2021) and in historical settings (McMillen & McDonald, 2002). This emphasis on identification complements the broader literature on land use regulation, which argues that zoning can be used to preserve local control and increase home values (Fischel, 2005) but at the cost of excluding less privileged households (Trounstine, 2018). The increase in home values is related to the strong preferences of U.S. households for low-density development (Gyourko & McCulloch, 2023). Historical zoning parameters beyond minimum lot sizes have received comparatively little attention in

economics due to the difficulty of observing them. Two existing papers that study the long-run, causal impact of zoning focus on central cities only (Shertzer et al., 2018; Twinam, 2018).

The archival zoning ordinances digitized for this paper represent a new avenue of inquiry for the study of zoning. The current literature on zoning largely relies on surveys (Glickfeld & Levine, 1992; Gyourko et al., 2008), digitized maps of contemporary regulations (Xu et al., 2023), and promising new methods using natural language processing to analyze current zoning codes (Bartik et al., 2025). While all of these methods are useful for understanding the constraints on current development (for instance, Kulka et al., 2024), none of them allow researchers to observe the exact regulations in place when a particular parcel was developed. Our approach, which trades off geographic coverage for an exceptional level of detail, provides a new benchmark for understanding both the impact of zoning and the accuracy of our measures of regulation. However, imputation approaches are currently limited to lot size regulations, and developing methods to study allowable uses remains a key challenge for future research. Observing the date when lots were subdivided in broader settings is another challenge for future work, as the sizable gap between the date of plat (which is typically not observed) and the date of structure (which is easily observed from providers such as Cotality) we document in the Chicago suburbs is likely present in many other settings.

Zoning has been linked to persistent racial segregation, disparities in public goods provision, and accelerating regional inequality (Ganong & Shoag, 2017; Gyourko & Krimmel, 2021; Sahn, 2025; Schuetz, 2022). Restrictive land use regulation is thus intertwined with some of the most critical socioeconomic challenges facing the United States. This paper contributes to this larger literature by clarifying the role of regulation in shaping the form of many suburban areas in the United States. Initial development is costly to change (Brooks & Lutz, 2016; Lindenthal et al., 2017), so the decisions made in past decades will constrain development far into the future, complicating efforts to increase the density and affordability of housing in high-demand areas of the United States.

2 Background on Suburban Zoning in the United States

American cities have adopted land use regulations since colonial times, with rules governing the location of noxious uses first appearing in the Massachusetts Bay Colony in 1692.[3] Early regulations typically reflected a piecemeal approach, regulating specific offensive uses such as tanneries (Schwieterman & Caspall, 2006, Ch. 2). An 1869 New Orleans' ordinance that required butchering to take place down river of the city was upheld by the Supreme Court in 1873 on 14th Amendment grounds, marking a key precedent for later jurisprudence on land use regulation. However, fragmented approaches had their limits, and in 1908 the city of Los Angeles adopted the nation's first use zoning ordinance. This ordinance mapped out three residential districts in which most industrial uses were disallowed. In contrast to later ordinances, existing businesses could be forced to vacate their premises without compensation.

The authority to regulate industrial uses derived from local governments' police power to control "nuisances." The Supreme Court placed some restrictions on this authority by striking down the wave of racial zoning laws that appeared in southern cities beginning in 1910. The *Buchanan v. Warley* decision of 1917 found that preventing homeowners from selling their home to a member of a different race constituted an inappropriate exercise of police power. But the Supreme Court viewed race-neutral, "comprehensive" zoning laws differently. These ordinances, which first appeared in New York City in 1916, created districts that permitted residential, commercial, and unrestricted uses and introduced city-wide setbacks for buildings of all types. The threat of industrial encroachment continued to motivate local governments, including the Ohio village of Euclid's adoption of a comprehensive zoning ordinance in response to Ambler Realty's plans for industrial development. This ordinance sparked the landmark 1926 decision in *Euclid v. Ambler*, which found that regulating allowable uses – including setting aside land for purely residential or commercial use – was a valid exercise of police power.

Municipalities across the United States adopted similar zoning ordinances over the next decade, and by 1936, 1,322 cities had them (about 85% of the total) (Jackson, 1987, p. 242). The spread of zoning was aided by the Standard State Zoning Enabling Act, which was drafted by the U.S. Department of Commerce under Herbert Hoover and released in 1924. This gave states a model

[3] "An Act for Prevention of Common Nuisances Arising by Slaughter-Houses, Still-Houses, Tallow Chandlers, And Curriers," Massachusetts Acts and Resolves, 1:59-60.

framework for authorizing municipal governments to zone, and in part explains why ordinances across the country are structured similarly. Ordinances typically contain a map of districts alongside a list of allowable uses and density restrictions specific to each district. Density restrictions typically take the form of limits on building heights, lot sizes, and lot coverage. City governments were concerned with the blocking of light and the creation of wind tunnels after steel-reinforced skyscrapers became viable, and the courts generally upheld height restrictions (Hall, 2014, pp. 36-47). In the suburbs, restrictions on lot sizes were more important, as we discuss in Section 3. The "discretionary" aspects of zoning, particularly related to multiple rounds of approvals and associated delays, emerged from progressive activism in the 1960s and 1970s and were not a major factor shaping the residential development we study in this paper (Schuetz, 2022, p. 20).

Suburban development prior to World War I had been concentrated in inner-ring suburbs and areas accessible by steam rail and electric streetcar lines. The expansion of private automobile ownership in the 1920s allowed developers to open land far from existing rail lines, and outlying areas found themselves under pressure to manage the resulting growth and provide the services that new commuters demanded (Keating, 1988, p. 89). New suburban settlements first had to incorporate as a municipality (a city, village, or incorporated town) before they could adopt a zoning ordinance. The ability to control development via land use regulation served as a powerful motivation for homeowners in newer suburban settlements to incorporate (Fischel, 2005, p. 222). Newly established local governments and private developers then coordinated around the adoption of zoning regulations, the subdivision of agricultural land on the periphery, and plans to extend roads and utilities into new areas (Weiss, 2002, p. 66). Local governments were especially interested in preventing "wildcat" lots, or disorganized and haphazard subdivision of land (Weiss, 2002, p. 116).

Zoning addressed some of the limitations of the other tools available to developers and homeowners to control undesirable land uses, namely the use of restrictive covenants on deeds. Developers used deed restrictions on new homes to ensure the kind of stability that White suburban homeowners desired. In practice, this meant the exclusion of commercial and industrial uses, which were viewed as having adverse impacts on home values and quality of life (Fischel, 2004; McMillen & McDonald, 2002). Developers within a municipality faced a collective action problem, since the value of any individual parcel depended heavily on what neighbors built. Restrictive covenants

solved this problem by contractually locking in land use expectations across a subdivision, reducing uncertainty and allowing developers to capture the value of neighborhood homogeneity in their initial lot prices. Zoning provided further guarantees on what kind of development would be allowed beyond the borders of a subdivision. Homeowners also wished to block apartments because dense residential development had long been associated with overcrowding, disease, and immigrant populations (Hirt, 2015, p. 117). Indeed, developers used restrictive covenants to block apartment buildings in the urban periphery even in the 19th century, before comprehensive zoning regulations were introduced (Wolf, 2008). Zoning made it possible to block apartment construction on a much broader scale.

Existing scholarship from the social sciences has focused on racially restrictive covenants, which were used extensively by developers to prevent the entry of racial minorities into White neighborhoods. Homeowners formed "neighborhood improvement associations" to organize covenants and resorted to violence to enforce them (Rothstein, 2017, p. 139). The Federal Housing Administration (FHA) reinforced the use of racially restrictive covenants through underwriting guidelines until such restrictions were rendered unenforceable by *Shelley v. Kraemer* in 1948 (Jackson, 1987, p. 208). The FHA also recommended the use of zoning regulations to maintain neighborhood stability, and large-lot, single-family development became a new tool of racial exclusion (Gordon, 2023, p. 155).

That comprehensive zoning laws impacted the racial composition of the suburbs is almost universally indicated by the existing literature. However, the impact of historical zoning regulations on the built environment today has received little quantitative attention because of the difficulties of observing the laws in place at a particular location and point in time. Identifying the impact of zoning is difficult because, given the strong preferences of homeowners for "orderly" residential development composed entirely of single-family homes, one may expect that the market would have delivered these kinds of neighborhoods even if *Euclid v. Ambler* (1926) had been decided differently. Indeed, the idea that zoning simply "follows the market" and has little overall impact on land use was influential in economics for decades (for instance, see Wallace, 1988). Put differently, zoning wasn't essential to shift new single-family homes away from the nearest apartment or business, as private developers would have had the incentive to do this anyway. The goal of our paper is to assess how important zoning regulations were in shaping the form of suburbs.

3 The Cook County Longitudinal Zoning Database

The data for this paper was constructed from archival zoning ordinances from the municipalities of suburban Cook County, the second most populous county in the country and home to the city of Chicago. Our panel of zoning regulations begins in 1921 with the first three suburbs to adopt zoning ordinances: Evanston, Glencoe, and Oak Park. Our panel ends in 1980. The zoning ordinances all have two components, the zoning district map and the associated bylaws. The maps and bylaws were typically archived separately, with maps in some libraries and the bylaws in others. We found the various ordinance components in academic libraries in Illinois and in public libraries, including the Library of Congress. In some cases we made public records requests to the municipal offices themselves. If these approaches did not work, we used Olcott's Blue Books of Chicago to fill in missing bylaw information.[4] All of the maps were digitized using the 2020 street grid from from the Cook County GIS office as a reference.[5]

Zoning maps and bylaws were updated infrequently, but bylaws changed more frequently than the underlying maps. We updated the bylaws each time they changed in a particular municipality for each year from 1921 to 1980. For the maps, we digitized the original zoning ordinance map adopted by a municipality in the 1920s, if the municipality existed and was zoned at that time. We then digitized updated or additional zoning ordinance maps at the start of each decade from 1940 to 1970, including newly formed municipalities as they incorporated. This approach allows us to assign the regulations in place when a parcel was subdivided with a high degree of accuracy. Because the maps and bylaws were changed infrequently, and major alterations were rare, our panel accurately describes the regulatory environment for most of the suburbs in Cook County up to 1980.

Cook County today contains 129 suburbs, 122 of which lie primarily within Cook County. Of these, 120 municipalities were incorporated and zoned by 1970. The coverage of the dataset expands each year as more suburbs incorporated and adopted zoning ordinances. The dataset covers 32 municipalities in the 1920s, 63 municipalities in 1940, 84 in 1950, 113 in 1960, and 111 in 1970. Cook County adopted a rural zoning ordinance in 1940 that applied to unincorporated land.

[4] The Blue Books were occasionally missing the most up to date regulations, and for this reason we tried to go back to the primary sources if they could be found.

[5] https://hub-cookcountyil.opendata.arcgis.com/datasets/4569d77e6d004c0ea5fada54640189cf_5/explore.

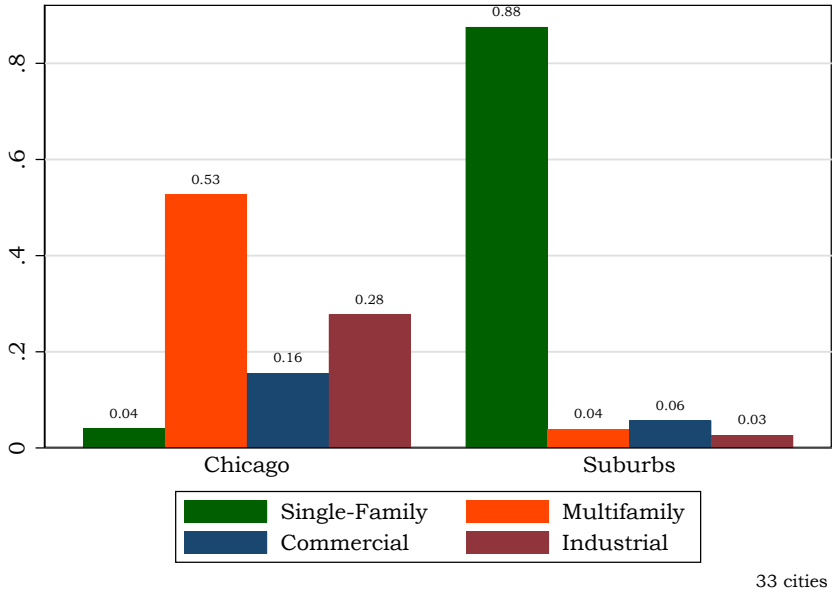
Therefore, parcels developed on unincorporated land before 1940 were not subject to regulation. The rural ordinance had very large minimum lot sizes and was intended to deter development on unincorporated land (Erdmann, 1940). We focus on parcels developed in incorporated suburbs after zoning was adopted and parcels developed in unzoned areas (either unincorporated areas before 1940, or incorporated suburbs before zoning was adopted).

To illustrate how we constructed the database for this paper, we reproduce a sample zoning ordinance map for Chicago Ridge in Appendix Figure A2a, along with its digitized counterpart in Appendix Figure A2b. This map is the zoning ordinance of 1945, which was still in place in 1950. The associated bylaws corresponding to each district can be seen in Appendix Figure A3. The various shading schemes correspond the allowable uses in each district. For instance, the double-hatched yellow area is reserved for "Heavy Industry," although the associated bylaws contain even more information, including the fact that residential uses were not explicitly banned. The two most restrictive districts allow only single-family homes but with different minimum lot sizes, 7,500 and 5,000 square feet. Appendix Figure A2c zooms in on the Chicago Ridge map to highlight the variation in zoning districts present, while Appendix Figure A2d shows that if we remove the zoning overlay, we can see from a contemporary aerial survey photo (circa 1938–1939) that the underlying area was largely vacant and undeveloped. The abundance of zoned but undeveloped land in our sample is an important part of our identification strategy discussed below.

Combining the various ordinances gives us an unprecedented view into the regulatory environment that shaped the development of the suburbs. Figure 1 shows the median use shares for the 32 suburbs in our sample that adopted zoning ordinances in the 1920s, compared with the initial zoning ordinance adopted by the city of Chicago in 1923. The median suburban municipality set aside a striking 88% of its land for single-family homes. Just 4% of land was zoned for apartments and 6% for commercial uses. The development allowed under these ordinances represents a dramatic break from existing urban form. Meanwhile, residential districts permitting apartments covered almost half of Chicago's land, with commercial areas allowing for mixed uses permitted on another 16%. We would expect some difference in use shares because the suburbs in this sample are further from the central business district of the city. We turn to the question of whether such proximity can explain the observed differences in Section 5.

We rely on several other data sources to construct our parcel-level dataset. National datasets do

Figure 1: 1923 Chicago zoning vs. early suburban zoning (zoned in 1920s)



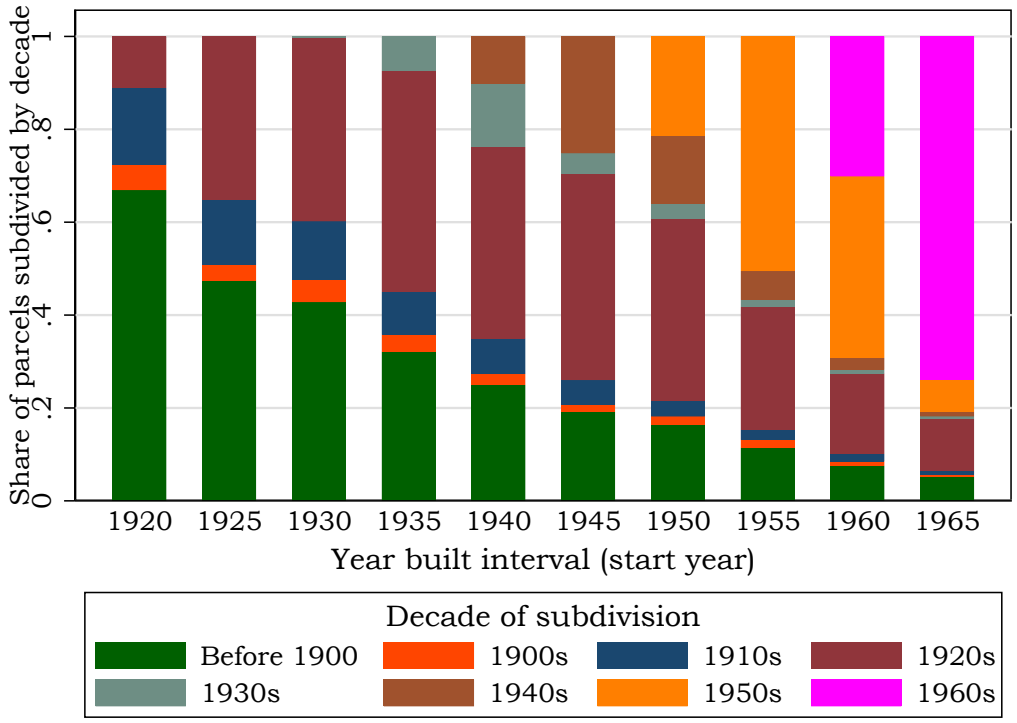
Note: The sample of suburbs includes all 33 Cook County municipalities with use zoning restrictions adopted in the 1920s.

not typically contain information on when parcels were platted. However, we obtained subdivision plat maps for the suburbs, along with detailed subdivision information, through a public records request to Cook County. This data is crucial for linking each parcel to the regulatory environment under which it was developed, because the date on which any structure was built on the parcel can be much later than the date on which the underlying land was subdivided. Figure 2 visualizes the gap between the year a parcel was subdivided and the year a structure was built on it in five-year intervals over our sample period. The average gap between year built and year subdivided across our whole sample is 21 years. More than half of the homes built in suburban Cook County in the early 1950s were built on parcels that were subdivided in the 1920s or before, underscoring the importance of using year of plat rather than the year built when studying questions related to lot sizes.

Additionally, we obtained information on when each parcel became part of an incorporated municipality from the Cook County GIS Office's Incorporation Inventory.[6] This allows us to determine if parcels were subject to the regulations adopted in that suburb at time of subdivision or

[6]Cook County Municipal Incorporation Inventory, accessed 2023. See https://maps.cookcountyil.gov/mii/.

Figure 2: Gap between Parcel Plat and Structure Built Year



Note: This figures shows the parcel plat distribution for houses built over five-year intervals. For example, the 1920 bar contains single-family houses built from 1920 to 1924, the 1925 bar from 1925 to 1929, and so on.

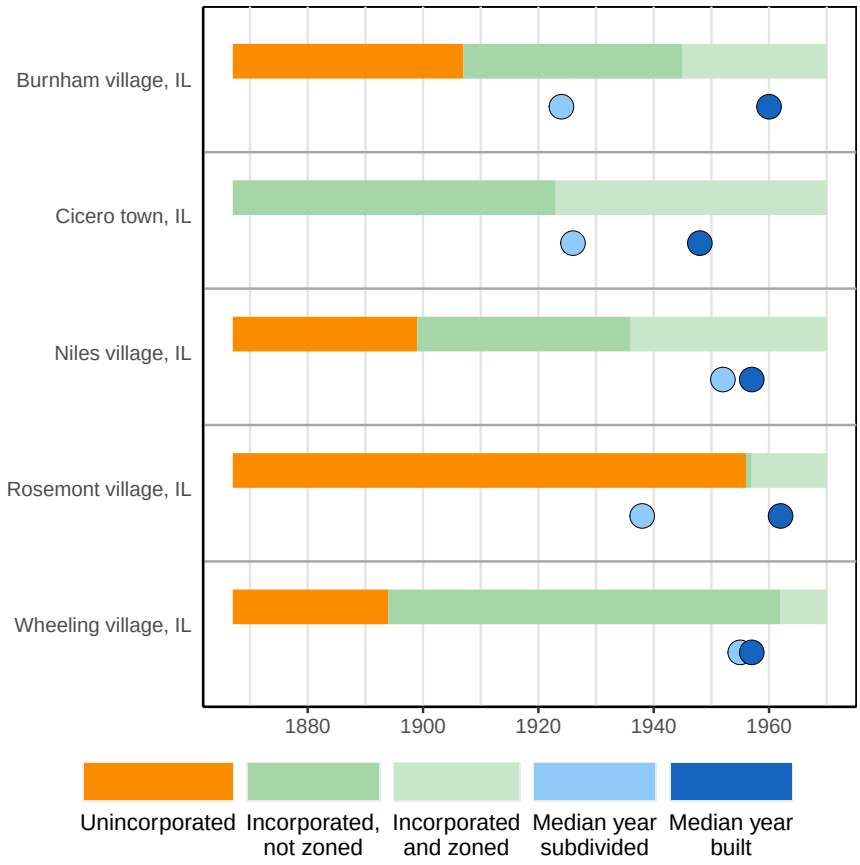
development. The parcel map for Cook County was also obtained through the Cook County GIS Office.[7] We obtained information on the location of present-day uses, including apartments and stores, from the Chicago Metropolitan Agency for Planning.[8]

This combined dataset contains rich variation in the regulatory environment under which suburbs were developed. Figure 3 illustrates the timing around development and regulation in Cook County for five representative municipalities, along with the median year that parcels were subdivided and houses were built. The inner ring suburb of Cicero was substantially built up by the time that zoning was adopted in December 1923, with about half of parcels subdivided after Cicero was incorporated but before it was zoned. On the other hand, much of Rosemont was subdivided before it was incorporated in the mid-1950s. Burnham Village and Niles Village adopted zoning

[7]Cook County GIS. Historical Lots, 2017 (updated August 2022). See https://hub-cookcountyil.opendata.arcgis.com/datasets/2d2d5e9fb3934612809109b6833e5897_17/explore.

[8]The 2018 Land Use Inventory for Northeastern Illinois can be found at https://datahub.cmap.illinois.gov/datasets/ef5f2092556c409d94d119bd821ec6da_2/explore?location=41.841836%2C-88.109641%2C9.13.

Figure 3: Development Timeline



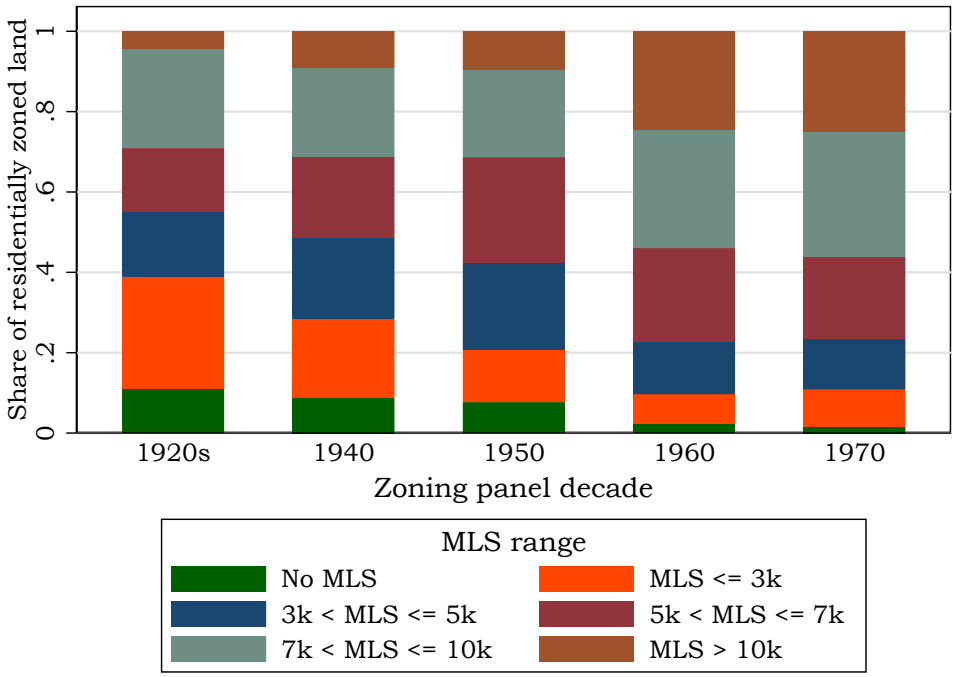
Note: This figure depicts the timeline of incorporation and zoning for five cities in our sample over the period 1867-1970. Cicero was the first of these cities to incorporate in 1867. Also depicted are the median year subdivided and median year built for residential parcels in each city.

around 1940, but Burnham had substantially more development before it was zoned relative to Niles. Most of Wheeling Village was subdivided and built up before zoning. The dataset we have assembled allows us to ask how, conditional on the year and location within the county, regulation shaped suburban development.

We also visualize the increasing restrictiveness of zoning ordinances over time using the easily comparable parameter of minimum lot sizes in Figure 4. This is the first visualization of the actual minimum lot sizes that were in place by *zoning district* over this period. It is worth noting that survey-based approaches to collect zoning information typically ask about the most restrictive lot size restriction in the municipality. With our data, we can see the whole range of density restrictions that applied in different zoning districts, and measure their actual spatial extent.[9] The median lot

[9]In this figure we weight zoning districts by land area for representativeness.

Figure 4: Distribution of Minimum Lot Size Restrictions by Year



Note: This figure summarizes the distribution of minimum lot size (MLS) required per household by year. Zoning district observations are weighted by land area. $N = 2,654$.

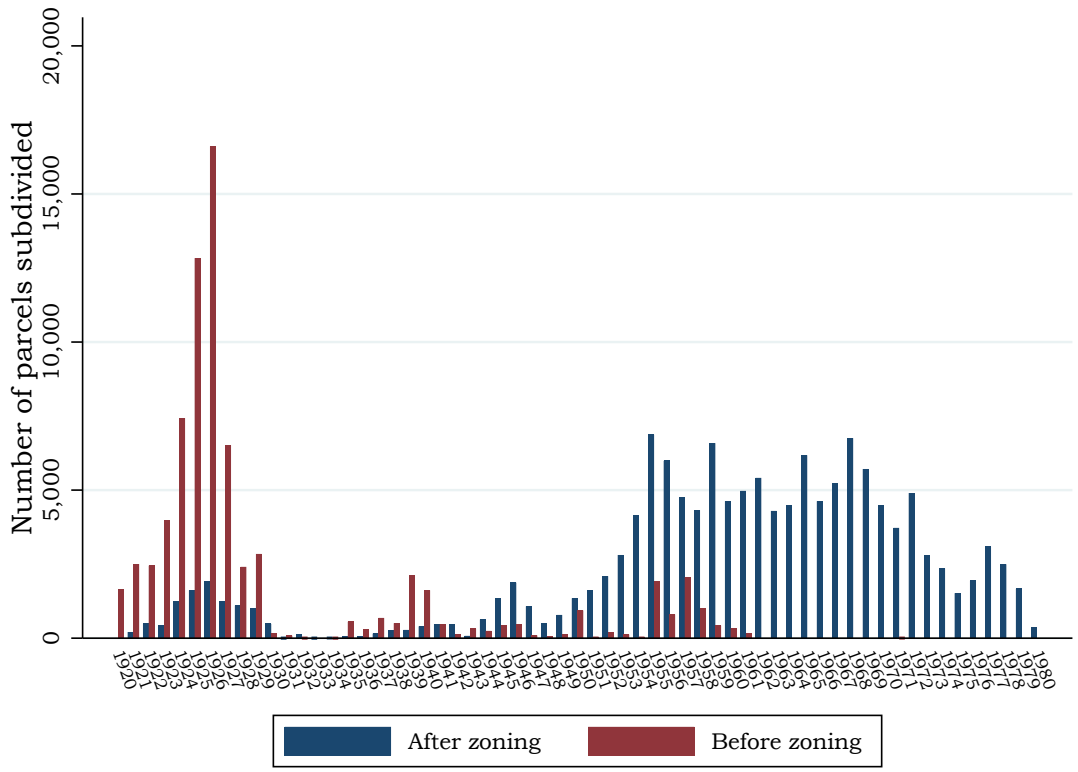
size requirement per household was 5,000 square feet in the 1920s and grew to 7,500 in the 1970s. We discuss below how lot sizes were often much larger than 7,500 square feet by the end of our sample period, underscoring the importance of having independent measures of regulation.

In our empirical work below, we also include covariates that measure the distance between our unit of observation and Lake Michigan, the nearest major river, the central business district of Chicago, the city boundary of Chicago, the nearest 1942 zoning use district in Chicago (single-family, townhome, apartment, commercial, and industrial), and the value of land in 1943. These controls have various sources.[10] For our analysis of zoning restrictiveness across ordinances, we rely on the division of Cook County into quarter-mile sections established by the Land Ordinance

[10]Cook County and the city of Chicago keep a wealth of geographic information online. We constructed the distance to the lake or river measure from https://hub-cookcountyil.opendata.arcgis.com/datasets/078a8acf872548eb9c91d68658f2895a_8/explore, the distance to city measure from https://data.cityofchicago.org/Facilities-Geographic-Boundaries/Boundaries-City/ewy2-6yfk, the distance to the CBD from https://data.cityofchicago.org/Facilities-Geographic-Boundaries/Boundaries-Central-Business-District/tksj-nvsw, and the distance to the nearest use district from our own digitization of Chicago's 1942 zoning ordinance. The source for this ordinance is the Chicago Planning Commission, 1942 Map of Zoning Districts of Chicago. The source of land values is Olcott's.

of 1785, which laid the ground for the Public Land Survey System (PLSS). We obtained the map of PLSS sections from the Cook County GIS office.[11] Finally, Walkscores were from accessed from Walkscore.com (as of 2023).

Figure 5: Parcel development by year and regulation



Note: This figure depicts the timeline of parcel subdivision for suburban Cook County by year and regulatory status.

Finally, using our new dataset, we can visualize residential development by whether it was zoned or not over time. Figure 5 demonstrates that unzoned development dominated in the 1920s, trailed off after World War II, and disappeared completely by 1970.[12] This timeline also motivates the empirical exercises we undertake in the rest of the paper.

[11] Cook County GIS (2022), Public Land Survey Section, see https://hub-cookcountyil.opendata.arcgis.com/datasets/217a635972fb4dfa95411e57a57d1250_3/explore.

[12] This figure also confirms the 1920s subdivision boom described by Homer Hoyt in his study of Chicago's development (Hoyt, 1933).

4 The Impact of Zoning on Suburban Land Use

In this section, we ask to what extent zoning influenced the distribution of land use in the suburbs, particularly towards single-family homes and away from everything else. To develop a geography that is independent of political boundaries, we rely on the grid produced by the Public Land Survey System (PLSS). Championed by Thomas Jefferson, the Land Ordinance of 1785 that created the PLSS was intended to manage the subdivision and sale of government lands west of the Appalachian Mountains (Gates, 1996). Importantly for our application, the initial subdivision of land into six-mile-wide squares (townships) was done by surveyors before the earliest known non-Indigenous settlement in the area that would become Chicago. These townships were subsequently divided into one-mile-wide squares and then made available to potential settlers (Hirt, 2015); these were further divided into quarter-mile sections (the second division); this is the grid we use as our unit of observation.

We further focus on greenfield development to minimize the chance that the initial zoning classification of land followed existing uses (Shertzer et al., 2018). To measure the diversity of subsequent land use and zoning, we use simple entropy indexes. For each quarter-section square, we calculate shares zoned for single-family residential, apartment, commercial, and industrial use in the earliest decade for which we observe zoning. Diversity is given by:

$$\sum_{i=1}^{N} s_i \ln(\frac{1}{s_i})$$

where N is the number of categories and s_i is the share of land devoted to zoning type i in the given decade. We also calculated shares devoted to actual land uses today using the same categories, plus a fifth category for townhomes, using the 2018 land use inventory from the Chicago Metropolitan Agency for Planning. The entropy index for zoning thus ranges from 0 to 1.35 and the entropy of land use today from 0 to 1.5.

To visualize the kind of variation present in the data, Figure 6 provides an aerial view of two different quarter-mile sections. Figure 6a shows a square of land contained only single-family homes and a small industrial area. This is low diversity of land use in our data. In contrast, Figure 6b contains a broad mix of single-family homes, apartments, commercial uses, and industry.

Figure 6: PLSS Illustration



(a) Entropy of post-zoning land use (low diversity)



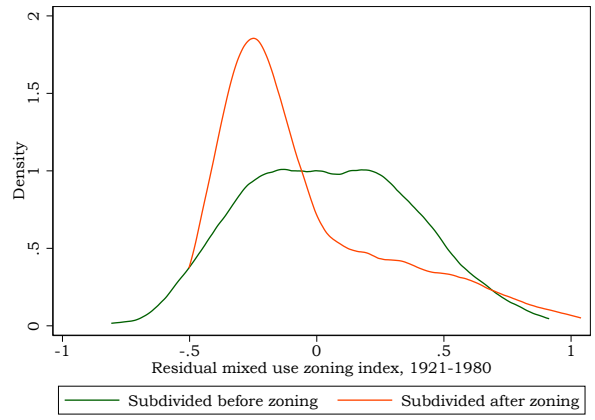
(b) Entropy of post-zoning land use (high diversity)

This figure provides a aerial view of the land use patterns of a quarter-section developed under zoning with low land use diversity in (a) and high land use diversity in (b).

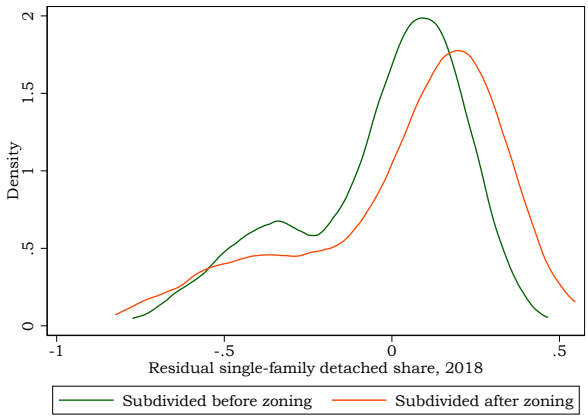
This is a high diversity of land use. Broadly speaking, land developed under zoning has a very different distribution from land that was developed prior to the adoption of such regulations. Across Cook County, the average single-family/apartment/commercial/industrial mix if zoning came before development was 80%/5%/5%/10%. But the respective land use distribution that emerged from unregulated development was 55%/15%/15%/15%. This is a strikingly different distribution of land use, particularly away from apartments and stores and towards single-family homes. The question we address in the remainder of this section is whether this difference arose because of zoning, or because of other factors specific to the timing and location of land that was developed after regulations were in place.

To provide our first piece of evidence on this point, we compare development patterns of quarter-

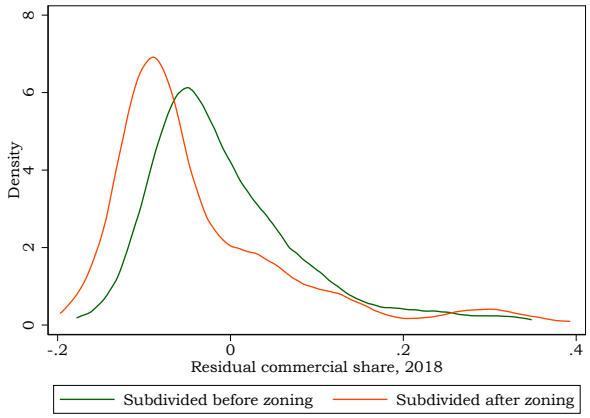
Figure 7: Impact of Zoning on Future Land Use Distribution



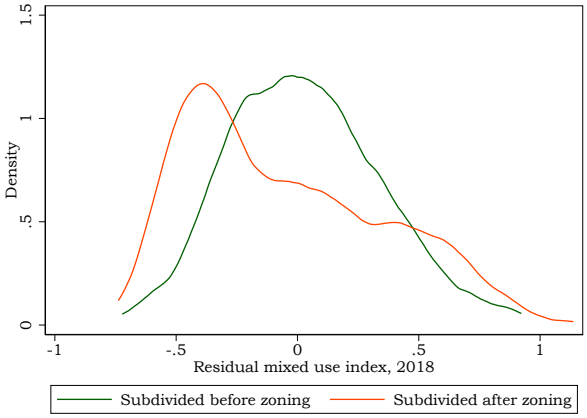
(a) Mixed use zoning index



(b) Share of land zoned for single-family homes



(c) Share of land zoned commercial



(d) Mixed land use index

Note: The outcome variable in each figure is residualized by the square's distance to the central business district of Chicago, distance to the boundary of Chicago, distance to the nearest of each zoning use type in Chicago in 1942 (industrial, commercial, apartment, townhome, and single family residential), distance to Lake Michigan, distance to the nearest major river, 1943 land value, 1940 population, 1940 Black share, and indicators for the median decade of development for parcels inside the square.

sections subdivided under zoning compared with those subdivided after zoning, residualizing for year of development, 1943 land value, 1940 population, and controls for the quarter-section's location (the square's distance to the central business district of Chicago, distance to the boundary of Chicago, distance to the nearest of each zoning use type in Chicago in 1942 (industrial, commercial, apartment, townhome, and single family residential), distance to Lake Michigan, distance to the nearest major river). The residualized density plots are visualized in Figure 7.

These density plots broadly suggest that the zoning had substantial impacts beyond what would

have been predicted by market forces. In particular, Figure 7a displays a remarkable concentration of low-diversity zoning in areas developed later, instead of the flatter distribution that emerged when zoning followed existing development. The decline in the diversity of zoning translated directly into a higher share of land reserved for single-family homes (Figure 7b) and a lower share of land reserved for commercial uses (Figure 7c). Collectively, we can see that the overall land use entropy distribution shifted to the left, representing a reduction in the diversity of land use today, relative to the distribution of land use entropy for quarter-sections subdivided before zoning (Figure 7d).

While these figures suggest shifts in development beyond what can be explained by our rich set of controls, there are limitations to making comparisons on the extensive margin, i.e., comparing places that developed before or after zoning. This comparison involves aspects of municipal decision-making that go beyond the scope of this paper. We thus turn instead to the intensive margin of zoning restrictiveness, which is possible in our data because regulated development became the norm after World War II. Specifically, we restrict our attention to quarter-sections that were only developed – that is, subdivided into parcels – after zoning regulations were in place. We then run the following regression:

$$y_i = \alpha + \beta z_i + \gamma' X + \epsilon, \tag{1}$$

where y_i is our outcome of interest. Choices for y_i include: the diversity (entropy) index of land uses in 2018 (residential, townhouse, apartment, commercial, industrial) for quarter section i; the share of quarter section i occupied by apartments in 2018; the share of quarter section i occupied by commercial uses in 2018; and the average Walkscore of the quarter section in 2023. z_i is the diversity (entropy) index of zoning for the quarter section i in the earliest year for which we observe zoning covering at least half of the quarter section. The vector X includes controls for the quarter section's distance to the central business district of Chicago, distance to the boundary of Chicago, distance to the nearest of each zoning use type in Chicago in 1942 (industrial, commercial, apartment, townhome, and single family residential), distance to Lake Michigan, distance to the nearest major river, 1943 land values, 1940 population, 1940 Black share of the population, and indicators for the median decade of development for parcels inside the square.

We argue that the unique data we have assembled allows us to give a causal interpretation to the β estimated in equation (1). Our identification argument has three components. First, we restrict the sample to quarter sections where virtually all subdivision activity occurred *after* zoning was already in place. Thus, our analysis uses only land that is essentially undeveloped, as depicted in Appendix Figure A2. The major source of endogeneity in studies of zoning's impact on contemporary outcomes is the fact that zoning typically followed pre-existing patterns of development when it was adopted; we can effectively eliminate this channel.

Second, while there is little to no pre-existing development to drive zoning, undeveloped land may still have differed in terms of its suitability for different uses. For example, industrial uses may have been more likely to locate near railroads and apartment buildings more likely to be built where underlying land values were higher. Our extensive set of controls captures key geographic and infrastructure determinants of future development, including transportation networks and location relative to the different use zones of Chicago, which should largely mitigate selection on observable characteristics of land. We also use geocoded full-count census data to measure the demographics of our quarter sections circa 1940, before the postwar building boom, and we include total population and Black share as controls. On our subdivided after zoning sample, the median 1940 population was zero individuals, and the 95th percentile population was just 66. We can compare this to the population of quarter sections where subdivision (but not necessarily building) pre-dated zoning; on that sample, we find the median population in 1940 was 438 and the 95th percentile population 3,636. Furthermore, our newly digitized data from Olcott's allows us to measure the estimated value of the predominantly agricultural land we study; these prices should capitalize the value of any other locational attributes we cannot directly measure.[13] We include quarter section median land value as a control in all of our regressions.

While we view the above two points as compelling, one could still argue that planners nonetheless correctly anticipated future development demands and tailored zoning to fit them. However, there is little evidence to suggest that planners knew what future demand would look like. Chicago's initial zoning notably allowed for far more density and industrial development than the city would ever see (Hoyt, 1933). Planners in Minneapolis in the 1920s anticipated the city would grow to a

[13]The Olcott's Blue Books are a well-known source of data on land values in the City of Chicago and its immediate inner-ring suburbs, and have been used in a number of studies. The data on agricultural land values we draw from Co., 1943 is considerably more obscure; we are not aware of any other researchers employing this data.

population of 1.5 to 2 million residents by the year 2000, and that public transit and high-density inner-city living would continue to be the dominant trend (Commission, 1953). These predictions were wildly off the mark. More importantly, there is little evidence to suggest that planners cared to tailor zoning to market demand in the first place, particularly in the suburbs. Indeed, the primary motivation of suburban zoning was to prevent the kind of development that would have occurred in the absence of regulation. *Euclid v. Ambler* arose specifically because planners attempted to stop already planned industrial development. Another Supreme Court decision invalidating a particular zoning ordinance followed two years later in *Nectow v. City of Cambridge*, which was spurred by the city's attempt to zone land for residential use in an area dominated by undesirable industrial activity. The frequency of court disputes involving zoning has been used as a way to measure the stringency of land use regulations (Ganong & Shoag, 2017). The fact that zoning routinely doesn't bend to the will of the market is arguably one of the major contributors to the current landscape of housing affordability in the United States.

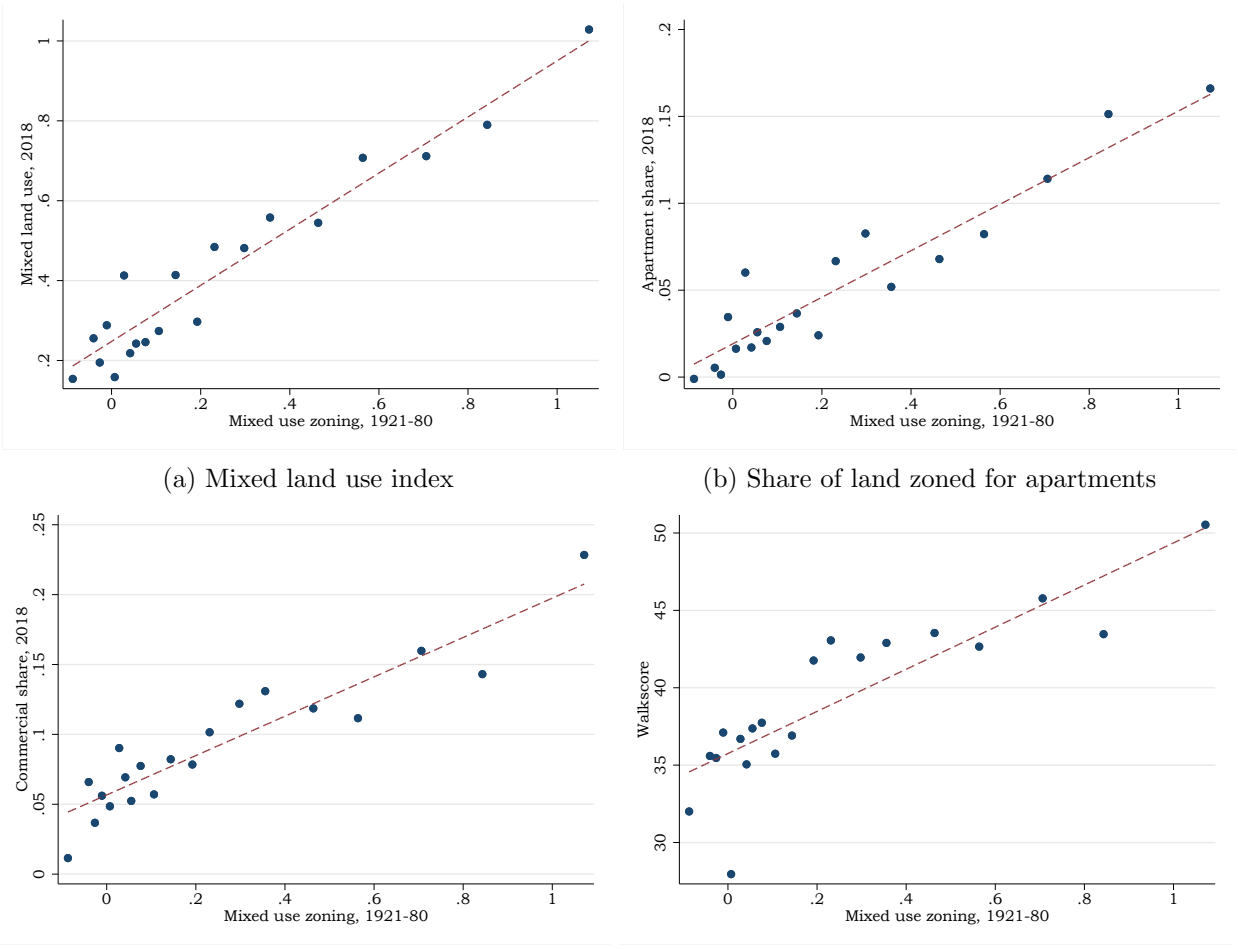
We can provide direct evidence on the previous point by estimating a modified version of equation (1). Instead of predicting future land use, we can predict historic zoning diversity itself, based on our suite of controls X:

$$z_i = \delta + \phi' X + \eta, \tag{2}$$

If zoning was intended to cater to future market demand, it should be predictable based on our controls, as long as those are correlated with this demand. We estimate equation (2) on four different samples, each reflecting a different relationship between zoning and land use. The R^2s and F-statistics from these regressions are presented in Appendix Figure A4. On the far right of these figures, we can see how effectively we predict zoning on the sample of observations where we know most development (building and subdivision) preceded zoning. This is the sample where development was largely market driven, with zoning following later on. Our controls predict zoning fairly well, as one would expect if zoning follows initial uses and our controls accurately capture the features predicting market demand. Moving to the left, we employ different samples where less and less development occurred prior to zoning. On our sample where 90% of building (but not subdivision) followed zoning, it is far less predicable. The farthest left sample is the one used in our analysis: almost all subdivision and building activity must have occurred after zoning was in

place. On this sample, zoning is essentially unpredictable, with an adjusted R^2 of just 0.02. The overall F-statistic for equation (2) is not even significant at the traditional confidence level. These results strongly suggest that zoning, when it preceded development, was not heavily influenced by market factors. They also lend credence to our argument that the controls we have assembled do effectively predict market demand factors.

Figure 8: Impact of Diverse Zoning on Future Development



(a) Mixed land use index

(b) Share of land zoned for apartments

(c) Share of land zoned commercial

(d) Median Walkscore

Note: Partial regression (FWL) binscatter plots with linear fit. Outcome and predictor variables are orthogonalized with respect to controls for the quarter section's distance to the central business district of Chicago, distance to the boundary of Chicago, distance to the nearest of each zoning use type in Chicago in 1942 (industrial, commercial, apartment, townhome, and single family residential), distance to Lake Michigan, distance to the nearest major river, 1943 land value, 1940 population, 1940 Black share, and indicators for the median decade of development for parcels inside the square. The sample is restricted to quarter sections that were at least 90% subdivided after zoning.

We now turn to exploring the impact of zoning assigned prior to development on the built

environment today. We begin with simple partial regression plots of equation (1) in Figure 8. Figure 8a visualizes the relationship between zoning diversity preceding development and an index of mixed land uses today. We see a clear upward trend, with more diversely-zoned places exhibiting much more diverse land use today, consistent with zoning having a substantial long-run impact. The rest of the figure shows sizable positive relationships between zoning diversity and the share of land set aside for commercial uses (Figure 8c), apartments (Figure 8b), and walkability (Figure 8d).

We also estimate the above equation and present the results in Table 1. Increasing the historic diversity of zoning by 1 (approximately moving from the 25th to 95th percentile) translates into a 0.7 increase in real land use diversity today, which corresponds to a move in contemporary diversity from the 25th to 75th percentile. We also see that more diverse initial zoning is associated with an increased share of land zoned for apartments and commercial uses, as well a reduction in the share of land zoned for single-family homes. Adopting the most flexible zoning we observe reduces the single family share by 41 percentage points and increases commercial and apartment shares by 27 percentage points, with the effect evenly split across these two use categories.

Table 1: Causal Impact of Zoning on Land Use

	Land use diversity, 2018		Single family, 2018		Apartment, 2018		Commercial, 2018	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Mixed use zoning, 1921-80	.7***	.71***	-.41***	-.44***	.13***	.13***	.14***	.14***
	(.051)	(.048)	(.045)	(.043)	(.023)	(.023)	(.027)	(.026)
Observations	391	391	391	391	391	391	391	391
R^2	0.39	0.34	0.38	0.19	0.24	0.14	0.19	0.10
Median of outcome	0.34	0.34	0.89	0.89	0.00	0.00	0.03	0.03
Controls	Yes	No	Yes	No	Yes	No	Yes	No
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1								

Note: Unit of observation is a quarter section. Regressions in odd-numbered columns include covariates for the quarter section's distance to the central business district of Chicago, distance to the boundary of Chicago, distance to the nearest of each zoning use type in Chicago in 1942 (industrial, commercial, apartment, townhome, and single family residential), distance to Lake Michigan, distance to the nearest major river, 1943 land value, 1940 population, 1940 Black share, and indicators for the median decade of development for parcels inside the square. The sample is restricted to quarter sections that were at least 90% subdivided after zoning.

Do these estimates reflect the impact of zoning, or the effects of other factors that were correlated

with zoning? In Table 1, we present the regression results for each outcome with and without controls. The estimates are nearly invariant to the inclusion of controls for other factors that could drive these differences, including the location and value of the land. These results together suggest that zoning regulations themselves shifted the allocation of land in the suburbs. If our estimated impacts of zoning were driven by omitted variables, these would have to be highly correlated with both historic zoning and present-day land use, but largely uncorrelated with any of the other factors we measure. As discussed above, we view this as highly unlikely.

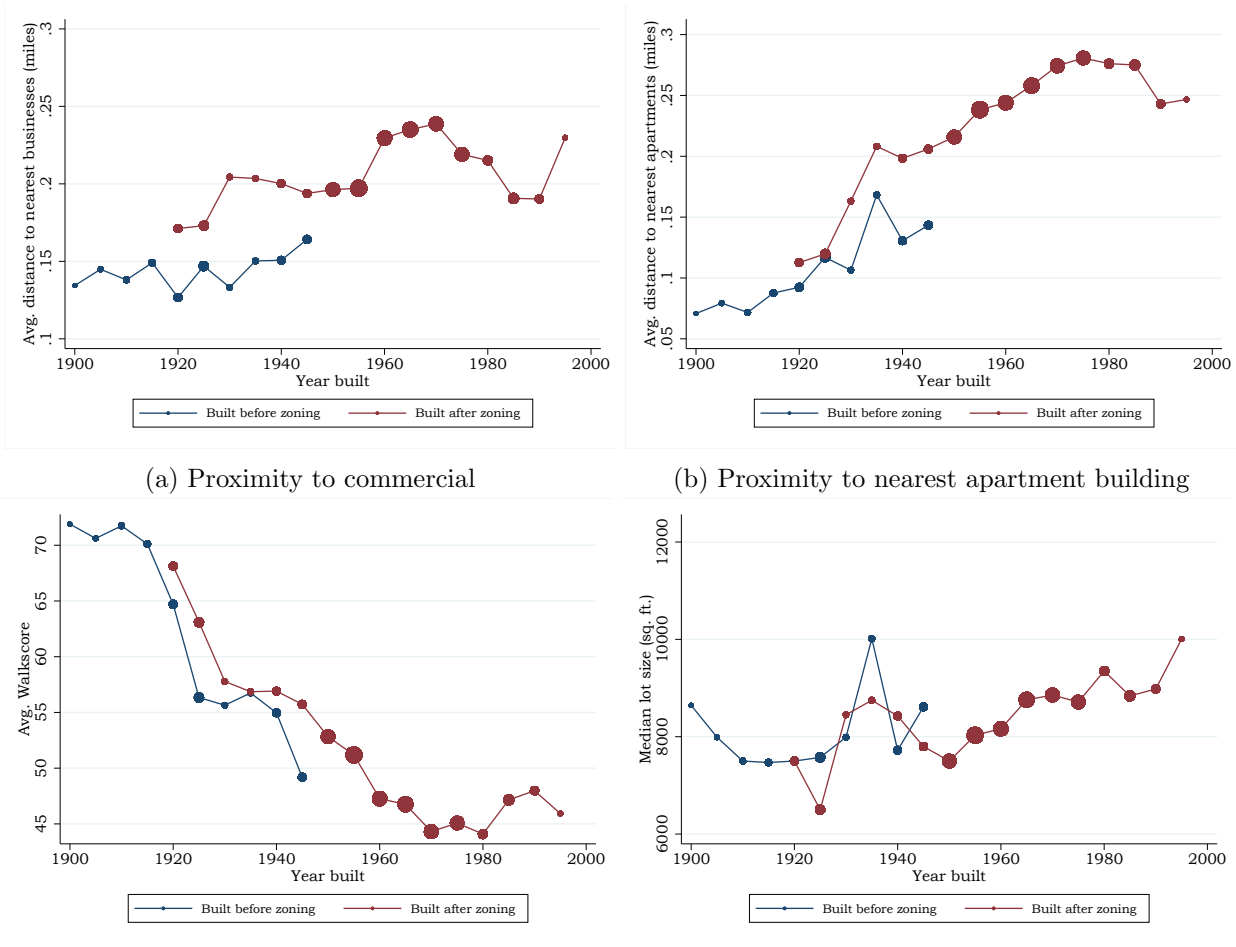
5 The Impact of Zoning on Residential Neighborhoods

We have thus far established that zoning itself shifted the distribution of land use towards single-family homes relative to the type of built environment that emerged in less restrictively regulated areas. In this section we focus on how zoning changed the built environment within all of these residential neighborhoods.

To understand the impact of zoning on residential neighborhoods, we need a strategy that allows us to disentangle the role of regulation from these broader changes in new neighborhoods being built over time, particularly as the development frontier moved further from Chicago. To visualize these trends, in Figure 9 we plot the characteristics of single-family homes in suburban Cook County today by the year in which they were built, separately for homes build under zoning or before it was adopted. The trends in commercial proximity in Figure 9a suggest that zoned residential development was generally further from the nearest store or retail establishment relative to single-family homes built in unzoned municipalities. However, the difference in average distance is about .06 miles, or 300 feet, which is not substantial, and both zoned and unzoned single-family home developments were gradually being built further from commercial uses.

We can also see that single-family homes were being built further from apartment buildings in both zoned and unzoned municipalities by the mid-1920s in Figure 9b. We similarly see declining walkability in the residential development in both zoned and unzoned municipalities in Figure 9c. The trends are very similar for this outcome, underscoring the need to also consider market explanations for changing development patterns when assessing the role of zoning. Figure 9d visualizes the trends in lot size across both regulated and unregulated development, which appear

Figure 9: Trends in Suburban Single-Family Home Characteristics by Year Built



(a) Proximity to commercial

(b) Proximity to nearest apartment building

(c) Walkability

(d) Lot size

Note: Panel (a) and (b) depict the evolution (by year built) of the median distance to nearest commercial and apartment use, respectively, for single-family homes in suburban Cook County municipalities by whether they were built before or after zoning was adopted. Commercial and apartment uses are taken from a 2018 survey by the Chicago Metropolitan Agency for Planning. Panel (c) depicts the median Walkscore for parcels by year built; this metric was taken from Walkscore.com. Panel (d) depicts the evolution of mean lot sizes for single family homes by year built (observed in 2017). Dot sizes are scaled by the number of parcels represented.

to follow each other relatively closely. Lot sizes continue to expand after World War II as unzoned development trailed off (see Figure 5).

These figures suggest a surprisingly limited role for the impact of regulation on residential neighborhoods over the prewar period, with broader market forces shaping the character of new neighborhoods whether regulations were in place or not. To explore this idea further, we consider the universe of residential subdivisions built in Cook County from 1921 (the first year of any suburban

zoning ordinance) to 1980 (the last year we treat as covered by the 1970 zoning ordinance) by their regulatory status at the time of development, which we continue to define as the date that the land was subdivided. Table 2 contains summary statistics for these subdivisions. Starting at the top of the table, zoning was associated with larger average lot sizes and reduced coefficients of variation of lot sizes within subdivisions. Lots subdivided under zoning had a median size of 10,814 square feet, while those subdivided before zoning were just 8,250 square feet. Lots subdivided *and* built up before zoning had a median size of 9,576 square feet, suggesting the potential for compositional effects. Table 2 also reports that subdivisions developed under zoning were further from the nearest commercial use (.23 versus .16 miles) and apartment building (.27 versus versus .17 miles) and less walkable.

These summary measures, while suggestive, conflate zoning with other factors that were changing residential development patterns over time. Our empirical approach aims to identify the impact of zoning on new residential subdivisions from other factors that could have shaped the built environment such as the year of development and the subdivision's location within Cook County. We first estimate the impact of zoning without controls using simple regressions relating subdivision characteristics to regulatory status at the time of development. The top panel of Table 3 reports the results of this regression with the following outcomes: subdivision average lot size, the coefficient of variation of lot size within the subdivision, average distance to the nearest commercial use, average distance to the nearest apartment building, and average Walkscore. The effect on lot size is sizeable and statistically significant while the effects on distance to nearest commercial and industrial uses are significant but economically small.

In the lower panel of Table 3 we repeat this exercise controlling for other observable characteristics of parcels, namely the year subdivision occurred as well as a vector of relevant distance variables. These include distance to the central business district of Chicago, distance to the boundary of Chicago, distance to the nearest of each zoning use type in Chicago in 1942 (industrial, commercial, apartment, townhome, and single family residential), distance to Lake Michigan, distance to the nearest major river, and the value of land as measured in 1943. These controls are the most important determinants of the kind of residential development that would be delivered by market forces. The estimated effect of zoning is remarkably robust to the inclusion of controls in the regression, particularly for average lot size in the subdivision. Having a zoning ordinance in

Table 2: Summary Statistics for Subdivisions, 1921-1980

	Subdivided after zoning	Subdivided before zoning	Subdivided & built before zoning
Actual lot size:			
▷ Average	10,814	8,250	9,576
▷ Median	9,000	6,730	7,798
CV of lot size:			
▷ Average	0.13	0.21	0.20
▷ Median	0.10	0.20	0.18
Dist. to commercial use in 2018:			
▷ Average	0.23	0.16	0.14
▷ Median	0.20	0.12	0.11
Dist. to apartments in 2018:			
▷ Average	0.27	0.17	0.16
▷ Median	0.21	0.12	0.11
Walkscore in 2023:			
▷ Average	47	55	57
▷ Median	48	56	58
Total number	6,702	1,186	305

Note: Summary statistics for residential subdivisions in Cook County; subdivisions contain an average of 27 individual parcels. Includes only subdivisions that are eventually incorporated or annexed into a suburban municipality, and excludes any subdivisions that were created on unincorporated land after the Cook County zoning ordinance of 1940 took effect. The "subdivided after zoning" column includes only subdivisions for which every parcel was subdivided after all parcels were subject to zoning. The "subdivided before zoning" column includes only subdivisions for which every parcel was subdivided before any were subject to zoning. The "subdivided & built before zoning" column includes only subdivisions for which every parcel was subdivided and at least 75% of parcels had homes constructed on them before being subject to zoning.

Table 3: Zoning and Prewar (1921-1945) Subdivision Characteristics

	Avg. lot size (1)	CV lot size (2)	Dist. to com (3)	Dist. to apt (4)	Dist. to ind (5)	Avg. Walkscore (6)
Subdivided after zoning	1,204.11**	-0.02**	0.03	0.00	0.15***	1.68
	(472.78)	(0.01)	(0.02)	(0.02)	(0.04)	(1.89)
Observations	680	660	680	680	680	680
R^2	0.02	0.01	0.01	0.00	0.03	0.00
Controls	No	No	No	No	No	No
Subdivided after zoning	1,494.32***	-0.04***	0.03	0.02	0.07*	0.43
	(472.67)	(0.01)	(0.02)	(0.02)	(0.04)	(1.38)
Observations	673	654	673	673	673	673
R^2	0.32	0.15	0.19	0.22	0.50	0.34
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Note: Unit of observation is a subdivision, which may contain multiple parcels. In both panels, we restrict to subdivisions platted between 1921 and 1945. We further restrict to subdivisions created within 5 years of zoning implementation. In panel the top panel, there are no additional covariates besides an indicator for whether or not the subdivision occurred under a zoning law. In the lower panel, we additionally include covariates for distances to the CBD of Chicago, the boundary of Chicago, the nearest of each zoning use type in Chicago in 1942, Lake Michigan, and the nearest river, as well as indicators for the year that subdivision began (which is typically the year most parcels were subdivided within each subdivision). Standard errors are clustered at year of subdivision.

place was associated with average lot sizes that were 1,494 square feet larger relative to subdivisions in unzoned municipalities, an increase of 19% relative to the pre-zoning mean. The effects of zoning on other aspects of prewar subdivisions were small however, with a zoning ordinance associated with just a .03 mile (150 feet) further distance to the nearest store. These results suggest that zoning explains little of the changes in the built environment of prewar neighborhoods beyond lot size.

We also explore the intensive margin impact of zoning in the postwar era, when unzoned development was gradually disappearing. Specifically, we focus on the relationship between minimum lot size regulations and the built environment from 1945 to 1980 in municipalities that adopted comprehensive zoning ordinances. In Table 4 we report the relationship between the log of average MLS with respect to the same set of characteristics of the built environment, again without (top) and with (lower) controls for year of development and location within Cook County. The inclusion of controls reduces the estimated elasticity of average MLS with with respect to average lot size from .54 to .48. The relationship between log average MLS and the other characteristics of the built environment is reduced by about half with controls. As we may expect, larger MLS requirements affected other aspects of the built environment. Doubling the MLS reduces the Walkscore by about

Table 4: Zoning and Postwar (1945–1980) Subdivision Characteristics

	Log avg. lot size (1)	Log dist. to com (2)	Log dist. to apt (3)	Log dist. to ind (4)	Avg. Walkscore (5)
Log avg. MLS	0.54***	0.56***	0.71***	0.62***	-16.35***
	(0.03)	(0.05)	(0.06)	(0.06)	(0.95)
Observations	5,784	5,777	5,700	5,784	5,784
R^2	0.17	0.04	0.05	0.05	0.10
Controls	No	No	No	No	No
Log avg. MLS	0.48***	0.33***	0.34***	0.39***	-6.64***
	(0.03)	(0.05)	(0.05)	(0.06)	(0.97)
Observations	5,749	5,742	5,665	5,749	5,749
R^2	0.27	0.11	0.17	0.26	0.25
Controls	Yes	Yes	Yes	Yes	Yes

Note: Unit of observation is a subdivision, which may contain multiple parcels. In both panels, we restrict to subdivisions platted after 1945 (inclusive) and subject to a minimum lot size. We exclude subdivisions with a greater than 15,000 square foot MLS (top 5% of the sample), as these areas were significantly more rural in character. In the top panel, there are no additional covariates besides the natural log of average MLS. In the lower panel, we additionally include covariates for distances to the CBD of Chicago, the boundary of Chicago, the nearest of each zoning use type in Chicago in 1942, Lake Michigan, and the nearest river, as well as indicators for the year that subdivision began (which is typically the year most/all parcels were subdivided within each subdivision). Standard errors are clustered at year of subdivision.

7 points (the average Walkscore for this sample is 48). Stores and apartments were also on average further away from single-family homes with larger MLS requirements.

Taken together, the robustness and magnitude of the effect on lot size strongly suggests that zoning impacted the built environment of suburbs beyond what we would have expected from the expanding urban frontier and forces in the private market. However, both zoned and unzoned developing were become less diverse and walkable as early as the 1920s. These results underscore the powerful incentives faced by developers to build detached single-family homes in exclusively residential neighborhoods.

6 Measuring Minimum Lot Size Regulations in the Past

The data work in this paper required a years-long archival effort and the existence of an unusually well-equipped county GIS office. It would thus be extraordinarily difficult to replicate this approach for a broader sample of metro areas. Yet zoning – particularly for minimum lot sizes – has become central to many housing policy debates, and researchers will continue to demand better data on

these regulations. We close the paper by considering what we can learn from our setting, in which nearly everything was observed, to inform research on broader geographic contexts.

First, recall that the date that land was subdivided is rarely observed and was often decades before houses were built on the resulting parcels. To illustrate why this is a challenge for identifying the impact of rezoning, we demonstrate how easy it is to "estimate" an economically meaningful effect of zoning when these regulations had little scope for impact. Consider our baseline estimate of the impact of mixed-use zoning on the diversity of the built environment today from the first column Table 1. The effect of .7 is identified from greenfield development, that is, quarter sections that were not subdivided before zoning was adopted. We repeat this estimate in the first column of Table 5. In column (2), we run the same regression on quarter sections that were subdivided when zoning was adopted by not yet built up. In these areas, zoning could still have had some scope for impact. The coefficient is .65 and significant at the one percent level.

We then restrict the sample to quarter sections where zoning could *not* have had much of an impact, namely because land was already developed. In column (3) we restrict attention to quarter sections that were subdivided before zoning was adopted in the municipality. Zoning still appears to have an economically important albeit attenuated impact on land use diversity today. In column (4) we consider only quarter sections that were almost entirely developed, that is, subdivided and built up, prior to the adoption of zoning. Even in these areas we "estimate" a significant effect of zoning that is very similar to the well-identified estimate. But zoning had virtually no scope to impact the diversity of land use in these areas. These results underscore how difficult it is to credibly estimate effects of zoning when these regulations are almost always designed around existing development. In other contexts, researchers simply cannot observe whether regulation or land subdivision came first. We emphasize that information on the year a house was built transaction records does not solve this problem because this date may be decades after the lots were drawn.

The difficulties of measuring timing manifest across approaches to estimate the impact of zoning. One increasingly common approach to measuring past lot size regulations without an archival data effort is to impute these zoning parameters from contemporary lot sizes and the date of construction of houses. Several recent papers use such approaches to consider the impact of minimum lot sizes on various outcomes such as home prices and racial segregation (Cui, 2024; Macek, 2024; Song, 2025; Zabel & Dalton, 2011). These papers estimate minimum lot size regulations using discontinuities

Table 5: Causal and "Causal" Effects of Zoning

	Land use diversity, 2018			
	(1)	(2)	(3)	(4)
Mixed use zoning, 1921-80	.7***	.65***	.46***	.63***
	(.051)	(.041)	(.051)	(.061)
Observations	391	615	326	89
R^2	0.39	0.37	0.47	0.83
Med. 1940 population	0	4	580	1,881
Controls	Yes	Yes	Yes	Yes
Subdivided after zoning	Yes	No	No	No
Built after zoning	No	Yes	No	No
Subdivided before zoning	No	No	Yes	No
Built before zoning	No	No	No	Yes
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1				

Note: Unit of observation is a quarter section and only the portion which is zoned. All regressions include covariates for the quarter section's distance to the central business district of Chicago, distance to the boundary of Chicago, distance to the nearest of each zoning use type in Chicago in 1942 (industrial, commercial, apartment, townhome, and single family residential), distance to Lake Michigan, distance to the nearest major river, 1943 land value, 1940 population, 1940 Black share, and indicators for the median decade of development for parcels inside the square.

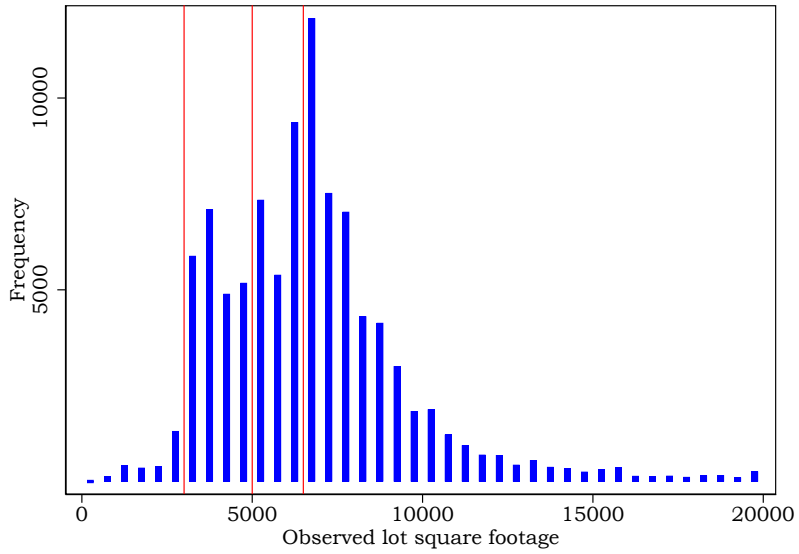
in the distribution of lots sizes across some area observed in property tax records or other national datasets. The intuition is that lot sizes will "bunch" to the right of binding minimum lot sizes, making it possible to detect such regulations using econometric methods. What can we learn from our setting to guide the interpretation of these more indirect approaches?

The primary difficulty with these approaches that we have very little understanding of what unregulated development would have looked like at the same time and place. Put differently, how lumpy would the lot size distribution be if private developers had subdivided the land before zoning ordinances were in place? An advantage of the dataset we have assembled for Cook County is that we can gain intuition on precisely this question as well as the distribution of lot sizes for neighborhoods platted before zoning. Because it is infeasible to reconstruct the parcel subdivision timeline and the complete history of maps and bylaws at a national level as we have done for Cook County, imputation methods will remain important for future work. Our goal here is to better understand what today's lot size distribution can tell us about the regulations of the past.

We begin with the top panel of Figure 10, which visualizes the distribution of lot sizes for all homes built in the 1950s across incorporated suburbs of Cook County. We see a substantial degree of "bunching" to the right of common MLSs such as 3,000, 5,000, and 6,000 square feet. Do these jumps in the distribution reflect regulation? Since we can observe the date of subdivision and match it to the regulations in place at the time, we can repeat this exercise restricting to homes built on parcels that were subdivided *before* zoning was adopted in the municipality. We see even more pronounced bunching around the same three minimum lot sizes. Because these lots were all subdivided before zoning was present, this bunching around round numbers is solely the result of developer choices.

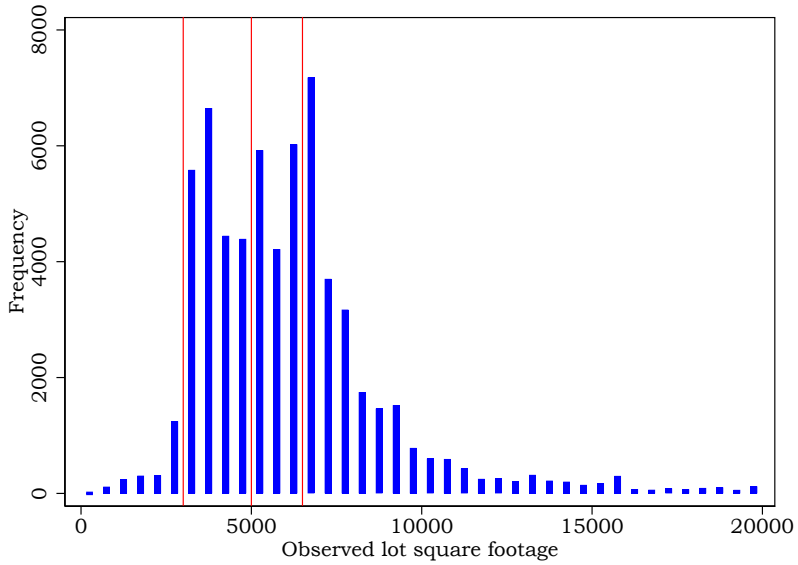
Why do lot sizes chosen by private developers exhibit this same bunching around round numbers? Advertisements in newspapers at the time reveal that developers often stated sizes of lots they were selling to aspiring homeowners. It was likely more appealing to subdivide land evenly and advertise "new homes on 5000 square foot lots!" rather than advertise lots of slightly smaller dimensions, appealing to the converse of the marketing logic that guides price setting. There is also ample historical evidence to suggest that developers intended to market their developments to buyers of a certain class. Uniformly large lots were one of many tools used to exclude lower-income households, and particularly African-American households, from these communities.

Figure 10: The Distribution of Lot Sizes for Suburban Homes Built in 1950s



(a) All houses built 1950s

Note: $N = 97,218$ parcels built in the 1950s. Red lines represent 3 common MLS values of 3,000, 5,000, and 6,000.



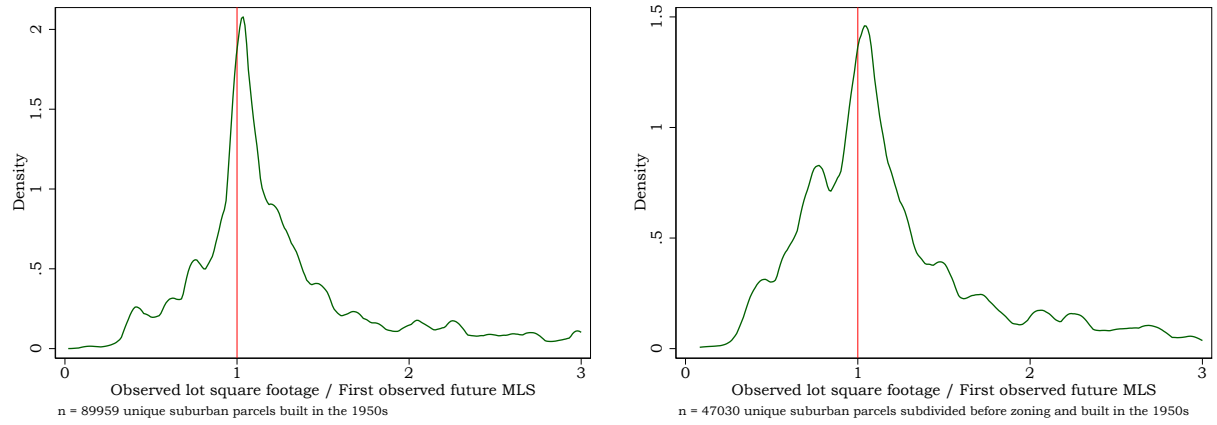
(b) Houses on lots subdivided before zoning

Note: $N = 63,457$ parcels subdivided before they were zoned and built in the 1950s. Red lines represent 3 common future MLS values of 3,000, 5,000, and 6,000.

If developer lot size choices bunch around common round numbers to a similar extent whether regulations were in place or not, what can economists learn about regulation from the current built environment? In the top panel of Figure 11, we plot the ratio of observed lot sizes to either the

minimum lot size in place at the time, or the first future minimum lot size to be adopted for that parcel if it was subdivided before zoning, for all homes built in the 1950s. As expected, we see the most mass at 1, consistent with lot size regulations being binding. However, if we reproduce the same plot for only parcels that were subdivided before zoning was adopted and compute the ratio of lot sizes to the *future* MLS, we see almost the same degree of mass around 1 (right panel of Figure 11). This figure is consistent with what we know about historical land use regulation from the city of Chicago (Shertzer et al., 2018), which is that zoning often followed existing land use patterns.

Figure 11: Minimum Lot Size Regulations Followed Earlier Subdivision



(a) Built in 1950s, first observed MLS

(b) Subdivided before zoning, future MLS

Put differently, minimum lot sizes can appear binding either because they were, or because regulations were designed to match existing subdivision, which frequently featured lot sizes of particular round numbers. Although it is difficult to detect whether the lot size distribution is driven by regulation or private markets, they are an important part of the built environment and worthy of further study, particularly because they are very costly to change (Brooks & Lutz, 2016).

7 Conclusion

In this paper, we construct the first panel dataset of zoning regulations and introduce the resulting Cook County Longitudinal Zoning Database. The dataset we have assembled for this paper represents a new opportunity to investigate the impact of land use regulation on the development of suburbs. In particular, we demonstrate the importance of observing the timing of the various forces

that operated on undeveloped land. Areas that were developed before zoning was adopted have smaller residential lots and more mixed uses relative to those developed under zoning. We argue that zoning drove much of this shift in the built environment and changed suburban form relative to what the market would have provided, even in the presence of strong demand for car-centric, low-density residential neighborhoods.

Zoning remains a critically important area of future research, although substantial obstacles have held back our understanding of the impact of these policies over the long run. Challenges for future work include developing methods to recover historical regulations related to allowable land uses, which to our knowledge has never been attempted. The results of this paper suggest that zoning was used to purge commercial uses and apartments from the suburbs, but this idea should be explored in other contexts beyond Chicago. A final challenge in this area is that wide gaps between the date a parcel was platted and the date a home was actually constructed may exist in many historical settings. The difficulty of observing subdivision dates on a large scale is an important consideration for research on lot sizes.

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A Appendix

A.1 Cook County Longitudinal Database Construction

The Cook County Longitudinal Database (CCLD) was constructed from numerous primary and secondary sources. Official records sourced directly from municipalities or academic and public libraries were used when available. Archives of local newspapers, which often printed zoning ordinances (including amendments) and zoning maps, were also an important source of official information, particularly for the earlier years of our study period. Another source of zoning laws was a three-volume collection of official suburban Cook County zoning ordinances as of May 1991/92 published by the Index Publishing Corporation. Information from these volumes was used in instances when a municipality's zoning ordinance in place as of 1991/92 reflected an older (unchanged) ordinance relevant to our study period. Secondary sources for zoning data were used to populate the remainder of the database when primary sources such as the official records were unavailable. These sources included various historic compendiums distributed by Geo. C. Olcott & Co. publishers, most notably editions of its *Olcott's Land Values Book of Chicago*, *Olcott's Land Values Blue Book of Cook County*, and *Chicago Zoning Ordinance and Zoning Maps* publications, each of which provides detailed information on select Cook County suburbs' zoning ordinances.

A suburban zoning ordinance at any given period in time consists of two separate components: the bylaws and the map. For our purposes, an ordinance's bylaws make up the explicit language outlining use parameters for any given parcel of land within the municipality's corporate boundaries. Use parameters are typically organized by zoning district. The aspects of an ordinance's bylaws most important to our study include:

- The establishment of individual and mutually exclusive zoning districts with the municipality,
- The numerous land-use restrictions unique to each zoning district (e.g., allowed uses, minimum lot size requirements, height restrictions, etc.), and
- The range of dates when a particular set of bylaws were in effect

The zoning ordinance's zoning map outlines how the ordinance's bylaws are distributed across space. These maps are typically very straightforward and depict the physical boundaries for each zoning district within the municipality. Additional information often included in a map is the publication date, the dates of revision, ordinance numbers linked to particular revisions, and brief summaries of the bylaws.

We digitized an ordinance's maps and bylaws with the goal of constructing a database that will allow us to observe the zoning parameters assigned to any particular parcel of land on any given date within our study period, 1921–1980. We start by digitizing all relevant bylaws from each municipality's first zoning ordinance (if available). We then repeat this exercise for every subsequent comprehensive zoning amendment known to have passed during or after our project's

study period.[14] Making use of an ordinance's precise start and end dates allows us to construct a database that observes the near-continuous evolution of an individual municipality's zoning bylaws over time.

As noted above, a zoning ordinance's map allows us to observe how the numerous restrictions outlined within a set of bylaws vary across space at a particular point in time. However, maps can change shape even when the underlying bylaws do not; this is most often due to municipal annexation of new territory or individual parcels or tracts of land being rezoned upon request of individual land owners. The CCLD therefore relies on observing a series of snapshots over time of a municipality's zoning map in order to observe the spatial-temporal evolution of its zoning bylaws. For municipalities first zoned in the 1920s, we digitized the zoning map as it would have looked around the time that the first zoning ordinance passed. For all subsequent periods, we digitized the map's shape as it would have been in the years centered around 1940, 1950, 1960, and 1970.[15]

Individual zoning maps were typically digitized by overlaying their images (either digitally through georeferencing techniques or visually) onto a set of baseline maps, such as contemporary land parcel and street grid maps, to help us identify nuanced spatial variation in historic zoning boundaries. Figure A2a and Figure A2b provide a brief example of our map-digitization technique, which often involved overlaying the original map onto the contemporary street grid.[16] Once the maps for a particular snapshot period were digitized, a municipality's relevant bylaws were merged to their corresponding map using a unique zoning district identifier.

We took special care to ensure that the map digitized for a particular snapshot period was relevant to the merged bylaws and vice versa. This is a particularly important step in instances when a major change to a municipality's bylaws occurred within the snapshot window (i.e., +/- 4 years from the year ending in 0). For example, if a comprehensive amendment to a municipality's zoning ordinance was passed in 1961, the new bylaws accompanying this revision would be assigned to the 1960 snapshot period (because the revision fell within +/- 4 of 1960). We would then take steps to make sure that the 1960s-era map merged to these bylaws reflected a period on/after the new ordinance's 1961 date of passage and not, for example, a 1959 map.

Table A1 provides tabulations summarizing the CCLD's degree of comprehensiveness across individual suburban municipalities for each snapshot period. The second column gives the count of incorporated suburbs within Cook County for the respective snapshot period. The third column reports the number of these municipalities that were zoned at the time. The last two columns of Table A1 report our progress towards digitizing the numerous maps and bylaws for each of these zoned municipalities. It is clear from this table that the CCLD achieves near-comprehensive

[14] The dates (and ordinance numbers) of particular amendments are typically documented within the language of the bylaws themselves, which considerably eased our data collection efforts by allowing us to make precise public record requests to a municipality for copies of the official records when needed.

[15] We rely on source maps dated as close as possible to the year ending in '0' when digitizing maps for 1940/50/60/70. We typically allow for a window of time of no more than +/- 4 years (centered around 1940/50/60/70) when choosing source maps to digitize. For example, we made every attempt to use maps dated no later than 1964 and no earlier than 1956 to construct the municipality's "1960-era map."

[16] The bylaws themselves also often provided official language describing a map's unique boundaries, particularly in earlier years when maps were less complex and therefore easy enough to describe using legal descriptions of land.

coverage of the suburban zoning landscape (map and bylaws) for each of the snapshot periods.

Table A1: Municipality-Level Summary Tabulations: Cook County Longitudinal Database

Snapshot Period	Municipalities	Zoned	Map Digitized	Bylaws Digitized
1920	87	43	35	42
1940	90	65	61	64
1950	99	89	85	83
1960	119	116	112	112
1970	122	122	115	116

Table A2 reports basic municipality-level summary statistics from the CCLD. While these statistics do not account for variation in land mass or population across suburbs, these values point to a suburban landscape dominated by low-density zoning restrictions. The average zoned municipality in the 1920s allocated 67% of its land towards single-family uses and only 16% of its land towards multi-family apartment uses. While average share of land zoned for single-family uses fell to 59% by the 1970s the average share allocated towards aparment uses fall to just 6%.

Table A2: Municipality-Level Summary Statistics: Cook County Longitudinal Database

		Mean Land Share Zoned for:					MLS per HH (sq. ft.)	
Snapshot Period	N	Single Family	Duplex	Apartment	Commercial	Industrial	Mean	Median
1920	35	0.67	0.02	0.16	0.08	0.06	5,811	4,993
1940	61	0.67	0.01	0.11	0.08	0.11	6,731	6,128
1950	81	0.62	0.04	0.08	0.07	0.15	6,971	6,133
1960	111	0.64	0.04	0.04	0.07	0.17	13,008	6,481
1970	114	0.59	0.04	0.06	0.08	0.19	12,619	6,345

Note: Individual municipality-level observations are not weighted when calculating summary statistics. All values reflect simple averages/medians across municipality-level observations. Zoning district land area shares do not necessarily sum to one because zoning districts for more minor uses (e.g., public, parking, forest preserve, etc.) are not included. A municipality's minimum lot size per household is calculated for residential districts only (i.e., single-family, duplex, or apartment districts) and weighted by individual districts' land areas. The sample is limited to zoned municipalities where *both* the zoning bylaws and zoning map are known.

Table A3 provides a deeper look into the CCLD by summarizing patterns across individual zoning districts. The first set of columns reports the share of all zoned suburban land assigned to each major land use. These values reveal a suburban regulatory environment where single-family zoning was dominant, accounting for approximately two-thirds of zoned suburban land in each of the CCLD's snapshot periods. Table A3 also shows that the minimum lot size required per household within the median residential district increased considerably over time, rising 50% from 5,000 square feet in the 1920s to 7,500 square feet around 1970. These patterns are investigated in the paper.

Figure A1 gives a visual summary of the municipal zoning landscape for each of the five "snapshot" periods included in the CCLD. The suburban municipalities incorporated during the respec-

Table A3: Zoning District-Level Summary Statistics: Cook County Longitudinal Database

	Land Share Zoned for:					MLS per HH (sq. ft.)	
Snapshot Period	Single Family	Duplex	Apartment	Industrial	Commercial	Mean	Median
1920	0.61	0.04	0.18	0.10	0.07	5,310	5,000
1940	0.64	0.02	0.13	0.09	0.12	6,388	6,223
1950	0.65	0.04	0.08	0.07	0.15	6,914	6,250
1960	0.67	0.04	0.04	0.07	0.17	32,182	7,260
1970	0.65	0.03	0.06	0.08	0.19	29,581	7,500

Note: Zoning district land area shares do not necessarily sum to one because zoning districts for more minor uses (e.g., public, parking, forest preserve, etc.) are not included. Statistics for minimum lot size per household are calculated for residential districts only (i.e., single-family, duplex, or apartment districts) and weighted by a zoning district's land area.

tive period of each map are identified as either "zoned" or "unzoned." Zoned municipalities are further stratified based on whether or not we were able to successfully digitize their zoning map for that particular period. The city of Chicago is outlined in blue within each map. The outer boundary (in black) outlines Cook County. Altogether, these maps depict an expanding suburban landscape that was evenly split between "zoned" and "unzoned" in the 1920s but within which zoning became nearly universally adopted by existing municipalities by 1950. The county's suburban land was almost fully covered by a zoned municipality's unique zoning regulations by the early 1970s.

A.2 Building a Parcel-Level Dataset

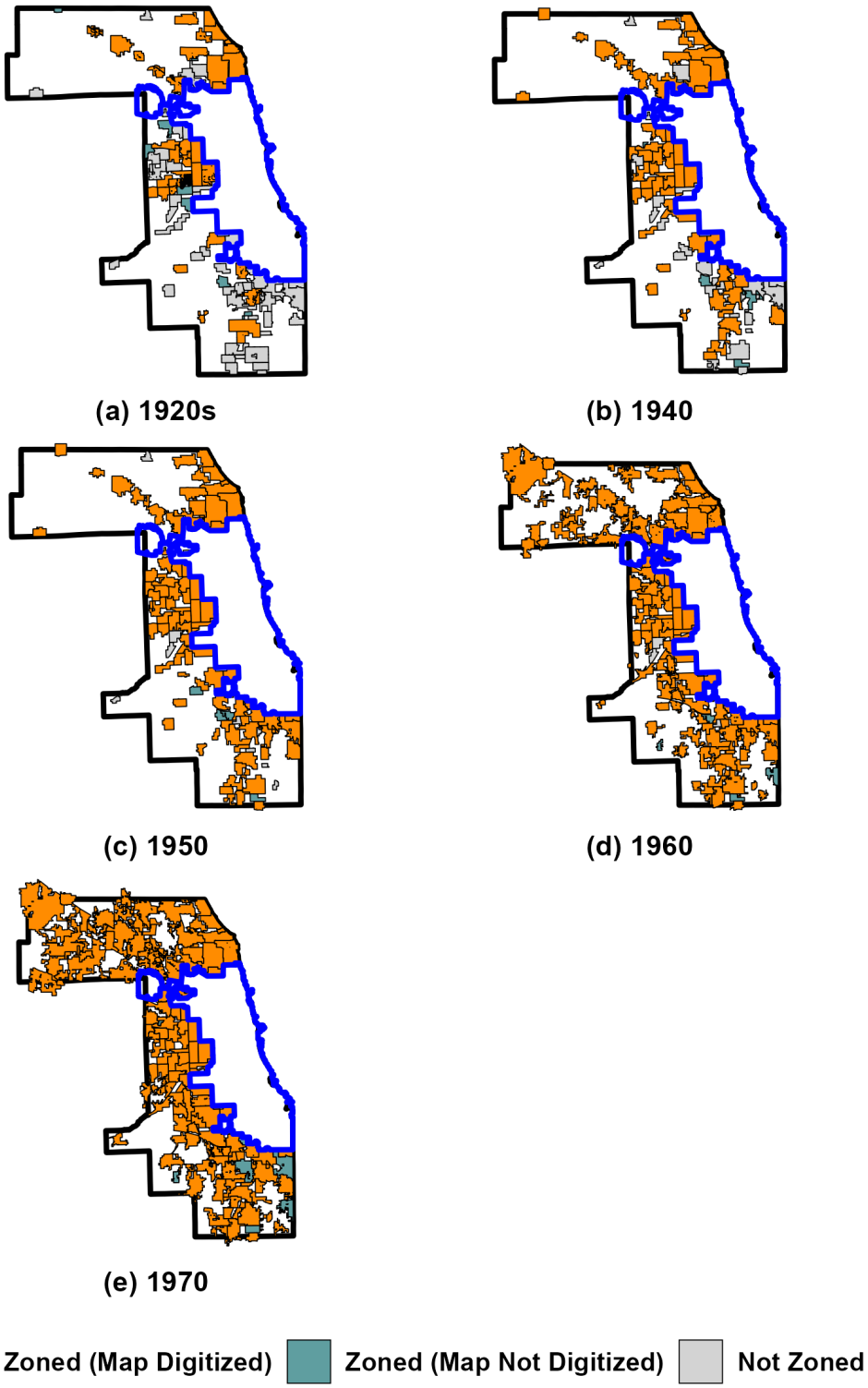
Data contained in the digitized zoning maps are assigned to individual suburban land parcels using a multi-step process involving numerous data files. We begin with a GIS shapefile of all Cook County land parcels as of 2017. This file is distributed by Cook County's GIS department and provides the exact location and shape for each parcel. We merge this GIS file with another file provided by the Cook County Assessor's office that provides the classification code and age for each parcel as of 2016.[17] This allows us to distinguish residential and nonresidential parcels as well as identify parcels used for single-family residential purposes.

We merge the parcel file with two additional publicly-provided shapefiles in order to assign each parcel its most recent date of subdivision and date at the time of subdivision. The subdivision shapefile (along with its accompanying attribute file) was obtained through a public records request to Cook County's GIS office. This file identifies the shape and location of individual subdivision plats as they were in 2017 as well as the exact date the plat was officially recorded within the county clerk's office. We use this shapefile to assign the exact date of the most recent subdivision to each individual parcel.[18] A parcel's date of subdivision is of particular importance to our study because

[17] Detailed characteristics beyond assessor classification codes and age are available for residential properties but are not used in our analysis. A property's age is set to "NA" for open undeveloped land and set to "NA". Tax-exempt properties, which are often publicly owned, are dropped.

[18] We assign parcels their earliest-observed date of subdivision in the rare case that a single parcel overlaps multiple

Figure A1: Digitized Zoning Maps



Note: See text for details regarding how these maps were constructed. Whitepsace outside of the city of Chicago identifies unincorporated suburban land.

a zoning ordinance's language regulating lot size almost always references the date of subdivision as the key cutoff date for determining whether or not the associated regulations stipulated within the ordinance are binding or not. Parcels subdivided prior to the passage of a particular zoning ordinance were almost always "grandfathered in" within the ordinance's nonconforming use clause, thus allowing their size and shape to remain in place. However, parcels subdivided after the zoning ordinance's passage were required to comply with the new ordinance's lot size restrictions, among other regulations outlined within the ordinance's bylaws.

The second shapefile, Cook County's Municipal Incorporation Inventory (MII), is a unique resource that documents the nearly-complete history of municipal incorporation/annexation activity within the county. Just like private real estate subdividers, individual municipalities are required to file a plat of incorporation/annexation with the county clerk's office for official record-keeping purposes. The MII is the product of an ambitious undertaking whereby Cook County set out to digitize the complete history of these municipal plats. The MII, like the subdivision shapefile, identifies the shape and location of nearly all historical municipal incorporation/annexation plats as well as their official date of record. We spatially merge our parcel file to the MII in order to assign each parcel the date at which it was annexed to whichever municipality would have had authority to restrict its development at the time that it was subdivided (if it was under the authority of a particular municipality at the time that it was subdivided). Unlike the subdivision shapefile, it is not uncommon for a single parcel to overlap multiple municipal incorporation/annexation features contained within the MII shapefile. This is because the MII was built with an eye towards documenting the complete history of municipal boundary changes over time, which often leads to overlapping plats across different periods of time. For example, it was not uncommon for a piece of land to be annexed to one municipality, disconnected from that municipality at a later date, and then re-annexed into another municipality at a later date. Timelines such as these introduce considerable complexity to the structure of the data once the MII and parcel file are spatially merged. The steps outlined below were taken in order to assign to each parcel the incorporation/annexation date that would be most appropriate for determining which municipality's zoning ordinance would have been binding at the time that the parcel was subdivided.

For parcels overlapping only a single MII feature:

1. We assign the incorporation/annexation date associated with that particular MII feature.

For parcels overlapping multiple MII features:

1. If the subdivision date precedes *all* overlapping incorporation/annexation dates, we assign the latest incorporation/annexation date. This parcel was not subject to any municipal zoning ordinance at the time of subdivision so this date is irrelevant to assigning any zoning ordinance that would have been in place at the time of subdivision.

2. If the subdivision date precedes all but one incorporation/annexation date, we assign the latter as the incorporation/annexation date date. This particular incorporation/annexation

subdivision plat features.

date date (and the associated municipality) is the only one that would have been associated with a potentially-binding municipal zoning ordinance at the time of subdivision.

3. If the subdivision date comes after multiple incorporation/annexation date dates, we assign the latest of these incorporation/annexation date dates, as this date is most likely aligned with whichever municipality the parcel belonged to at the time that it was subdivided. These parcels reflect cases where they initially belonged to one municipality, were then disconnected from that municipality, and then re-annexed into another municipality after which they were eventually subdivided, perhaps under the latter municipality's binding zoning ordinance if one was in place at the time.

Once each individual parcel is assigned its appropriate subdivision and incorporation/annexation dates, the full parcel file is merged with the full collection detailed zoning maps included in the CCLD. This is done separately for each CCLD snapshot period (see Figure A1). We then append these files. In order to avoid problems associated with small boundary errors in our digitized zoning maps, we keep only those parcels that, within a snapshot period, overlap at most one zoning district. We then determine the date that a parcel was zoned by interacting the date that it was incorporated/annexed into its municipality with the date the municipality itself was first zoned. The algorithm is straightforward:

- If date(muni zoned) $<$ date(parcel inc/anx into muni) $\Rightarrow$ date(parcel zoned) = date(parcel inc/anx into muni)
- If date(muni zoned) $>$ date(parcel inc/anx into muni) $\Rightarrow$ date(parcel zoned) = date(muni zoned)
- Parcel observations overlapping zero zoning districts for a particular time frame receive "NA" for date(parcel zoned)

The next step involves assigning parcels the zoning regulations that would have been in place at the time of subdivision, if observed. We accomplish this by separating the parcel file into three mutually exclusive sub-files based on whether or not a parcel was zoned at the time of subdivision and, if zoned, whether or not we observe the detailed map/bylaws that were in place at the time of subdivision (the bylaws regulating a particular parcel at the time that it was subdivided are only known if the detailed zoning maps has also been digitized).

The three files and the underling conditions for a parcel's inclusion within each respective file are:

- **Parcels Zoned when Subdivided: Associated Bylaws are Known**
  1. date(parcel subdivided) $\geq$ date(parcel zoned),
  2. date(bylaws begin) $\leq$ date(parcel subdivided) $\leq$ date(bylaws end), and

3. if multiple parcel × map snapshot observations still exit (which is common for municipalities that do not regularly update their bylaws), keep the the observation associated with the earliest-observed map snapshot.

- **Parcels Zoned when Subdivided: Associated Bylaws are Unknown**

  1. date(parcel subdivided) ≥ date(parcel zoned) and
  2. date(parcel subdivided) ≤ min(date bylaws begin)

- **Parcels Not Zoned when Subdivided**

  1. year(parcel subdivided) < 1921 *or* date(parcel subdivided) < date(parcel zoned)

We append these three files to construct the parcel-level file. Table A4 provides basic summary tabulations.

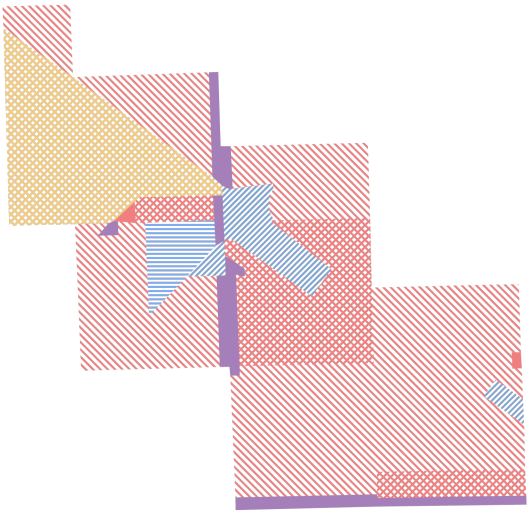
Table A4: Summary Tabulations of Parcel-Level File

Observation Type	Frequency
Not Zoned	332,886
Zoned(Known)	207,680
Zoned(Unknown)	28,522
Total	569,088

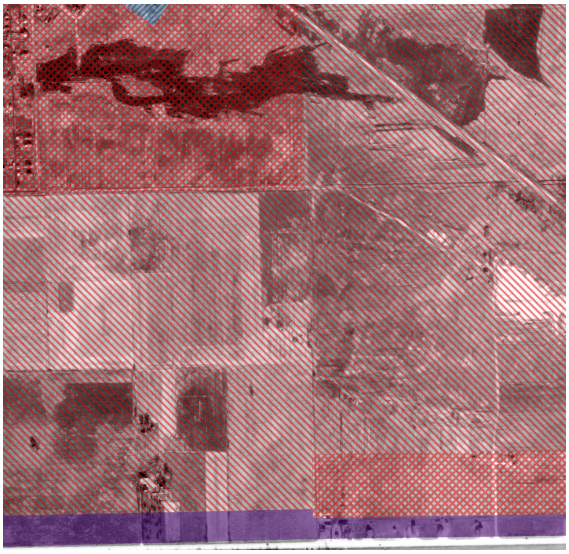
Figure A2: Zoning Maps for Chicago Ridge, IL in 1945



(a) Original paper map



(b) Digitized zoning map

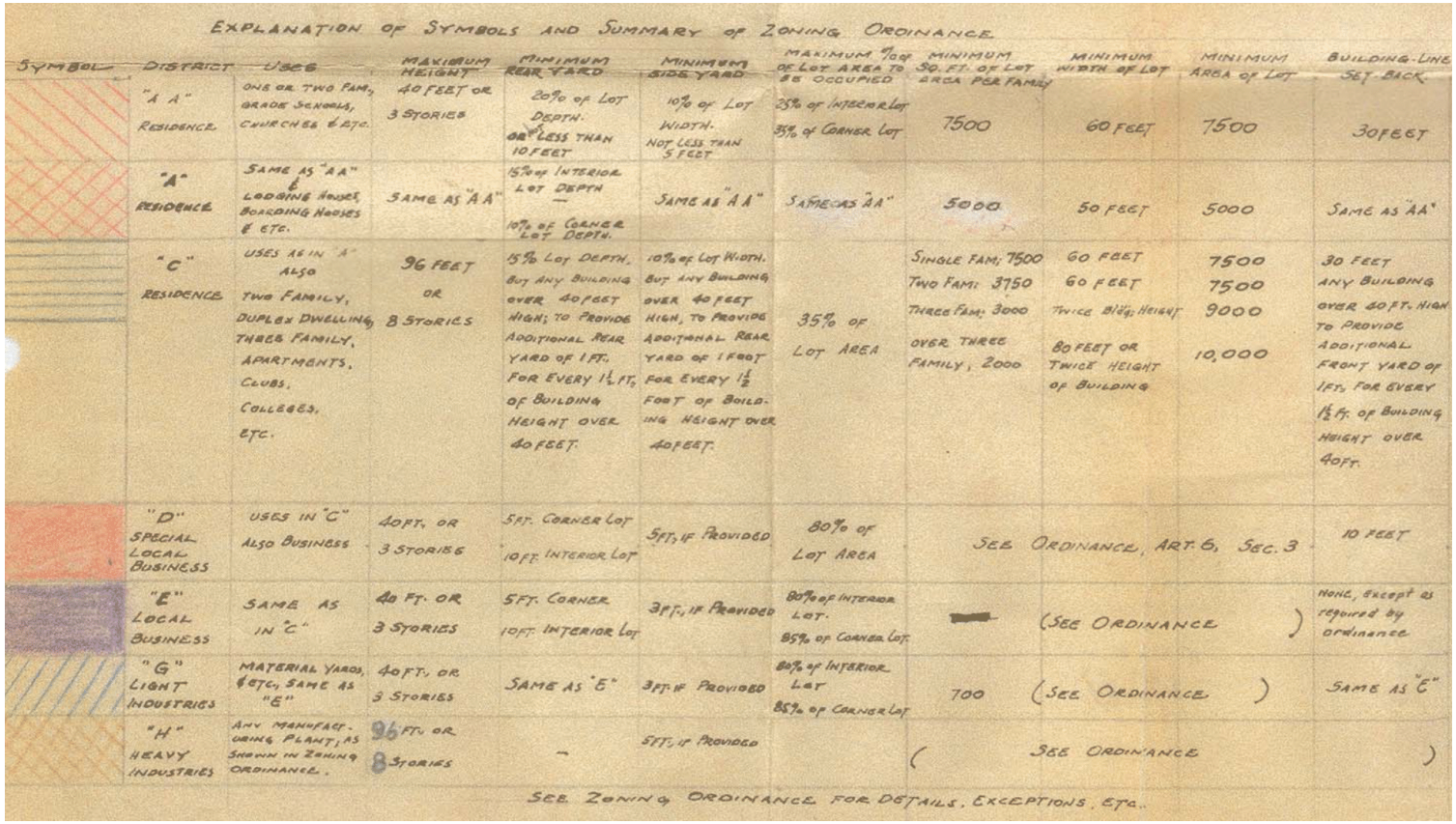


(c) Zoning variation in 1945



(d) Aerial survey photo, 1938-9

Figure A3: Chicago Ridge 1945 Ordinance Legend



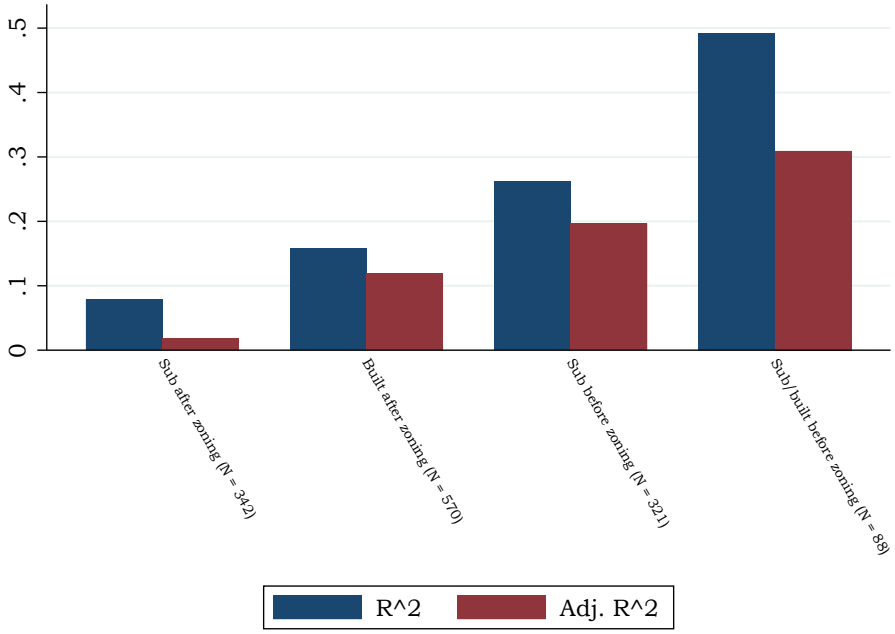
EXPLANATION OF SYMBOLS AND SUMMARY OF ZONING ORDINANCE

SYMBOL	DISTRICT	USES	MAXIMUM HEIGHT	MINIMUM REAR YARD	MINIMUM SIDE YARD	MAXIMUM % OF LOT AREA TO BE OCCUPIED	MINIMUM SQ. FT. OF LOT AREA PER FAMILY	MINIMUM WIDTH OF LOT	MINIMUM AREA OF LOT	BUILDING LINE SET BACK
	"A A" RESIDENCE	ONE OR TWO FAM., GRADE SCHOOLS, CHURCHES ETC.	40 FEET OR 3 STORIES	20% of LOT DEPTH. OR LESS THAN 10 FEET	10% of LOT WIDTH. NOT LESS THAN 5 FEET	25% of INTERIOR LOT 35% of CORNER LOT	7500	60 FEET	7500	30 FEET
	"A" RESIDENCE	SAME AS "AA" & LODGING HOUSES, BOARDING HOUSES & ETC.	SAME AS "AA"	15% of INTERIOR LOT DEPTH — 10% of CORNER LOT DEPTH.	SAME AS "AA"	SAME AS "AA"	5000	50 FEET	5000	SAME AS "AA"
	"C" RESIDENCE	USES AS IN "A" ALSO TWO FAMILY, DUPLEX DWELLING, THREE FAMILY, APARTMENTS, CLUBS, COLLEGES, ETC.	96 FEET OR 8 STORIES	15% Lot DEPTH, BUT ANY BUILDING OVER 40 FEET HIGH; TO PROVIDE ADDITIONAL REAR YARD OF 1 FT. FOR EVERY 1½ FT. OF BUILDING HEIGHT OVER 40 FEET.	10% of Lot WIDTH. BUT ANY BUILDING OVER 40 FEET HIGH, TO PROVIDE ADDITIONAL REAR YARD OF 1 FOOT FOR EVERY 1½ FOOT OF BUILDING HEIGHT OVER 40 FEET.	35% OF LOT AREA	SINGLE FAM; 7500 TWO FAM: 3750 THREE FAM; 3000 OVER THREE FAMILY; 2000	60 FEET 60 FEET TWICE BLG'G HEIGHT 80 FEET OR TWICE HEIGHT OF BUILDING	7500 7500 9000 10,000	30 FEET ANY BUILDING OVER 40 FT. HIGH TO PROVIDE ADDITIONAL FRONT YARD OF 1 FT. FOR EVERY 1½ FT. OF BUILDING HEIGHT OVER 40 FT.
	"D" SPECIAL LOCAL BUSINESS	USES IN "C" ALSO BUSINESS	40 FT. OR 3 STORIES	5 FT. CORNER LOT 10 FT. INTERIOR LOT	5 FT. IF PROVIDED	80% OF LOT AREA	SEE ORDINANCE, ART. 6, SEC. 3			10 FEET
	"E" LOCAL BUSINESS	SAME AS IN "C"	40 FT. OR 3 STORIES	5 FT. CORNER 10 FT. INTERIOR LOT	3 FT. IF PROVIDED	80% of INTERIOR LOT. 85% of CORNER LOT.	—	(SEE ORDINANCE)		NONE, EXCEPT AS required by ordinance
	"G" LIGHT INDUSTRIES	MATERIAL YARDS, ETC, SAME AS "E"	40 FT. OR 3 STORIES	SAME AS "E"	3 FT. IF PROVIDED	80% of INTERIOR LOT 85% of CORNER LOT	700	(SEE ORDINANCE)		SAME AS "E"
	"H" HEAVY INDUSTRIES	ANY MANUFACTURING PLANT; AS SHOWN IN ZONING ORDINANCE.	96 FT. OR 8 STORIES	—	5 FT. IF PROVIDED		(SEE ORDINANCE)			

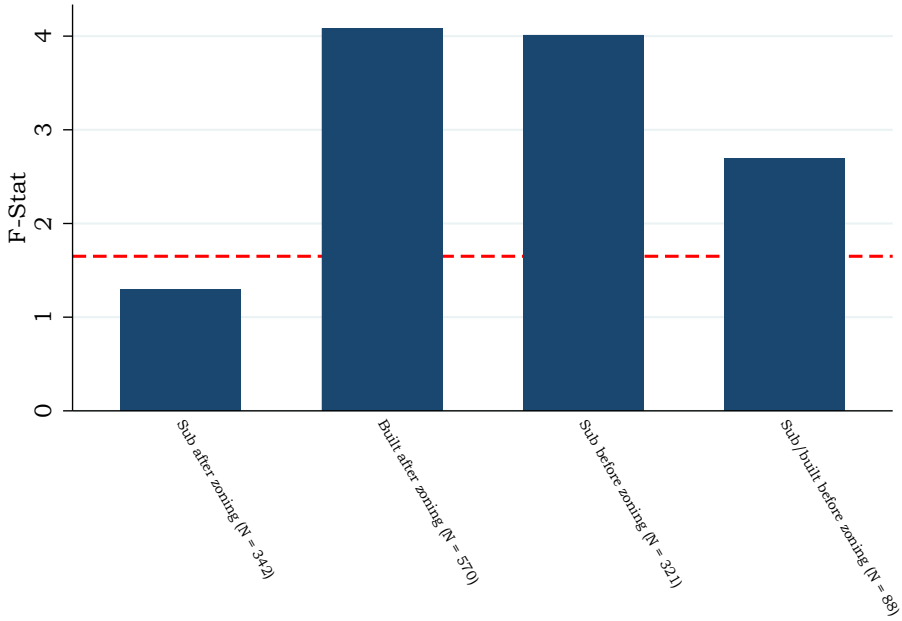
SEE ZONING ORDINANCE FOR DETAILS, EXCEPTIONS, ETC.

Contains bylaws for each zoning district in 1945.

Figure A4: Predicting zoning diversity



(a) R^2 and adjusted R^2 from estimating equation (2) on different samples.



(b) F-statistic from estimating equation (2) on different samples; dashed red line depicts significance at the 5% confidence level.