Why zoning is too restrictive*

Jack Favilukis[†] Jaehee Song[‡]

February 23, 2024

Click here for most recent version.

Abstract

Hsieh and Moretti (2019) estimate that zoning restrictions lowered aggregate growth by 36%. If restrictions are so costly, why do they exist? We propose a novel theory for why zoning restrictions are more stringent than the social optimum. The more administrative entities – each making its own zoning decisions – that a metro is fragmented into, the more restrictive zoning is in the metro. When zoning decisions are made locally, voters choose restrictive zoning due to local congestion externalities but fail to internalize the effects of restrictive zoning on metro-level affordability. Empirically, the HHI of administrative entities within a metro alone explains 12% of the variation in zoning restrictions across the U.S. This theory also provides clear policy advice – zoning decisions should be made at a more global level. Indeed, facing housing affordability crises, several cities, states, and nations have begun to do exactly this.

Keywords: Determinants of zoning, Housing affordability

JEL classification: R21, R23, R52

*We thank seminar and conference participants at Baruch College and the Urban Economic Association

†Sauder School of Business, University of British Columbia. Email:jack.favilukis@sauder.ubc.ca

‡Leeds School of Business, University of Colorado. Email: jaehee.song@colorado.edu

1 Introduction

Hsieh and Moretti (2019) estimate that restrictions on housing supply have lowered aggregate U.S. growth by 36% between 1964 and 2009. If zoning restrictions are so costly, why do they exist? We propose a novel theory for why zoning restrictions exist and why they are more stringent than the social optimum. The more administrative entities – each making its own zoning decisions – that a metro is fragmented into, the more restrictive zoning rules will be across the entire metro. This is because when zoning decisions are made locally, voters choose restrictive zoning due to local congestion externalities but fail to internalize the effects of restrictive zoning on metro-level house prices and affordability.

This theory provides a testable prediction – metros split into more administrative units will have more restrictive zoning. We find strong empirical support for this prediction. A metro-level HHI index based on the number of administrative units that the metro is split into alone explains 12% of the variation in residential zoning, as measured by average minimum lot sizes (MLS), across Core-Based Statistical Areas (CBSA) in the U.S. This theory also provides clear policy advice – make zoning decisions less local and more global makes zoning less restrictive and brings zoning policy closer to the social optimum. Indeed, facing housing affordability crises, several cities, states, and nations have begun to do exactly this.[1]

We start by building a model of a metro with multiple neighborhoods populated by owner-occupiers who vote for zoning restrictions.[2] Because of a local congestion externality, the fewer people live within a particular neighborhood, the higher the utility of living in that neighborhood. Naturally, equilibrium house prices are also higher in such a neighborhood. Therefore, all else equal, owners always prefer tighter zoning restrictions in their own neighborhoods. However, tighter zoning across all neighborhoods raises house prices throughout

1. For example, the states of California and Oregon and the city of Minneapolis have, in effect, overridden single-family zoning by allowing additional units to be built on any parcel formerly zoned as single-family. The city of Vancouver has overridden local regulations to allow higher density near transit stops. New Zealand has required that larger cities allow up to three stories and three dwellings on all existing parcels.

2. Much of the rest of the literature relies on owner-renter conflicts to motivate zoning. While this channel is likely important, our mechanism works even without this conflict.

the metro, making residents unhappy due to the possibility of needing to move. We show that if zoning decisions are made globally, at the metro level, then voters will choose the same level of zoning as the social planner. However, if zoning decisions are made locally within each neighborhood, then voters will choose a more restrictive level of zoning. This is because voters choosing local zoning do not internalize their effect on global house prices.

We build a second similar model, which shows an alternative way to motivate the same empirical prediction. In the first model, high metro-wide house prices hurt owner-occupiers because they may need to move within the metro. The second model instead focuses on the across-metro migration channel. High metro-wide house prices discourage in-migration and reduce the metro's population. This hurts locals because a lower population weakens the agglomeration externality and leads to lower metro-wide wages. When zoning decisions are made locally, local landowners do not internalize the effect of high house prices in their own neighborhoods on metro-wide wages, leading to zoning that is too restrictive. In both models, as fragmentation, measured by the number of neighborhoods making independent zoning decisions grows, zoning rules across the entire metro become more restrictive, and the utility of the metro's residents falls.

We then empirically investigate the key implication of our model: when a larger region (e.g. metro) is fragmented into a larger number of smaller jurisdictions (e.g. municipalities) that each decide their own zoning regulation, then the larger region will have more restrictive overall zoning, all else equal. For each core-based statistical area (CBSA) in the U.S., we construct a measure of how decentralized decision-making is within that CBSA by computing a Herfindahl-Hirschman index (HHI) based on the area of each zoning authority unit that makes up that CBSA – this is our independent variable of interest. Our dependent variable of interest is a CBSA-level measure of zoning stringency. We compute this by aggregating up the neighborhood-level zoning stringency measure from Song (2022) to the CBSA level. This measure estimates minimum lot sizes (MLS) by neighborhood using CoreLogic property tax data and has uniquely broad geographic coverage, which enables us to analyze zoning stringency cross-sectionally across the entire U.S.

To address the endogeneity of zoning jurisdiction HHI, we adopt an instrumental variable (IV) approach and include a rich set of location characteristics as control variables. First, considering that zoning was first adopted in 1916 in New York City and most actively adopted in the mid–1900s in other parts of the country, we measure historical CBSA-level HHI as of 1900 and use it as an IV. Second, we control for the political lean, climate conditions, land use composition, land developability, industrial compositions, and demographics in the 1900s. The identification assumption is that pre-1900 municipality boundaries are as good as random conditional on observable location characteristics.

We find a strong positive relationship between the number of jurisdictions making independent zoning decisions in a CBSA (low HHI) and the stringency of zoning in that CBSA (high MLS). The univariate OLS regression indicates that HHI alone explains 12% of the variation in zoning across CBSAs. The main IV regression indicates that when a metro with the median HHI had a centralized zoning authority, zoning would have been 50% less stringent. This empirical finding is robust to using alternative zoning stringency measures such as the Density Restriction Index from the Wharton Land Use Survey (Gyourko et al., 2021). Furthermore, we find that stringent zoning due to granular municipal institutions as of 1900 reduces population while increasing housing costs, as predicted by our model.

Primarily, our paper relates to the literature on the determinants of zoning. One strand of this literature argues that zoning is the result of a political conflict between pro-zoning homeowners, anti-zoning renters, anti-zoning developers or owners of vacant land, and anti-zoning business owners. Fischel (2004) writes that the original purpose of zoning was to protect homeowners in residential areas from devaluation by industrial and apartment use. Ellickson (1977) and Glaeser et al. (2005) argue that because owners are better organized, zoning tends to be too restrictive.[3]

3. Other papers making similar arguments include Brueckner (1995), Ortalo-Magne and Prat (2007), Hilber and Robert-Nicoud (2013), Parkhomenko (2018), and Parkhomenko (2021). Ellickson (1977) also postulates that it is easier for homeowners to become better organized in smaller municipalities, which implies stricter zoning in smaller municipalities – similar to our paper. However, both papers focus on owner-renter conflicts, which is, while likely important, orthogonal to our mechanism. Our channel does not require households to be heterogeneous.

Another strand, sometimes referred to as exclusionary or fiscal zoning, argues that the primary purpose of zoning is to allow certain neighborhoods to stay homogenous or to exclude certain socioeconomic groups. This may be attributed to racial or social prejudice or to economic reasons such as minimizing the tax burden. For example, if lower-income people consume more public goods than the tax revenue that they pay, a neighborhood could keep them out by regulating large minimum lot sizes, which lower-income people cannot afford.[4]

A third strand, like our paper, focuses on externalities as rationale for zoning.[5] There are only four papers that we are aware of that consider the roles of municipal boundaries for zoning. Fischel (2008) argues that metros with more fragmented governments should have stricter zoning – exactly the same argument we make – however, he neither solves a full model nor provides empirical evidence. Khan (2022) conjectures that the costs of development are much more local than the benefits, leading to externalities for any development near a municipal border. He uses Ward boundary changes in Chicago to measure this externality. Like us, he argues that making zoning more global should reduce this externality, but unlike our paper, he does not investigate a relationship between zoning stringency and the locality of the zoning decision process. Helsley and Strange (1995), like in our paper, show that due to congestion externalities, decentralized decision making can lead to inefficiently restrictive zoning. However, unlike our paper, they never propose or test the hypothesis that the more jurisdictions a metro is split into, the more restrictive zoning will be. In fact, in their model zoning is most restrictive when there are just two competing jurisdictions, and zoning approaches efficient level as the number of jurisdictions rises — this is the opposite of our model and also not in line with our empirical findings. On the other hand, Hamilton (1978)

4. Along the same lines, Hamilton (1975) shows that in the presence of public goods, zoning would be the mechanism through which the Tiebout (1956) hypothesis would work – without zoning, anyone can move into a very small house in a neighborhood with high public goods, and consume those goods. Zoning allows citizens who prefer higher spending on public goods to sort themselves into the same neighborhood. Calabrese et al. (2007) numerically solve a model similar to Hamilton (1975) but with more realistic features, they show that zoning is likely to be strict, leads to aggregate welfare gains as in Tiebout (1956), but also leads to large welfare transfers, with poorer households suffering. Other papers in this strand of literature include Fischel (1978), Mills and Oates (1975), Erickson and Wollover (1987), and Wheaton (1993).

5. Some examples include Cooley and LaCivita (1982), Brueckner (1990), Engle et al. (1992), Brueckner (1998), Rossi-Hansberg (2004), Allen et al. (2016), and Vermeulen (2016).

makes exactly the opposite prediction from ours — zoning should be least restrictive when there are many small jurisdictions within a larger metro.[6] Our paper is also related to Albouy et al. (2019), who build a model in which cities are endogenously formed at locations which differ by their productivity. Due to decreasing returns to scale, local governments would choose city sizes that are too small relative to the social planner, leading to too many cities and lower aggregate welfare.

Most of the papers above are purely theoretical and do not empirically test the predictions of the theories, and empirical literature on the determinants of zoning is limited. Empirically, stricter zoning has been found to be associated with higher income, productivity, fiscal health, education, amenities, share of whites, and liberal lean — many of these are consistent with the fiscal and exclusionary zoning theories. The relationship between homeownership and zoning appears somewhat ambiguous — inconsistent with the owner-renter conflict theories. The relationship between zoning and density also appears ambiguous.[7] Of course, some of

6. Making zoning more restrictive raises house prices and reduces population, but also raises metro-wide wages if there are decreasing returns to scale in labor. If the metro is made up of many small jurisdictions, owners do not internalize the effect of local zoning on metro-wide wages, giving them relatively less incentives to restrict zoning.

7. Gyourko and Molloy (2015) provide a survey of the literature, and we highlight some of it here. Erickson and Wollover (1987) provide empirical support for the fiscal theory by showing that poorer communities in Philadelphia are more likely to zone for business for its tax benefits, despite the negative externalities of having business near residential. Lutz (2015) finds that in New Hampshire, communities in stronger fiscal health chose more restrictive zoning. Rolleston (1987) studies 185 communities in New Jersey and also finds support for the fiscal theory, as well as for exclusionary zoning because zoning was stricter in communities with fewer minorities. Khan (2022) studies zoning in Chicago Wards and also shows that a higher home-ownership rate is associated with stricter zoning, which supports the theories of political conflict. However, several other studies (e.g. Brueckner (1998), Glaeser and Ward (2009)) found no effect of ownership rate. Glaeser and Ward (2009) find that across 182 Massachusetts towns, those with lower past density had stricter zoning rules. Similarly, Evenson et al. (2003) find that across 351 Massachusetts towns, the current density is positively correlated with maximum future allowed density (e.g. looser zoning) and that higher income towns allow less commercial development but do not have stricter overall zoning. On the other hand, Gyourko et al. (2008) show that across the U.S., higher income and education were associated with stricter zoning. Somewhat in contrast with the negative association between higher density and stricter zoning found by Glaeser and Ward (2009) and Evenson et al. (2003), Hilber and Robert-Nicoud (2013) finds that higher past density was associated with stricter zoning and Saiz (2010) finds that across U.S. cities, those with less developable land had stricter zoning. Saiz (2010) also shows that fewer Christians and more college grads were associated with stricter zoning. Shertzer et al. (2016) show that in Chicago, zoning in minority neighborhoods was less restrictive and allowed for higher density, possibly to keep minorities out of white neighborhoods. Kahn (2011) shows that politically liberal cities tend to have more restrictive zoning. Parkhomenko (2021) argues that cities with better amenities and stronger productivity growth have more restrictive zoning.

these variables may be endogenous to zoning regulation. We are not aware of any papers that have linked zoning restrictions to the way administrative boundaries are drawn within a metro, as we do.

The empirical part of our study relies on being able to measure zoning for different metros across the U.S. Quigley et al. (2008), Jackson (2018), Mawhorter and Reid (2018), Menendian et al. (2020), Bronin (2022), and Metropolitan Area Planning Council (2020) all use either surveys or manual collection of local zoning ordinances to measure zoning restrictions in individual cities or states, but not across the entire U.S. Gyourko et al. (2008) and Gyourko et al. (2021) use surveys to construct the commonly used Wharton Residential Land Use Regulatory Index (WRLURI) for 2450 jurisdictions across the U.S., Puentes et al. (2006) use similar methods to create an index for 1844 jurisdictions. Gyourko and Krimmel (2021) show that the difference between the average and marginal costs of land can proxy for zoning restrictions. We use an estimate of minimum lot sizes by neighborhood across the entire U.S. from Song (2022) as our measure of zoning restriction; Section 3 provides more detail on how this measure is constructed. One benefit of our measure is that it is available across all jurisdictions, whereas many important jurisdictions are missing from WRLURI.[8] Additionally, our measure does not rely on subjective surveys. Instead, it quantitatively measures minimum lot sizes across different jurisdictions.

There is also tangentially related literature on the effects of zoning on other quantities of interest, Quigley and Rosenthal (2005) and Gyourko and Molloy (2015) provide extensive surveys. More restrictive zoning has been shown to increase house prices, reduce development, increase segregation, gentrification, and inequality, and reduce welfare.[9]

8. For example, for the San Diego metro area, the cities of La Mesa, National City, San Marcos, Vista, Chula Vista, El Cajon, and Poway are available. However, the city of San Diego, which makes up 42% of the metro's population, is missing.

9. Glaeser and Gyourko (2002), Green et al. (2005), Glaeser and Ward (2009), Huang and Tang (2012), Kok et al. (2014), and Landis and Reina (2021) study prices; Rosen and Katz (1981) and Brueckner (1990) provide several additional references. Mayer and Somerville (2000), Jackson (2016), Wu and Cho (2007), and Anagol et al. (2022) study quantities. Kahn et al. (2010), Lens and Monkkonen (2026), Trounstine (2020), Sahn (2021), and Kulka (2022) study segregation and inequality. Turner et al. (2014), Albouy and Ehrlich (2018), and Hsieh and Moretti (2019) study welfare implications.

2 Model

We present two different models both of which predict that the more administrative (voting) entities there are in a metro, the more restrictive zoning regulation will be in that metro. The channels in the two models are related, but distinct. In both models, more restrictive zoning in one's immediate neighborhood benefits local home owners through lower congestion externalities and higher house prices. However, more restrictive metro-wide zoning raises metro-wide house prices.

In the first model, high metro-wide house prices hurt owner occupiers because they may need to move to another neighborhood.[10] When zoning regulation is decided locally, voters do not internalize their effect on metro-wide house prices and choose zoning that is too restrictive. We refer to this as the 'Migration within metro' channel.

In the second model, high metro-wide house prices hurt owner occupiers because high prices reduce migration from other metros, which reduces metro-wide wages by weakening the agglomeration externality. The lower wages make all metro residents worse off. When zoning regulation is decided locally, voters do not internalize their effect on metro-wide wages and choose zoning that is too restrictive. We refer to this as the 'Migration across metros' channel, it works even if home owners never migrate to other neighborhoods within the metro and are not directly affected by house prices outside of their neighborhood.

2.1 Migration within metro channel

There are two periods, $t = 0$ and $t = 1$. There is a fixed amount of land, normalized to one unit per household, which the households own in equal proportion. Let h_0 represent the amount of housing (e.g. square feet of floor area) to be built per unit land. For simplicity, we assume that construction costs are negligible, therefore any $0 < h_0 < \infty$ is feasible. However,

10. Even if they do not need to move to another neighborhood, they may dislike high metro-level house prices because they want their children to be able to afford a home, or because they want to consume services provided by low wage earners who must be able to live in the metro.

higher h_0 implies higher congestion costs $\phi(h_0)$, which limits the equilibrium value of h_0. These higher congestion costs can be thought of as higher traffic due to density, lack of green space, pollution, or blocked viewlines.

In period $t = 0$, the zoning rules are decided, that is, the households decide how much housing h_0 is allowed to be built per unit of land. A low h_0 can be interpreted as a high minimum lot size, or a prohibition to subdivide lots, or a low maximum floor area (to lot size) ratio, or a low maximum building height, or any other restriction on density.[11]

In period $t = 1$, conditional on the existing zoning rules and quantity of housing h_0, households sell the housing they were endowed with at (endogenous) price p for $x = ph_0$, inelastically supply one unit of labor minus the congestion cost ϕ at (exogenous) wage w, choose non-durables consumption c, and choose housing h. The household's utility function and budget constraint at $t = 1$ are:

$$\begin{aligned} u(x) &= \max_{c,h} c^{\alpha_c} h^{\alpha_h} \\ \text{s.t. } & ph + c = x + w(1 - \phi(h_0)) \text{ and } x = ph_0 \end{aligned} \tag{1}$$

where $\alpha_c + \alpha_h = 1$. No new housing is built at $t = 1$ therefore, in equilibrium:

$$\begin{aligned} h_0 &= h \\ c &= w(1 - \phi(h_0)) \end{aligned} \tag{2}$$

The wage w measures workers' exogenous productivity and can be normalized to one without loss of generality.

11. An alternative is to interpret h_0 as land allowed for development. Households jointly own all land, which is plentiful. At $t = 0$ they decide how much of the total land to parcel out for private ownership – this is h_0 per household, with the remainder being public land for parks, roads, etc. In this case, a low h_0 represents a low ratio of developable land to total land.

2.1.1 Planner's problem

Plugging the equilibrium definition of c into the household's problem, the planner solves:

$$u = \max_h (w(1 - \phi(h)))^{\alpha_c} h^{\alpha_h} \tag{3}$$

The first order condition is:

$$\alpha_h(1 - \phi(h)) = (1 - \alpha_h)h\phi'(h) \tag{4}$$

This is a single equation with a single unknown, which fully describes the solution to the planner's problem.

Multiple neighborhoods Suppose that the metro is made up of m identical neighborhoods, where within each neighborhood, the relationship between congestion ϕ and housing per unit of land h is described by the same equation $\phi(h)$. That is, congestion is fully local, with each neighborhood's h affecting its own ϕ, but having no effect on other neighborhoods. Suppose also that between $t = 0$ and $t = 1$, some households receive random shocks requiring them to move from the neighborhood where they own housing at $t = 0$, to another neighborhood. Since all neighborhoods are the identical, the planner's solution will be symmetric across neighborhoods. Within each neighborhood the solution will be fully described by equation 4.

2.1.2 Decentralized problem with global voting

Our goal is to solve for the zoning, or equivalently housing supply, that will be chosen by voters at $t = 0$. To do so, we work backwards. In period $t = 1$, the household takes net worth x, price p, and congestion $\phi(h_0)$ as given, and solves the problem in equation 1. Substituting the budget constraint $c = x + w(n - \phi) - ph$ and solving for the first order condition:

$$\alpha_c(x + w(1 - \phi) - ph)^{-1}p = \alpha_h h^{-1} \tag{5}$$

Rearranging and plugging into the budget constraint gives the household's optimal choices and utility at $t = 1$:

$$\begin{aligned} c &= \alpha_c(x + (1-\phi)w) \\ h &= \tfrac{\alpha_h(x+(1-\phi)w)}{p} \\ u &= \overline{\alpha} p^{-\alpha_h}(x + (1-\phi)w) \end{aligned} \tag{6}$$

where $\overline{\alpha} = \alpha_c^{\alpha_c}\alpha_h^{\alpha_h}$.

In equilibrium, it must be that $x = ph$. Plugging this into the demand function for housing in equation 6, we can solve for the equilibrium relationship between price and quantity:

$$p = \frac{\alpha_h(1-\phi(h))w}{(1-\alpha_h)h} \tag{7}$$

The price is lower when housing supply is high or when the congestion externality is high. We can plug this into the household's utility function at $t = 1$ to solve for utility as a function of the quantity of housing:

$$u(h) = w^{\alpha_c} h^{\alpha_h}(1-\phi(h))^{1-\alpha_h} \tag{8}$$

At $t = 0$ households decide the zoning rules h to maximize their expected utility. Equation 8 is identical to the planner's problem in equation 3 and its solution is identical to the planner's solution in equation 4. If households are allowed to vote, the planner's solution would be implemented and the externality fully internalized. This is because all households are identical and congestion affects them all equally. There would be no benefit for any individual to vote for lower housing h and lower congestion $\phi(h)$ since she cannot create lower congestion locally to benefit just her own property value.

Multiple neighborhoods Suppose, just as in section 2.1.1, that the metro is made up of m identical neighborhoods, where within each neighborhood, the relationship between congestion ϕ and housing per unit of land h is described by the same equation $\phi(h)$. That is, congestion is fully local, with each neighborhood's h affecting its own ϕ, but having no effect on other neighborhoods. Suppose also that between $t = 0$ and $t = 1$, some households receive random shocks requiring them to move from the neighborhood where they own housing at $t = 0$, to another neighborhood.

If the zoning decisions are made at the metro level, rather than neighborhood by neighborhood, then the solution will be identical to the solution above and in equation 4. This is because households cannot affect the zoning restrictions of individual neighborhoods, therefore, they cannot benefit from having any alternative global rule. In other words, because there is just one global rule, this problem is isomorphic to one in which the entire metro is single large neighborhood with the same h and ϕ throughout, and in which households never have to move out of the large neighborhood.

2.1.3 Decentralized problem with local voting

Again, as in section 2.1.1, the metro is made up of m identical neighborhoods, where within each neighborhood, the relationship between congestion ϕ and housing per unit of land h is described by the same equation $\phi(h)$. That is, congestion is fully local, with each neighborhood's h affecting its own ϕ, but having no effect on other neighborhoods. A household who owns housing in neighborhood i at $t = 0$ will stay in neighborhood i with probability q and will move to neighborhood $j \neq i$ with probability $\frac{1-q}{m-1}$.

Conditional on moving from neighborhood i to neighborhood j at $t + 1$, the household solves:

$$\begin{aligned} u_j(x_i) &= \max_{c_{ij}, h_{ij}} c_{ij}^{\alpha_c} h_{ij}^{\alpha_h} \\ \text{s.t. } & p_j h_{ij} + c_{ij} = x_i + w(1 - \phi(h_{0,j})) \end{aligned} \tag{9}$$

This household's optimal solution is identical to equation 6, we rewrite it here to make explicit dependence on i and j:

$$\begin{aligned} c_{ij} &= \alpha_c (x_i + (1 - \phi) w) \\ h_{ij} &= \frac{\alpha_h (x_i + (1-\phi) w)}{p_j} \\ u_j(x_i) &= \overline{\alpha} p_j^{-\alpha_h} (x_i + (1 - \phi_j) w) \end{aligned} \tag{10}$$

We search for a symmetric Nash equilibrium to solve this problem. A household who owns in neighborhood i at $t = 0$ believes that in all other neighborhoods, housing will be $\hat{h}$, prices $\hat{p}$, net worth $\hat{x} = \hat{h}\hat{p}$, and congestion $\hat{\phi} = \phi(\hat{h})$. Given these beliefs, demand in neighborhood i at $t = 1$ will be:

$$h_i = \frac{\alpha_h(qx_i + (1-q)\hat{x} + (1-\phi_i)w)}{p_i} = \frac{\alpha_h(qh_ip_i + (1-q)\hat{h}\hat{p} + (1-\phi_i)w)}{p_i} \tag{11}$$

because a fraction q of the residents will be locals and $1-q$ movers. We can solve this for the price at $t = 1$ in neighborhood i as a function of the zoning choice h_i:

$$p_i = \frac{\alpha_h((1-q)\hat{h}\hat{p} + (1-\phi(h_i))w)}{(1-q\alpha_h)h_i} \tag{12}$$

Note that the monetary value of a household's real estate is $p_ih_i = \frac{\alpha_h((1-q)\hat{h}\hat{p}+(1-\phi(h_i))w)}{(1-q\alpha_h)}$, which is constant if there is no congestion externality, and decreasing in h_i (equivalently, increasing in the restrictiveness of zoning) if there is a congestion externality.

The expected utility of a household who owns in neighborhood i is:

$$u_i = \sum q_{ij}u_j(x_i) = \overline{\alpha}\left(qp_i^{-\alpha_h}(x_i + (1-\phi(h_i))w) + (1-q)\hat{p}^{-\alpha_h}(x_i + (1-\hat{\phi})w)\right) \tag{13}$$

Equation 13 is simply an expectation of the utility in equation 10 over staying in the current neighborhood, with probability q and moving with probability $1-q$. One can then plug in $x_i = h_ip_i$ and p_i from equation 12 into equation 10 to get an equation for utility u_i as a function of zoning choices in one's own neighborhood h_i and beliefs about zoning $\hat{h}$ and prices $\hat{p}$ in other neighborhoods.

The household chooses zoning rules h_i by maximizing u_i in equation 13. The first order condition is an equation for h_i as a function of beliefs $\hat{h}$ and $\hat{p}$. Finally, because the equilibrium is assumed to be symmetric, set $h_i = \hat{h}$ in the first order condition. Also, set $p_i = \hat{p}$ and $h_i = \hat{h}$ in the equation 12. This gives two equations for two unknowns: $\hat{h}$ and $\hat{p}$, solving these two provides a full solution to this problem.

Note that the number of neighborhoods m does not directly matter, the probability q

of staying in your own neighborhood is a sufficient statistic. Of course, holding the size of the metro constant, splitting it into more neighborhoods m implies a lower probability q of staying in your own neighborhood.

It is useful to consider two special cases. If $q = 1$, that is households always stay in their own neighborhood, then the utility function becomes identical to equation 8 and the solution identical to the planner's solution. In this case, households fully internalize the effect of zoning rules on house prices.

Another special case is $q = 0$, that is households never stay in their own neighborhood. In this case the utility function is strictly decreasing in the congestion externality $\phi(h_i)$. Since we assume that $\phi(h_i)$ is increasing in h_i, households would choose the smallest possible h_i.[12]

2.1.4 Numerical example

Let $\phi(h) = \phi_0 h^{\phi_1}$ then we can explicitly solve for the planner's solution:

$$h = \left(\frac{\alpha_h}{\phi_0(\alpha_h + (1 - \alpha_h)\phi_1)} \right)^{1/\phi_1} \tag{14}$$

We set $\alpha_h = 0.25$, $\alpha_c = 1 - \alpha_h$, $\phi_0 = 0.1$, $\phi_1 = 2.0$, and $w = 1$. The panels on the left of Figure 1 present model results for varying values of q, the probability of moving to a neighborhood which makes its zoning rules independently. The x-axis plots the number of independent zoning jurisdictions or neighborhoods per metro $m = 1/q$. [13] A metro where all zoning decisions are made at the metro level (global) corresponds to $q = 1.0$ and $m = 1.0$. A

12. If the externality $\phi(h_i)$ is strictly increasing in h_i, then there is no solution as households choose zoning to be as restrictive as possible by setting $h_i = 0$. This is because, due to Cobb-Douglas preferences, the sales proceeds $p_i h_i = \alpha_h(\hat{h}\hat{p} + (1 - \phi(h_i))w)$ are maximized as h_i approaches zero. Of course, this extreme case is unrealistic and occurs because of the functional form chosen. With a more realistic functional form, a low q_i would still lead to zoning that is too restrictive, but there would be an interior solution for h_i. As proposed by Fischel (1978), it would be more realistic to assume that the congestion externality $\phi(h)$ is flat or even decreasing in h for low values of h (i.e. having very few people around means it is difficult to buy and sell goods and services), and increasing in high values of h (i.e. high density leads to traffic, pollution, lack of green spaces, etc).

13. For simplicity, we assume that all neighborhoods are equal sized and the probability of moving from one to another is uniform. In general, if there is heterogeneity in the size of neighborhoods, the relationship between q and m should still be negative but more complicated than a simple inverse.

decrease in q (increase in m) implies that the zoning decisions shift from metro level (global) to neighborhood level (local). As zoning decisions become more local, zoning for the entire metro becomes more restrictive — h falls which corresponds to lower density or less flexibility to subdivide or larger lot sizes. This leads to higher house prices p and lower congestion ϕ for the entire metro. However, there is too little congestion and not enough housing, leading to a fall in utility u. This is because the the planner's problem, which is equivalent to the global zoning ($q = 1.0$) case, optimally trades off the benefits of housing supply and the costs of congestion. When q is lower, households deciding on local zoning rules do not internalize the effect of their zoning decisions on metro level house prices, and choose restrictive zoning to raise their own house values. This leads to too little congestion and not enough housing supply.

2.2 Migration across metros channel

Before formally writing down the model, we summarize the differences between this model and the model in section 2.1. First, the population is no longer fixed, rather there is a fixed number M of property owners across m neighborhoods, and an endogenously determined N immigrants who move to the metro if it is better than their reservation utility. Second, we set $q = 1$, that is landowners who own in neighborhood i also live in neighborhood i; we do this as a contrast to the model in section 2.1 where $q < 1$ is necessary for the mechanism of that model. Third, the wage w is no longer constant, rather it positively depends on total population $M + N$ through an agglomeration externality – this is the key ingredient necessary for the mechanism of this section's model. Fourth, congestion ϕ now depends on population $M + N$ rather than structures per unit of land h. Fifth, we introduce a construction cost λ per unit of structures.[14]

14. If the utility function is Cobb-Douglas and if there are no construction costs, then optimal structures h are infinite. We require positive construction costs to get an interior solution for h. However, construction costs are not important for our mechanism. For example, if the utility function is CES with stronger complementarity than Cobb-Douglas, then the model has an interior solution for h even with zero construction costs. In this case, our key results on the relationship between the number of voting neighborhoods m and the restrictiveness of zoning h are the same as in the models presented in the text.

2.2.1 Land owners

There are two periods, $t = 0$ and $t = 1$. There are M land owners living in m identical neighborhoods in the metro at $t = 0$. There is a fixed amount of land, normalized to one unit per land owner. Let h_0 represent the amount of housing (e.g. square feet of floor area) to be built per unit land. The inverse of h_0 will also represent how restrictive zoning is, since less housing per unit of land represents lower housing density. The cost of constructing h_0 housing units, expressed in utility units, is λh_0.

At $t = 0$, the land owners decide the zoning rules in their own neighborhood, their problem is:

$$u_0 = \max_{h_0} u_1(h_0) - \lambda h_0 \tag{15}$$

where $u_1(h_0)$ is the $t = 1$ utility of an owner with h_0 units of housing and λh_0 is the cost of building the housing.

At $t = 1$, we assume that landowners who own in neighborhood i stay in the same neighborhood. We do this as a contrast to the model section 2.1; as shown there, allowing owners to move neighborhoods strengthens the channel. Each landowner in neighborhood i inelastically supplies one unit of labor minus the congestion cost ϕ_i at (endogenous) wage w. The owner chooses consumption c and housing h to maximize utility. The owner takes wages w, house prices p_i, and congestion ϕ_i as given. The landowner's problem is:

$$\begin{aligned} u_1(h_0) &= \max_{c,h} c^{\alpha_c} h^{\alpha_h} \\ \text{s.t. } & p_i h + c = p_i h_0 + w(1 - \phi(h_0)) \end{aligned} \tag{16}$$

where $\alpha_c + \alpha_h = 1$.

This problem can be solved analytically:

$$\begin{aligned} c &= \alpha_c(h_0 p_i + (1 - \phi_i)w) \\ h &= \tfrac{\alpha_h(h_0 p_i + (1-\phi_i)w)}{p_i} \\ u_1(h_0) &= \overline{\alpha} p_i^{-\alpha_h}(h_0 p_i + (1 - \phi_i)w) \end{aligned} \tag{17}$$

where $\overline{\alpha} = \alpha_c^{\alpha_c} \alpha_h^{\alpha_h}$.

Plugging this into the owner's problem at $t = 1$, we can rewrite it as:

$$u_0 = \max_{h_0} \overline{\alpha} p_i^{-\alpha_h} (h_0 p_i + (1 - \phi_i) w) - \lambda h_0 \tag{18}$$

where w, p_i, and ϕ_i are beliefs about metro-wide wages, local house prices, and local congestion. These beliefs depend both on the zoning choices made in the owner's neighborhood, as well as on the zoning choices made in other neighborhoods, and the choices made by immigrants.

2.2.2 Immigrants

There are an additional N immigrants that move to the metro at $t = 1$ if their utility from living in the metro is at least as high their reservation utility $\underline{u}_m$. Their utility function is identical to the owners, but they have no wealth. Similar to equation 17, the immigrants' optimal choices and utility from living in neighborhood i of the metro are:

$$\begin{aligned} c &= \alpha_c (1 - \phi_i) w \\ h &= \tfrac{\alpha_h (1 - \phi_i) w)}{p_i} \\ u_{m,i} &= \overline{\alpha} p_i^{-\alpha_h} (1 - \phi_i) w \end{aligned} \tag{19}$$

2.2.3 Equilibrium

We search for a symmetric Nash equilibrium to solve this problem. Owners in neighborhood i take the zoning choice $\hat{h}_0$ of all other neighborhoods as given and choose $h_{0,i}$ to maximize their utility in equation 18. As an intermediate step to solve this problem, we must also solve for the housing price in one's own neighborhood p_i, housing price in the other neighborhoods $\hat{p}$, congestion in one's own neihborhood ϕ_i, congestion in the other neighborhoods $\hat{\phi}$, immigrants in one's own neighborhood N_i, immigrants in each of the other neighborhoods $\hat{N}$, and the metro-wide wage w, all as functions of $\hat{h}_0$ and $h_{0,i}$.

The equilibrium is characterized by nine equations and nine unknowns. The unknowns are $h_{0,i}$, $\hat{h}_0$, p_i, $\hat{p}$, ϕ_i, $\hat{\phi}$, N_i, $\hat{N}$, and w. The nine equations are:

$$
\begin{aligned}
\underline{u}_m &= \overline{\alpha} p_i^{-\alpha_h}(1-\phi_i)w \\
\underline{u}_m &= \overline{\alpha} \hat{p}^{-\alpha_h}(1-\hat{\phi})w \\
\frac{M}{m} h_{0,i} &= \frac{\alpha_h}{p_i}\left(\frac{M}{m} h_{0,i} p_i + (\frac{M}{m} + N_i)(1-\phi_i)w\right) \\
\frac{M}{m} \hat{h}_0 &= \frac{\alpha_h}{\hat{p}}\left(\frac{M}{m} \hat{h}_0 \hat{p} + (\frac{M}{m} + \hat{N})(1-\hat{\phi})w\right) \\
\phi_i &= \phi_0 \left(\frac{M}{m} + N_i\right)^{\phi_1} \\
\hat{\phi} &= \phi_0 \left(\frac{M}{m} + \hat{N}\right)^{\phi_1} \\
w &= \omega_0 \left(M + N_i + (m-1)\hat{N}\right)^{\omega_1} \\
h_{0,i} &= \arg\max_{h_{0,i}} \quad \overline{\alpha} p_i^{-\alpha_h}(h_{0,i} p_i + (1-\phi_i)w) - \lambda h_{0,i} \\
h_{0,i} &= \hat{h}_0
\end{aligned}
\tag{20}
$$

The first and second equations above are the immigrants' indifference conditions between living in neighborhood i, living in any other neighborhood, or living outside of the metro. They use the immigrants' utility derived in equation 19. The third equation equates supply of housing in neighborhood i on the left hand side with demand on the right hand side. To compute demand, we sum the demand of owners in equation 17 and the demand of immigrants in equation 19, noting that the numbers of owners and immigrants in neighborhood i are $\frac{M}{m}$ and N_i respectively. Similarly, the fourth equation equates supply of housing with the demand for housing in any other neighborhood. The fifth and sixth equations define the congestion externality in neighborhood i and in any other neighborhood. The seventh equation defines the metro-wide wage; it is increasing in total population where total immigrants are $N = N_i + (m-1)\hat{N}$. The eighth equation is the Nash equilibrium condition implying that conditional on their beliefs about all other endogenous variables, the owners in neighborhood i choose the housing supply (equivalently, the zoning restrictions) to maximize their own utility, derived in equation 18. Finally, the ninth equation specifies that the equilibrium is symmetric.

An important condition for an equilibrium to exist is that the agglomeration parameter must be sufficiently weak. In this case, as the number of immigrants rises, wages rise due to the agglomeration externality, but prices rise by even more, which lowers the utility of living in the metro; this pins down the number of immigrants in the metro.

2.2.4 Numerical example

We set $\alpha_h = 0.25$, $\alpha_c = 1 - \alpha_h$, $\phi_0 = 0.1$, $\phi_1 = 2.0$, $\omega_0 = 1$, $\omega_1 = 0.13$, $M = 1$, $\underline{u}_m = 0.65$, and $\lambda = 0.1$. The model's qualitative implications are the same for all parameter combinations we have tried.[15] The agglomeration externality parameter ω_1 is the most important parameter to quantitatively strengthen our channel. Following estimates in ?, we set $\omega_1 = 0.13$.

The panels on the right of Figure 1 present model results for varying values of m, the number of neighborhoods which make their zoning rules independently. The results are qualitatively similar to those of of the model in section 2.1, presented on the left of the figure, however the channel is somewhat different. A metro where all zoning decisions are made at the metro level (global) corresponds to $m = 1$. An increase in m implies that zoning decisions shift from metro level (global) to neighborhood level (local). As zoning decisions become more local, zoning for the entire metro becomes more restrictive — h falls which corresponds to lower density or less flexibility to subdivide or larger lot sizes. This leads to higher house prices p and lower congestion ϕ for the entire metro. However, this also leads to a reduction in the number of immigrants N, and therefore a reduction in the metro's population. Because of the positive agglomeration externality ($\omega_1 > 0$), the reduction in population leads to lower metro-wide wages. This increase in house prices and reduction in housing, congestion, population, and wages is suboptimal – as m rises, utility falls. This is because as m rises, owners deciding on local zoning rules do not internalize the effect of their zoning decisions on metro level wages, and choose restrictive zoning to raise their own house

15. As explained earlier, for there to be an interior solution with Cobb-Douglas utility, it must be that the construction cost $\lambda > 0$, otherwise optimal housing choice is $h_{0,i} = \infty$. However, the channel does not require construction costs. For example, with CES utility and the elasticity of substitution between housing and non-durable consumption below one (more complementarity than Cobb-Douglas), the optimal housing choice $h_{0,i}$ is finite even when there are no construction costs ($\lambda > 0$). In this case, the model's qualitative implications are still the same. ? provide empirical evidence showing that indeed, the elasticity of substitution is below one.

values. The agglomeration externality is crucial for this channel – if $\omega_1 = 0$, an increase in m has no effect on housing supply, house prices, congestion, population, or utility.

3 Empirical Analysis

In this section, we empirically examine the relationship between the concentration of zoning authorities and zoning restrictiveness. To do so, we compile a map of local municipalities to compute the Herfindahl-Hirschman index (HHI) of governments in each metro. We also measure the zoning stringency using geographically detailed minimum lot size (MLS) data from Song (2022).

One major empirical challenge is the endogeneity of zoning jurisdiction boundaries. On one hand, more exclusive communities may create their own local municipalities and set stringent zoning. This is especially concerning because zoning was most actively adopted in the mid– to late–1900s, which coincides with postwar suburbanization. On the other hand, a metro with lax zoning may become populated, leading to the creation of new municipalities. As such, current HHI may be endogenous, and therefore, we instrument the HHI with the historical HHI as of 1900. Additionally, we control for a rich set of location characteristics that may affect the granularity of municipalities and zoning stringency.

The identification assumption here is that the granularity of local governments as of 1900 is as good as random and not correlated to the stringency of zoning, which was set in the 1900s and onward, controlling for the observable location characteristics. In particular, we control for the political lean, climate conditions, the land area by land uses (commercial, industrial, and agricultural), land developability, and the proportion of residential development built after 1940 and 1970, when the zoning laws were most actively adopted. We also control for demographic, housing, and industrial characteristics in the mid– to late–1900s and the early 2000s. Appendix A.1 provides more detail on the data sources of the control variables.

3.1 Zoning stringency

Our dependent variable of interest is the restrictiveness of local zoning in each metro. To measure zoning stringency, we use neighborhood-level minimum lot size estimates (MLS) from Song (2022). MLS is a common residential zoning restriction across the U.S., it restricts the lot size to be no smaller than the allowed MLS. To construct this measure, Song (2022) looks for a structural break in the distribution of lot sizes for newly built houses using CoreLogic property tax data at the zoning district level, when available, or at the Census Block Group level. This measure of local zoning stringency has a unique advantage in its comprehensive nationwide coverage and is suitable for our cross-sectional analysis of zoning. We first take the median of these neighborhood-level MLS estimates in each municipality, weighted by the number of parcels in each neighborhood, and aggregate the municipality median MLS estimates at the CBSA level by taking the average. For robustness, we aggregate these neighborhood-level MLS estimates in different ways, for example, taking the 25th or 75th percentiles in each municipality (See Section 3.6). Local zoning is considered to be more stringent in municipalities where the zoning stringency measure (median MLS) is bigger.

3.2 Herfindahl-Hirschman index of zoning jurisdictions

Here we describe our independent variable of interest. We construct the zoning jurisdiction Herfindahl-Hirschman index (HHI) to characterize how decentralized zoning decisions are in each metro. The zoning jurisdiction HHI is defined as:

$$HHI_i = \left(\frac{\delta_1}{\sum_{j=1}^{n_i}\delta_j} * 100\right)^2 + \left(\frac{\delta_2}{\sum_{j=1}^{n_i}\delta_j} * 100\right)^2 + \ldots \left(\frac{\delta_{n_i}}{\sum_{j=1}^{n_i}\delta_j} * 100\right)^2 \tag{21}$$

where i is the metro, j is the zoning jurisdiction in metro i, n_i is the number of zoning jurisdictions in metro i, and δ_j is the residential area of jurisdiction j. Metros are defined to be CBSA. This index ranges from 0 (infinitely many small jurisdictions) to 10,000 (a single large jurisdiction); if all jurisdictions were equal-sized, then the index would be equal to $HHI_i = 10,000/n_i$. Our theoretical model implies that there is a negative relationship between zoning jurisdiction HHI and zoning restrictiveness: when zoning decisions are more decentralized (lower HHI), zoning regulations are stricter.

To identify local governmental units that can set zoning laws, we follow Song (2022) to compile the 2019 Census County Subdivision and Census Place maps and refer to the 2010 Census Guide to State and Local Census Geography. Specifically, local zoning authority depends on the state institution and may be an incorporated place (often a city or town), a minor civil division (often a town or township), or a county. For example, in Connecticut, incorporated places are dependent of any minor civil divisions and have no zoning authority. Hence, all minor civil divisions are zoning jurisdictions in Connecticut. In another example, only incorporated places in California have zoning authorities, and counties set zoning for unincorporated areas. For California, therefore, all incorporated places and counties with unincorporated areas are zoning jurisdictions. As such, in each state, some combinations of incorporated places, minor civil divisions, and counties are defined to be zoning jurisdictions.

We identify 21,067 municipalities (1,155 counties, often unincorporated areas governed by counties, 9,583 incorporated places, and 10,329 minor civil divisions) with functioning local governments in 909 CBSAs of the contiguous United States and construct a map of them in a shapefile format. We then merge the map of municipalities with CoreLogic Tax Assessor data. CoreLogic Tax Assessor data includes detailed parcel-level information on land uses and building characteristics for the near-universe of residential and non-residential properties. We use the data to obtain residential areas in each municipality to compute the zoning jurisdiction HHI in each metro.

3.3 Instrumental variable: historical HHI

We construct the HHI of local governments as of 1900 in each CBSA as an instrumental variable. To do so, we compile various sources for years of establishment for municipalities. We consider years of incorporation as years of establishment for incorporated places while considering years of creation for minor civil divisions and counties.

We collect years of incorporation from the following sources. First, we use the Municipal Incorporation Data compiled by Goodman (Goodman, 2023). This data has close-to-complete coverage of incorporation years of incorporated places in most states except for NE, OK, SD, and UT. To complement this, we additionally use IPUMS Census sample data from 1850, 1860, 1870, 1880, and 1900 and determine whether incorporated places appear in this data. These 1% and 5% sample Census includes the INCORP variable, which describes which incorporated place the household lives in. We match the state and name of incorporated places with the IPUMS dictionary to decide whether incorporated places appear in the Census data prior to 1900.[16]

Similarly, we use the MCD variable in IPUMS Census data, which describes which minor civil division the household lives in, to determine the existence of minor civil divisions prior to 1900. Since the IPUMS data is not a full-count sample, we further digitize 242 historical maps that were drawn before 1900 and detect names of minor civil divisions on the maps.[17] We assume the minor civil division was created prior to 1900 if and only if a minor civil division appears in the IPUMS Census data or on the historical maps.

3.4 Descriptive statistics

We construct a sample of 19,153 municipalities in 834 Core-Based Statistical Areas (CBSA) for analysis with existing MLS estimates. Note that 75 CBSAs are excluded from the sample because of missing MLS estimates.[18] The municipalities in the sample cover 84.6 million single-family residential tax parcels and 11.8 million multi-family residential tax parcels in CoreLogic, the near universe of residential properties in all CBSAs.[19]

16. Note that the INCORP data field does not appear in the full-count Census.

17. Note that the MCD data field does not appear in the full-count Census.

18. The missing MLS data is due to incompleteness of underlying CoreLogic data. In estimating MLS, Song (2022) restricts to single-family construction built after 1940, and in some counties, year of construction is mostly missing in CoreLogic. In Section 3.6, we present the results using another version of MLS estimates from Song (2022) which use all single-family home construction to infer MLS and thus have full coverage. The empirical results are consistent.

19. According to 2020 American Community Survey, there are 86 million single-family housing units and 42 million multi-family housing units in CBSAs in the contiguous United States.

Table 1 presents the summary statistics of the analysis sample. The sample shows a large variation in its zoning stringency, measured by average min lot sizes. The municipality-level average of minimum lot size has a mean of 46,703 square feet (1.07 acres) and a standard deviation of 72,149 square feet (1.66 acres).[20] The 10th percentile municipality average is 7,498 square feet (0.17 acre), and the 90th percentile is 114,824 square feet (2.64 acres). Across CBSA, the median min lot size is 27,332 square feet (0.63 acre), and the standard deviation is 27,715 square feet (0.64 acre).[21]

Figure 2 illustrates the univariate relationship between zoning jurisdiction HHI and min lot size at the CBSA and county levels. Zoning jurisdiction HHI and min lot size show a strong negative correlation, with the coefficient estimates of −0.222 from the log-log regressions. The R^2 implies that approximately 12% of the cross-sectional variation in minimum lot sizes across CBSAs is explained by zoning jurisdiction HHI.

3.5 Empirical results

Our baseline IV regression takes the form

$$\log MLS_i = \beta_0 + \beta_{HHI} \cdot log\widehat{HHI}_i + X_i\beta_X + \epsilon_i \tag{22}$$

where i is a metro, MLS is the municipality average of neighborhood-level minimum lot sizes, HHI is the metro-level zoning jurisdiction HHI (instrumented by historical HHI as of 1900), and X is a vector of location characteristics. We run the analysis where the metro is defined to be a Core-Based Statistical Area (CBSA).

We examine the effects of HHI on the stringency of zoning, measured by $\log MLS$. Section 3.6 discusses robust results under alternative functional form assumptions. Columns (1) and (2) in Table 2 report the results from the CBSA-level OLS regressions without instrumenting for HHI. Column (2) includes the rich set of location controls, including 1940 and 1969

20. The municipality-level median is weighted by the number of parcels in each zoning district.

21. In each CBSA, we again take the median the municipality-level min lot size to compute its zoning stringency.

demographics, land use compositions, industrial compositions, weather, and political lean. As predicted by our model, HHI is strongly negatively related to zoning stringency measured by minimum lot sizes; metros where zoning decisions are more dispersed (low HHI) have more strict zoning (high MLS). HHI's t-statistic is −3.79, this is higher than any of the t-statistics among our large set of controls. HHI's univariate R^2 is 0.122, about a third of the R^2 in the full multivariate regression.

To address the endogeneity of HHI, our baseline regression adopts HHI as of 1900 as an instrument. In 28 CBSAs, there were no municipalities before 1900. Hence, we include the indicator variable of whether CBSAs had established municipalities before 1900 as a control variable while setting their HHI as of 1900 to 10,000. Columns (3) and (4) in Table 2 report the results from the CBSA-level IV regressions. First, we find a strong first-stage result: HHI as of 1900 positively related to current HHI, controlling for observables, with a coefficient of 0.957 and a t-statistic of 72.74 (see Appendix Table A.2 for the regression table). Second, the main IV regression result shows strong support for our theory. The slope coefficient of −0.214 from the full regression in Column (4) indicates that if a CBSA with the median level of HHI had a centralized zoning authority, zoning would have been 50% less stringent. Similarly, an increase in concentration from the 25th to the 75th percentile of HHI would lead to a reduction in minimum lot sizes of 34%.[22]

We then investigate whether more stringent zoning driven by granular zoning authorities leads to higher housing costs, as predicted by our model. In particular, we run the following CBSA-level IV regression

$$y_i = \beta_0 + \beta_{MLS} \cdot log\widehat{MLS}_i + X_i\beta_X + \epsilon_i \tag{23}$$

where y_i is a CBSA-level outcome variable that includes population and housing cost. We instrument $\log MLS$ with log HHI as of 1900 and include the full set of location controls X.

22. Going from the median HHI to one entity implies HHI changing from 4,084 to 10,000 and MLS changing by $1 - e^{-0.215\log(100000)}/e^{-0.215\log(4084)} = 0.497$; going from the 25th to the 75th percentile implies HHI changing from 1,199 to 7,738 and MLS changing by $1 - e^{-0.215\log(7738)}/e^{-0.215\log(1100)} = 0.343$.

Table 3 reports the regression results. Columns (1) and (2) report the IV regression results with the CBSA population as outcome variables in different functional forms. Although the coefficient of $\widehat{MLS}$ loses its statistical significance in one of the coefficients, we find a negative relationship between $\widehat{MLS}$ and population. In addition, Columns (1) and (2) report the IV regression results with the CBSA housing cost as outcome variables in different functional forms. We find a positive and significant relationship between $\widehat{MLS}$ and housing costs. The results imply that more stringent zoning due to the granular structures of municipalities as of 1900 decreases population while increasing housing costs, as predicted by our theory.

3.6 Robustness checks

Alternative min lot size estimates

Panels A and B in Table 4 present the robustness checks using alternative CBSA-level min lot size measures. Panel A uses alternative MLS estimates from Song (2022), where neighborhood-level min lot size estimates are estimated from all single-family construction instead of restricting them to construction after 1940. These alternative MLS estimates cover all 909 CBSAs, while the precision may be lower than the baseline estimates due to including older single-family construction. Panel B uses the baseline MLS estimates from Song (2022), thus covering 834 CBSAs, but adopts a different aggregation scheme. Here, we use the median of municipality-level median MLS in each CBSA instead of taking the average. Both alternative min lot size measures generate consistent results, with small coefficient changes in the full specification (4).

Using Wharton index

Panel C in Table 4 presents the robustness checks using more commonly used Wharton indices as the outcome variable (Gyourko et al., 2021). Density Restriction Index (DRI) in the Wharton Residential Land Use Survey characterizes the stringency of density restrictions and reflects the largest minimum lot size (MLS) required in each municipality.[23] Although the survey does not have as many municipalities as our baseline min lot size estates, the survey includes DRI in 2,434 municipalities of 560 CBSAs in the contiguous United States.[24] We take the average of the DRI at each CBSA and repeat the CBSA-level OLS and IV regressions. The results are consistent with our prediction, with a coefficient of -0.1758 and a t-statistic of -2.62 in the full IV regression.

4 Conclusion

We identify a novel reason for why zoning rules are too strict – they are determined locally and the decision makers do not internalize the effect of these rules on global house prices. We provide empirical evidence showing strong support for this mechanism in the cross-section of metros – the more subdivided a metro is in terms of decision making, the more stringent its zoning rules are. This implies that policy makers worried about housing affordability should redirect zoning decision to county, metro, or state levels. Since 2019, several locales have done exactly this.

23. DRI takes a value of 0 if there is no MLS imposed in the jurisdiction, 1 if the largest MLS is no larger than 0.5 acres, 2 if it is in between 0.5 and 1 acres, 3 if it is in between 1 and 2 acres, and 4 if it is larger than 2 acres.

24. DRI is 0 for 160 of the 2,434 municipalities, 1 for 946 municipalities, 2 for 379 municipalities, and 4 for the rest 627 municipalities.

Figure 1 — Model results

The left panels in this figure present results from the 'Migration within metros' model in section 2.1 as we vary the probability (q) of staying in one's own neighborhood and increase the probability of moving to a neighborhood making independent zoning decisions. This is equivalent to increasing the number of equal sized jurisdictions ($m = 1/q$) that make independent zoning decisions; we plot m on the x-axis. The right panels present results from the 'Migration across metros' model in section 2.2 as we vary the number of neighborhoods (m) that make independent zoning decisions. The vertical panels show, respectively, metro-wide housing quantity h (equivalently, the inverse of zoning restrictiveness), house prices p, congestion ϕ, number of immigrants N (perfectly correlated with population $M + N$), and utility u.

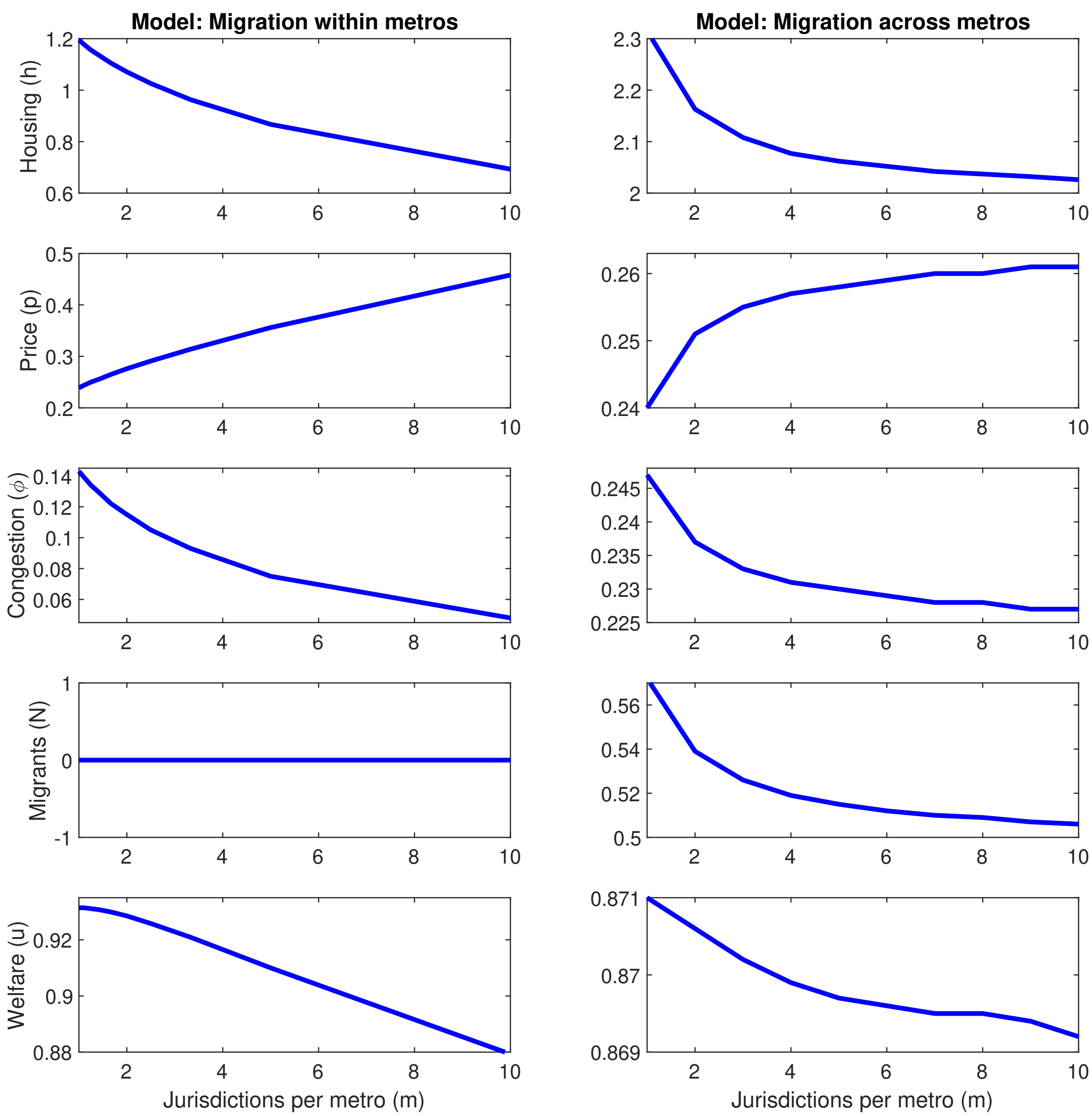

Figure 2 — Correlation between zoning jurisdiction HHI and min lot size

The figure depicts the scatter plots (black dots) and their fitted lines (blue solid lines) where the x-axis is zoning jurisdiction HHI and the y-axis is minimum lot size at the CBSA level. Both axes are on a logarithmic scale. It also depicts binned data points with 20 bins (red crosses) and shows the coefficient estimate and R^2 from the univariate regression of log min lot size on log HHI at the CBSA level ($N = 834$).

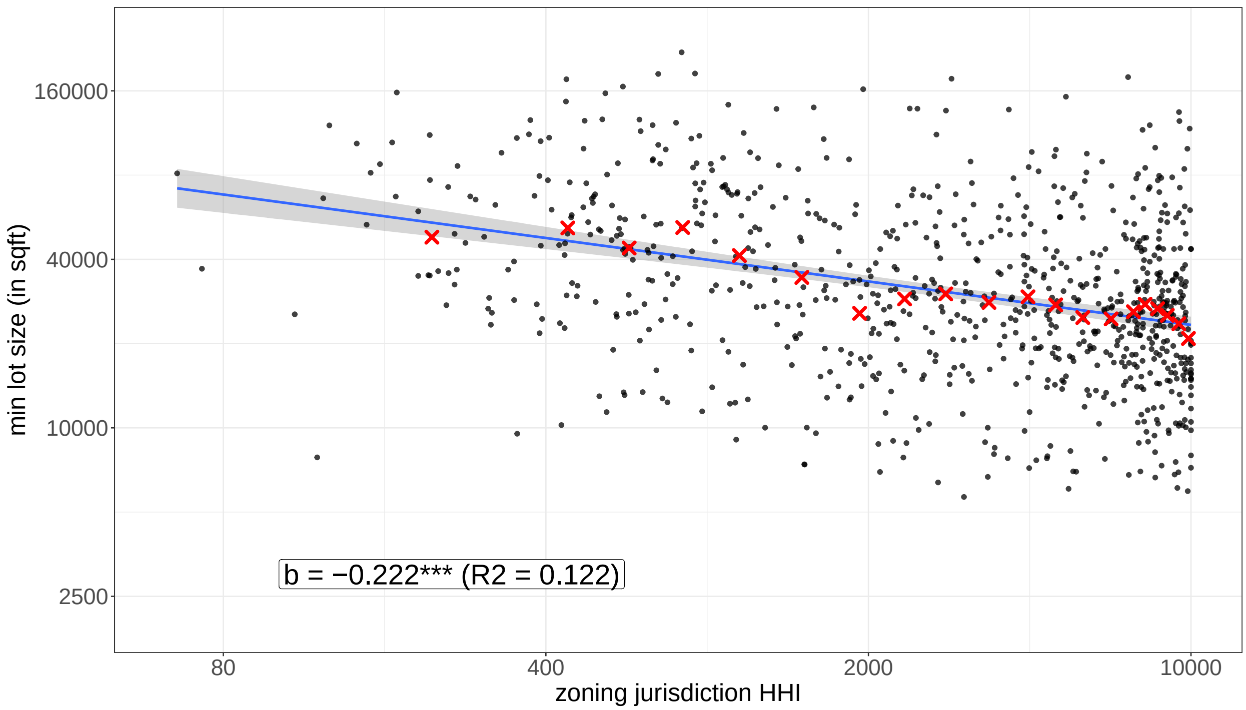

Table 1 — Summary statistics

This table reports the mean, standard deviation, 10th percentile, 25th percentile, 50th percentile, 75th percentile, and 90th percentile of the min lot sizes, the zoning jurisdiction HHI, the number of municipalities, and the area of residential land. In panel A, we compute the median of min lot size at each municipality weighted by the number of parcels in each zoning district and present the summary statistics. In panel B, we compute the mean of municipality-level min lot size in each CBSA and present the summary statistics. We also compute the zoning jurisdiction HHI, the number of municipalities, and the residential area in each CBSA to present the summary statistics.

	(1) Mean	(2) SD	(3) 10th	(4) 25th	(5) 50th	(6) 75th	(7) 90th
A. municipality-level							
median MLS (in sqft)	46,703	72,149	7,498	10,359	18,034	43,560	114,824
B. CBSA-level							
median MLS (in sqft)	27,332	27,715	8,800	12,071	18,729	37,462	43,560
zoning jurisdiction HHI	4,485	3,285	527	1,199	4,084	7,738	9,178
HHI as of 1900	4,886	3,520	543	1,247	4,662	8,574	9,770
# municipality	23.0	40.0	4	6	12	23	50
# municipality as of 1900	16.5	31.3	1	3	7	17	36
residential area (in acre)	245,350	570,453	18,677	39,253	100,754	215,994	511,744

Table 2 — Estimated effect of HHI on zoning stringency

This table presents the results of the regression in equation 22. The dependent variable is a measure of zoning stringency, defined as the log of median minimum lot size in the metro. Column (1) is a univariate regression, and Column (2) includes the full set of control variables. Columns (3)-(4) report the coefficients of CBSA-level IV regressions. The coefficients of land use compositions and industry shares are omitted due to space limitations.

	Outcome variable: log min lot size			
	(1)	(2)	(3)	(4)
	OLS		IV: HHI as of 1900	
log HHI	-0.2222***	-0.1944***	-0.2576***	-0.2136***
	(0.0205)	(0.0309)	(0.0213)	(0.0328)
1(No municipality before 1900)		0.3952***	0.0287	0.3899***
		(0.1245)	(0.1296)	(0.1245)
log Area of residential land		0.1619***		0.1646***
		(0.0351)		(0.0351)
2001 land developability		-0.0012		-0.0011
		(0.0010)		(0.0010)
log 1969 population		-0.3303***		-0.3432***
		(0.0811)		(0.0815)
1969 % white		-7.577		-8.353
		(8.979)		(8.992)
log 1940 population		0.1293*		0.1299*
		(0.0765)		(0.0765)
1940 % white		0.0060		0.0057
		(0.0070)		(0.0070)
1940 % Black		0.0122*		0.0118
		(0.0073)		(0.0073)
1940 % Hispanic		0.0002		0.0001
		(0.0035)		(0.0035)
log 1940 avg. rent		-0.0008		0.0002
		(0.0364)		(0.0364)
log 1940 avg. home value		0.0736		0.0680
		(0.0954)		(0.0954)
1940 ownership rate		-0.0022		-0.0025
		(0.0029)		(0.0029)
log 1940 avg. income		-0.1209		-0.1207
		(0.0903)		(0.0903)
1940 % with nonwage income		0.0037		0.0038
		(0.0048)		(0.0048)
2000 % republican votes		-0.0308**		-0.0301**
		(0.0122)		(0.0122)
2000 % democratic votes		-0.0374***		-0.0368***
		(0.0130)		(0.0130)
avg. temperature		0.0994***		0.0938***
		(0.0234)		(0.0236)
avg. temperature in Jan		-0.0964***		-0.0914***
		(0.0171)		(0.0173)
avg. precipitation		0.0698**		0.0683**
		(0.0298)		(0.0298)
Observations	834	834	834	834
Adjusted R^2	0.12230	0.36353	0.11817	0.36322

Significance: ***: 0.01, **: 0.05, *: 0.1

Table 3 — Estimated effect of zoning stringency on other outcomes

This table presents the results of the regression in equation 23. The dependent variable in Columns (1) and (2) is the CBSA-level total population from 2020 ACS 5-year estimates. Columns (1) and (3) are level regressions, and the dependent variable in Columns (3) and (4) is the CBSA-level median monthly housing costs from 2020 ACS 5-year estimates, and Columns (2) and (4) are log regressions. All columns report the coefficients of CBSA-level IV regressions, including the full set of controls. The coefficients of land use compositions and industry shares are omitted due to space limitations.

	Outcome: total population		Outcome: median housing cost	
	(1)	(2)	(3)	(4)
	pop in mn.	log pop	$ monthly cost	log cost
log $\widehat{MLS}$	-0.5983**	-0.0755	90.39**	0.0841**
	(0.2505)	(0.0657)	(44.41)	(0.0427)
1(No municipality before 1900)	0.4437**	-0.0309	-85.52**	-0.0834**
	(0.2247)	(0.0590)	(39.84)	(0.0383)
log Area of residential land	-0.0113	0.0244	-50.72***	-0.0450***
	(0.0649)	(0.0170)	(11.50)	(0.0111)
2001 land developability	-0.0037**	-0.0009**	0.5875*	0.0006*
	(0.0017)	(0.0004)	(0.3020)	(0.0003)
log 1969 population	0.3195**	1.081***	167.9***	0.1858***
	(0.1344)	(0.0353)	(23.83)	(0.0229)
1969 % white	91.95***	17.84***	11,907.5***	10.33***
	(14.09)	(3.696)	(2,497.6)	(2.399)
log 1940 population	0.4373***	-0.0854***	-56.40**	-0.0754***
	(0.1251)	(0.0328)	(22.18)	(0.0213)
1940 % white	-0.0030	0.0006	1.972	0.0026
	(0.0113)	(0.0030)	(1.999)	(0.0019)
1940 % Black	-0.0081	-0.0028	-0.0948	0.0016
	(0.0123)	(0.0032)	(2.177)	(0.0021)
1940 % Hispanic	-0.0060	-0.0026*	-1.516	-0.0007
	(0.0055)	(0.0015)	(0.9828)	(0.0009)
log 1940 avg. rent	0.0033	-0.0516***	5.860	0.0047
	(0.0579)	(0.0152)	(10.26)	(0.0099)
log 1940 avg. home value	0.1248	0.0239	107.1***	0.1062***
	(0.1539)	(0.0404)	(27.28)	(0.0262)
1940 ownership rate	-0.0062	0.0038***	-0.9849	-0.0008
	(0.0045)	(0.0012)	(0.8030)	(0.0008)
log 1940 avg. income	-0.1200	0.0470	39.16	0.0743***
	(0.1467)	(0.0385)	(26.02)	(0.0250)
1940 % with nonwage income	0.0214***	-0.0028	5.655***	0.0056***
	(0.0076)	(0.0020)	(1.346)	(0.0013)
2000 % republican votes	-0.0312	-0.0200***	-24.20***	-0.0253***
	(0.0215)	(0.0056)	(3.818)	(0.0037)
2000 % democratic votes	-0.0297	-0.0221***	-21.76***	-0.0253***
	(0.0231)	(0.0061)	(4.099)	(0.0039)
avg. temperature	0.0800	0.0080	-41.60***	-0.0274***
	(0.0514)	(0.0135)	(9.105)	(0.0087)
avg. temperature in Jan	-0.0346	0.0108	36.71***	0.0230***
	(0.0433)	(0.0114)	(7.687)	(0.0074)
avg. precipitation	-0.0699	-0.0633***	-42.25***	-0.0272***
	(0.0512)	(0.0134)	(9.081)	(0.0087)
Observations	815	815	815	815
Adjusted R^2	0.42072	0.96705	0.63752	0.67150

Significance: ***: 0.01, **: 0.05, *: 0.1

Table 4 — Robustness checks

This table presents robustness checks to alternative zoning stringency measures and functional-form assumptions in equation 22. Panel A uses alternative min lot size estimates from Song (2022) using all single-family construction instead of post-1940 with complete coverage. Panel B aggregates municipality-level median min lot sizes at the CBSA level by taking the median instead of the mean. Panel C uses the Density Restriction Index (DRI) in 2018 Wharton Land Use Survey. We take the unweighted average of municipality-level DRI at each CBSA to construct the outcome variable. The coefficients of control variables are omitted due to space limitations.

	A. MLS estimate: all construction			
	(1)	(2)	(3)	(4)
	OLS		IV	
log HHI	-0.2718***	-0.2473***	-0.3025***	-0.2677***
	(0.0193)	(0.0286)	(0.0201)	(0.0304)
Controls	No	Full	No	Full
Observations	909	909	909	909
Adjusted R^2	0.17914	0.40389	0.17595	0.40354

	B. Functional form: median			
	(1)	(2)	(3)	(4)
	OLS		IV	
log HHI	-0.1031***	-0.2040***	-0.1230***	-0.2258***
	(0.0189)	(0.0275)	(0.0196)	(0.0292)
Controls	No	Full	No	Full
Observations	834	834	834	834
Adjusted R^2	0.03320	0.34677	0.03571	0.34625

	C. Density Restriction Index in Wharton Survey			
	(1)	(2)	(3)	(4)
	OLS		IV	
log HHI	-0.1591***	-0.1885***	-0.1485***	-0.1758***
	(0.0376)	(0.0628)	(0.0393)	(0.0671)
Controls	No	Full	No	Full
Observations	560	560	560	560
Adjusted R^2	0.02944	0.08721	0.02843	0.08714

IID standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

References

Albouy, David, Kristian Behrens, Frédéric Robert-Nicoud, and Nathan Seegert. 2019. "The optimal distribution of population across cities." *Journal of Urban Economics* 110 102–113. https://doi.org/10.1016/j.jue.2018.08.004.

Albouy, David, and Gabriel Ehrlich. 2018. "Housing productivity and the social cost of land-use restrictions." *Journal of Urban Economics* 107 101–120. https://doi.org/10.1016/j.jue.2018.06.002.

Allen, Treb, Costas Arkolakis, and Xiangliang Li. 2016. "Optimal city structure." *Working paper.*

Anagol, Santosh, Fernando V. Ferreira, and Jonah M. Rexer. 2022. "Estimating the Economic Value of Zoning Reform." *Working paper.*

Bronin, Sara. 2022. "Zoning by a Thousand Cuts." *Cornell Journal of Law and Public Policy.*

Brueckner, Jan K. 1990. "Growth Controls and Land Values in an Open City." *Land Economics* 66 (3): 237–248, `http://www.jstor.org/stable/3146726`.

Brueckner, Jan K. 1995. "Strategic control of growth in a system of cities." *Journal of Public Economics* 57 (3): 393–416. https://doi.org/10.1016/0047-2727(95)80003-R.

Brueckner, Jan K. 1998. "Testing for Strategic Interaction Among Local Governments: The Case of Growth Controls." *Journal of Urban Economics* 44 (3): 438–467. https://doi.org/10.1006/juec.1997.2078.

Calabrese, Stephen, Dennis Epple, and Richard Romano. 2007. "On the political economy of zoning." *Journal of Public Economics* 91 (1): 25–49. https://doi.org/10.1016/j.jpubeco.2006.09.004.

Cooley, Thomas F., and C.J. LaCivita. 1982. "A theory of growth controls." *Journal of Urban Economics* 12 (2): 129–145. https://doi.org/10.1016/0094-1190(82)90010-9.

Ellickson, Robert C. 1977. "Suburban Growth Controls: An Economic and Legal Analysis." *The Yale Law Journal* 86 (3): 385–511, `http://www.jstor.org/stable/795798`.

Engle, Robert, Peter Navarro, and Richard Carson. 1992. "On the theory of growth controls." *Journal of Urban Economics* 32 269–283.

Erickson, Rodney A., and David R. Wollover. 1987. "LOCAL TAX BURDENS AND THE SUPPLY OF BUSINESS SITES IN SUBURBAN MUNICIPALITIES*." *Journal of Regional Science* 27 (1): 25–37. https://doi.org/10.1111/j.1467-9787.1987.tb01142.x.

Evenson, Bengte, William C. Wheaton, Joseph Gyourko, and John M. Quigley. 2003. "Local Variation in Land Use Regulations [with Comments]." *Brookings-Wharton Papers on Urban Affairs* 221–260, `http://www.jstor.org/stable/25067399`.

Fischel, William A. 1978. "A Property Rights Approach to Municipal Zoning." *Land Economics* 54 (1): 64–81, `http://www.jstor.org/stable/3146203`.

Fischel, William A. 2004. "An Economic History of Zoning and a Cure for its Exclusionary Effects." *Urban Studies* 41 (2): 317–340. 10.1080/0042098032000165271.

Fischel, William A. 2008. "Political structure and exclusionary zoning: Are small suburbs the problem?" In *Fiscal decentralization and land policies*, edited by Ingram, G.K., and Y.-H. Hong, Chap. 5 111–136, Cambridge, MA: Lincoln Institute of Land Policy.

Glaeser, Edward L., and Joseph Gyourko. 2002. "The Impact of Zoning on Housing Affordability." *NBER Working Paper 8835*.

Glaeser, Edward L., Joseph Gyourko, and Raven E. Saks. 2005. "Why Have Housing Prices Gone Up?" *American Economic Review* 95 (2): 329–333. 10.1257/000282805774669961.

Glaeser, Edward L., and Bryce A. Ward. 2009. "The causes and consequences of land use regulation: Evidence from Greater Boston." *Journal of Urban Economics* 65 (3): 265–278. https://doi.org/10.1016/j.jue.2008.06.003.

Goodman, Christopher B. 2023. "Municipal Incorporation Data, 1789-2020." March, https://github.com/cbgoodman/muni-incorporation/.

Green, Richard K., Stephen Malpezzi, and Stephen K. Mayo. 2005. "Metropolitan-Specific Estimates of the Price Elasticity of Supply of Housing, and Their Sources." *American Economic Review* 95 (2): 334–339. 10.1257/000282805774670077.

Gyourko, Joe, and Jacob Krimmel. 2021. "The impact of local residential land use restrictions on land values across and within single family housing markets." *Journal of Urban Economics* 126 103374. https://doi.org/10.1016/j.jue.2021.103374.

Gyourko, Joseph, Jonathan S. Hartley, and Jacob Krimmel. 2021. "The local residential land use regulatory environment across U.S. housing markets: Evidence from a new Wharton index." *Journal of Urban Economics* 124 103337. https://doi.org/10.1016/j.jue.2021.103337.

Gyourko, Joseph, and Raven Molloy. 2015. "Chapter 19 - Regulation and Housing Supply." In *Handbook of Regional and Urban Economics*, edited by Duranton, Gilles, J. Vernon Henderson, and William C. Strange Volume 5. of Handbook of Regional and Urban Economics 1289–1337, Elsevier, . https://doi.org/10.1016/B978-0-444-59531-7.00019-3.

Gyourko, Joseph, Albert Saiz, and Anita Summers. 2008. "A New Measure of the Local Regulatory Environment for Housing Markets: The Wharton Residential Land Use Regulatory Index." *Urban Studies* 45 (3): 693–729. 10.1177/0042098007087341.

Hamilton, Bruce W. 1975. "Zoning and Property Taxation in a System of Local Governments." *Urban Studies* 12 (2): 205–211. 10.1080/00420987520080301.

Hamilton, Bruce W. 1978. "Zoning and the exercise of monopoly power." *Journal of Urban Economics* 5 (1): 116–130. https://doi.org/10.1016/0094-1190(78)90040-2.

Helsley, Robert W., and William C. Strange. 1995. "Strategic growth controls." *Regional Science and Urban Economics* 25 (4): 435–460. https://doi.org/10.1016/0166-0462(95)02095-C, Recent Advances in Urban Economics and Land Use: A Special Issue in Honour of Hiroyuki Yamada.

Hilber, Christian A.L., and Frédéric Robert-Nicoud. 2013. "On the origins of land use regulations: Theory and evidence from US metro areas." *Journal of Urban Economics* 75 29–43. https://doi.org/10.1016/j.jue.2012.10.002.

Hsieh, Chang-Tai, and Enrico Moretti. 2019. "Housing Constraints and Spatial Misallocation." *American Economic Journal: Macroeconomics* 11 (2): 1–39. 10.1257/mac.20170388.

Huang, Haifang, and Yao Tang. 2012. "Residential land use regulation and the US housing price cycle between 2000 and 2009." *Journal of Urban Economics* 71 (1): 93–99. https://doi.org/10.1016/j.jue.2011.08.001.

Jackson, Kristoffer. 2016. "Do land use regulations stifle residential development? Evidence from California cities." *Journal of Urban Economics* 91 45–56. https://doi.org/10.1016/j.jue.2015.11.004.

Jackson, Kristoffer. 2018. "Regulation, land constraints, and California's boom and bust." *Regional Science and Urban Economics* 68 130–147. https://doi.org/10.1016/j.regsciurbeco.2017.10.005.

Kahn, Matthew E. 2011. "Do liberal cities limit new housing development? Evidence from California." *Journal of Urban Economics* 69 (2): 223–228. https://doi.org/10.1016/j.jue.2010.10.001.

Kahn, Matthew E., Ryan Vaughn, and Jonathan Zasloff. 2010. "The housing market effects of discrete land use regulations: Evidence from the California coastal boundary zone." *Journal of Housing Economics* 19 (4): 269–279. https://doi.org/10.1016/j.jhe.2010.09.001.

Khan, Asad. 2022. “Decentralized Land-Use Regulation with Agglomeration Spillovers: Evidence from Aldermanic Privilege in Chicago.” *Working paper.* https://doi.org/10.1016/j.jue.2010.10.001.

Kok, Nils, Paavo Monkkonen, and John M. Quigley. 2014. “Land use regulations and the value of land and housing: An intra-metropolitan analysis.” *Journal of Urban Economics* 81 136–148. https://doi.org/10.1016/j.jue.2014.03.004.

Kulka, Amrita. 2022. “Sorting into neighborhoods: the role of minimum lot sizes.” *Working paper.*

Landis, John, and Vincent J. Reina. 2021. “Do Restrictive Land Use Regulations Make Housing More Expensive Everywhere?” *Economic Development Quarterly* 35 (4): 305–324. 10.1177/08912424211043500.

Lens, Michael C., and Paavo Monkkonen. 2026. “Do strict land use regulations make metropolitan areas more segregated by income?” *Journal of the American Planning Association* 82 (1): 6–21.

Lutz, Byron. 2015. “Quasi-Experimental Evidence on the Connection between Property Taxes and Residential Capital Investment.” *American Economic Journal: Economic Policy* 7 (1): 300–330. 10.1257/pol.20120017.

Mawhorter, Sarah, and Carolina Reid. 2018. “Terner California Residential Land Use Survey.” *University of California, Berkeley.*

Mayer, Christopher J, and C.Tsuriel Somerville. 2000. “Land use regulation and new construction.” *Regional Science and Urban Economics* 30 (6): 639–662. https://doi.org/10.1016/S0166-0462(00)00055-7.

Menendian, Stephen, Samir Gambhir, Karina French, and Arthur Gailes. 2020. “Singe-family zoning in the San Francisco Bay area.” *Berkeley, CA: Haas Institute for a Fair and Inclusive Society.*

Metropolitan Area Planning Council. 2020. "Zoning Atlas." https://zoningatlas.mapc.org/.

Mills, Edwin S., and Wallace E. Oates. 1975. *Fiscal zoning and land use controls: the economic issues.* Lexington, MA: Lexington Books.

Ortalo-Magne, Francois, and Andrea Prat. 2007. "The Political Economy of Housing Supply: Homeowners, Workers, and Voters." *Working paper.*

Parkhomenko, Andrii. 2018. "The Rise of Housing Supply Regulation in the U.S.: Local Causes and Aggregate Implications." *Working paper.*

Parkhomenko, Andrii. 2021. "Local Causes and Aggregate Implications of Land Use Regulations." *Working paper.*

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

Quigley, John M, Steven Raphael, and Larry A. Rosenthal. 2008. "Measuring land-use regulations and their effects in the housing market." *Working paper.*

Quigley, John M, and Larry A. Rosenthal. 2005. "The Effects of Land Use Regulation on the Price of Housing: What Do We Know? What Can We Learn?" *Citiscape: A Journal of Policy Development and Research* 8 (1): .

Rolleston, Barbara Sherman. 1987. "Determinants of restrictive suburban zoning: An empirical analysis." *Journal of Urban Economics* 21 (1): 1–21. https://doi.org/10.1016/0094-1190(87)90019-2.

Rosen, Kenneth T., and Lawrence F. Katz. 1981. "Growth Management and Land use Controls: The San Francisco Bay Area Experience." *Real Estate Economics* 9 (4): 321–344. https://doi.org/10.1111/1540-6229.00247.

Rossi-Hansberg, Esteban. 2004. "Optimal urban land use and zoning." *Review of Economic Dynamics* 7 (1): 69–106. https://doi.org/10.1016/S1094-2025(03)00056-5.

Sahn, Alexander. 2021. "Racial Diversity and Exclusionary Zoning: Evidence from the Great Migration." *Working paper.*

Saiz, Albert. 2010. "The Geographic Determinants of Housing Supply*." *The Quarterly Journal of Economics* 125 (3): 1253–1296. 10.1162/qjec.2010.125.3.1253.

Shertzer, Allison, Tate Twinam, and Randall P. Walsh. 2016. "Race, Ethnicity, and Discriminatory Zoning." *American Economic Journal: Applied Economics* 8 (3): 217–46. 10.1257/app.20140430.

Song, Jaehee. 2022. "The effets of residential zoning in U.S. housing markets." *Working paper.*

Tiebout, Charles M. 1956. "A Pure Theory of Local Expenditures." *Journal of Political Economy* 64 (5): 416–424, `http://www.jstor.org/stable/1826343`.

Trounstine, Jessica. 2020. "The Geography of Inequality: How Land Use Regulation Produces Segregation." *American Political Science Review* 114 (2): 443–455. 10.1017/S0003055419000844.

Turner, Matthew A., Andrew Haughwout, and Wilbert van der Klaauw. 2014. "Land Use Regulation and Welfare." *Econometrica* 82 (4): 1341–1403. https://doi.org/10.3982/ECTA9823.

Vermeulen, Wouter. 2016. "Agglomeration externalities and urban growth controls." *Journal of Economic Geography* 17 (1): 59–94. 10.1093/jeg/lbv047.

Wheaton, William C. 1993. "Land Capitalization, Tiebout Mobility, and the Role of Zoning Regulations." *Journal of Urban Economics* 34 (2): 102–117. https://doi.org/10.1006/juec.1993.1029.

Wu, JunJie, and Seong-Hoon Cho. 2007. "The effect of local land use regulations on urban development in the Western United States." *Regional Science and Urban Economics* 37 (1): 69–86. https://doi.org/10.1016/j.regsciurbeco.2006.06.008.

Appendix

A Figures and Tables

Table A.1 — Data sources

Variable	**Source**
Land area by uses (total residential land area, % residential,% agricultural, % commercial, % industrial, % multifamily among residential)	CoreLogic property tax records in 2018
% residential properties built after 1940 and 1970	CoreLogic propertytax records in 2018
1969 demographics (total population, % white)	Survey of Epidemiology and End Results
1940 housing and financial characteristics (total population, % white, % Black, % Hispanic, % homeownership, avg home value, avg rent, avg income, % with nonwage income)	IPUMS complete-count Census
Presidential election returns (% rep., % dem. from 2000)	MIT Election Data + Science Lab
Weather condition (avg temperature year-around and in Jan, avg precipitation)	PRISM Weather data
Land developability index in 2021	National Land Cover Database
1990 industry shares (by # of establishments)	County Business Patterns

Table A.2 — First Stage Regressions

This table presents the coefficients of the 1st stage IV regression in equation 22. The dependent variable is a current HHI, and the instrument is HHI as of 1900. Column (1) is a univariate regression, and Column (2) includes the full set of control variables. The coefficients of land use compositions and industry shares are omitted due to space limitations.

	Outcome variable: log HHI	
	(1)	(2)
log HHI as of 1900	0.9712***	0.9617***
	(0.0078)	(0.0121)
1(No municipality before 1900)	-0.3041***	-0.2198***
	(0.0493)	(0.0477)
log Area of residential land		0.0267**
		(0.0134)
2001 land developability		0.0002
		(0.0004)
log 1969 population		-0.1983***
		(0.0307)
1969 % white		-10.87***
		(3.434)
log 1940 population		0.0898***
		(0.0294)
1940 % white		-0.0003
		(0.0027)
1940 % Black		-0.0010
		(0.0028)
1940 % Hispanic		0.0007
		(0.0013)
log 1940 avg. rent		0.0116
		(0.0140)
log 1940 avg. home value		0.0430
		(0.0367)
1940 ownership rate		-0.0035***
		(0.0011)
log 1940 avg. income		0.0429
		(0.0347)
1940 % with nonwage income		0.0022
		(0.0018)
2000 % republican votes		0.0085*
		(0.0047)
2000 % democratic votes		0.0088*
		(0.0050)
avg. temperature		-0.0070
		(0.0090)
avg. temperature in Jan		0.0004
		(0.0066)
avg. precipitation		0.0381***
		(0.0115)
Observations	834	834
Adjusted R^2	0.94979	0.96243

Significance: ***: 0.01, **: 0.05, *: 0.1