Decentralized Zoning with Agglomeration Spillovers: Evidence from Aldermanic Privilege in Chicago*

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Abstract

With the rising cost of living in urban areas, local control of land-use regulation has come under increasing scrutiny. This paper uses novel data on tens of thousands of zoning changes over two decades in Chicago to study the causes and consequences of local determination, exploiting for identification Chicago's tradition of Aldermanic Privilege–which delegates zoning authority to each of 50 City Wards. I find that homeownership causally restricts zoning, with race, income and congestion concerns less relevant. To measure the spillover effects of neighborhood-level zoning decisions, I then integrate locally-controlled, endogenous zoning into a structural model of city structure. Renters and homeowners sort into neighborhoods on heterogeneous location preferences, and then vote on local zoning decisions–potentially ignoring the productivity and amenity spillovers of additional density on other neighborhoods. Having accounted for the endogeneity of zoning, I estimate relatively small net benefits of density on local amenities, and document evidence that the negative effects of density are more than twice as concentrated as the positive effects. These results emphasize how policymakers interested in zoning reforms must contend with local hetereogeneity in the effects of agglomeration.

Keywords: Zoning, Agglomeration, Real Estate, Public Economics

JEL Codes: R32, H73, D62, R31, R38

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Contents

1 Introduction

Restrictive land-use regulation, or zoning, has been the focus of increasing academic and political attention. Many studies have implicated zoning behind issues ranging from the increasing price of housing (Glaeser and Saks, 2005) to racial segregation. (Nelson, Dawkins and Sanchez, 2004) As a result, various reforms have been proposed at both the State and Federal level, and several leading Democratic Presidential Candidates explicitly refer to the need to reform zoning laws in their platforms.[1]

But the *decentralization* of zoning regulation presents a significant challenge to these top-down reforms. Generally under the purview of municipalities, land-use regulation is determined by local officials and planners and usually subject to significant community influence. A majority of municipalities report significant local community and local official involvement in zoning decisions. (Gyourko, Saiz and Summers, 2008) Even municipal-level reforms, such as loosening regulation around mass-transit, have been stymied by local community opposition to development. (Freemark, 2019)

Why does the decentralization of zoning authority matter? The classic model of local public good provision as in Tiebout (1965) is instructive. Zoning regulation restricts the *density* of development, and density has consequences for quality of life, productivity, and other local characteristics. On the one hand, local determination allows for communities to provide varying degrees of density in accordance with constituent preferences over density and housing composition. On the other hand, inefficiencies in the level of development may result to the extent that there exist agglomeration externalities–or the spillover effects of density–which communities do not internalize. The effects of decentralization depend, therefore, on the preferences over which residents sort as well as the form, size and spatial extent which the externalities take.

In this paper, I conceptualize the zoning externality in the form of its effects on commuting market access and agglomeration effects on amenities and productivity. This is in contrast to the literature which has generally focused on the *fiscal* externalities of zoning or spillover effects on land and housing prices. (Mills and Oates (1975), Fischel (1980), Turner, Haughwout and van der Klauuw (2014)) A growing literature examines the effects of inelastic housing supply on the misallocation of labor at a national level, e.g. Hsieh and Moretti (2019), Parkhomenko (2018) and Albouy and Ehrlich (2018). However, I am unaware of work that examines this issue at the intra-city level, between neighborhoods. Given substantial evidence that agglomeration effects attenuate very rapidly with distance, with most effects localized to within several miles, there is considerable scope for inefficiencies in the allocation of labor to result *within* cities.

I incorporate locally-determined, endogenous zoning regulation over density into the workhorse quantitative city model of Ahlfeldt et al. (2015) with recent contributions of Tsivanidis (2018), Severen (2018)

[1] California's SB-35 (2017) and the Federal H.O.M.E.Act (2018). V.P. Biden and Sen. Warren propose using block grants as incentives to State and Local governments to loosen local zoning regulations.

and Allen, Arkolakis and Li (2015). Neighborhoods are spatially linked through commuting, with wages and amenities serving as an attractive force, and travel times and housing prices serving as a congestive force. Crucially, there exist agglomeration externalities in density which are not necessarily internalized by each neighborhood's planning official.

Empirically, I first document the existence of highly-localized influence over land-use regulation operating through non-market channels, including causal evidence of homeowner-driven opposition to development, heretofore difficult to empirically establish. Based on the empirical patterns I observe, I incorporate heterogeneity in home tenure into the model, with homeowners and renters sorting based on tenure-specific amenities. I also distinguish between positive and negative agglomeration externalities, in order to estimate the extent to which the negative externalities of density–such as congestion and pollution–are more spatially concentrated than the positive externalities–such as improved safety or consumption amenities.

My empirical analysis exploits a rich data set of tens of thousands of re-zoned parcels over two decades, and a unique institutional context ideal for identification–the City of Chicago and *Aldermanic Privilege*. While most large cities in the United States practice *de facto* decentralized, community-driven zoning processes, their institutional features do not lend themselves to causal analysis. For example, New York City empowers 59 community boards with authority to review proposed changes in zoning; however, the boundaries of these boards' jurisdictions are static, and New York City's central Department of Planning maintains ultimate planning authority. Chicago similarly delegates authority over zoning decisions to 50 Wards according to the long-established tradition of Aldermanic Privilege. But the Ward's boundaries shift over time and lack compactness, therefore providing both spatial and temporal variation in the political constituency to which a given neighborhood belongs. Further, Chicago's central planning department rarely intervenes in small-scale neighborhood zoning decisions, allowing me to identify the local determinants of zoning restrictiveness.

This paper also contributes to the literature on identifying agglomeration spillovers by exploiting exogenous variation in land-use regulation. Much of the literature in this area relies on quasi-experimental changes in employment, e.g. manufacturing plant openings in Greenstone and Moretti (2010), or instruments representing supply shifters in real estate reflecting the cost side of production, e.g. location of bedrock in Rosenthal and Strange (2008). However, the supply-side is also affected by land-use regulation, which is itself by correlated with natural features and other factors that make development difficult. (Saiz, 2010) This approach therefore conflates the effects of land-use regulation with other drivers of housing costs, and suffers from a potential positive selection problem by measuring the effects of density in precisely those places where the benefits of agglomeration were large enough to warrant flexible land-use regulation. This paper attempts to address this issue by identifying agglomeration effects in a way that captures the endogeneity of zoning, and finds smaller amenity benefits to density when taking this into account.

The remainder of the paper is organized as follows. I begin by providing background–describing how zoning authority varies across the United States, explaining how Aldermanic Privilege operates in Chicago and why it is relevant to this analysis, and then outline the conceptual framework for evaluating the welfare effects of decentralized zoning authority. Then, I detail the quantitative city model, with emphasis on how my model departs from the literature by incorporating home tenure and endogenous, locally-varying zoning regulation.

I use the model to motivate the reduced-form analysis of tens of thousands of zoning changes, or re-zonings, in Chicago between 2002 and 2016. First, I investigate the determinants of zoning changes, explaining variation in observed zoning restrictiveness–the change in the zoned floor-to-area ratio for every re-zoned parcel–by local demographic and economic characteristics. Controlling for prices, parcel characteristics and other demand-side determinants of density, I find that homeownership significantly predicts more restrictive zoning. I also find strong political effects on zoning, such as more restrictive residential zoning near Ward boundaries, and evidence of preferences of local officials (i.e., Alderman). Aggregating zoning changes to the Census Block and Census Tract levels, I find that homeownership is causally restricting zoning, instrumenting for housing demand using neighborhood-level, Bartik-style labor demand instruments.

I then move to the structural estimation,building on the reduced-form motivation for the determinants of zoning and evidence of the relevance of the institutional context. I recover estimates of amenities and productivity, and describe how zoning changes causally influence these measures, and how it varies by resident tenure type. I then describe my identification strategy which exploits a political re-districting in Chicago in order to recover estimates of the agglomeration externalities. I estimate the size and spatial extent of agglomeration externalities within the context of decentralized and endogenous zoning, showing where they are similar and differ from the literature and how they are relevant to this context. I also find that the costs of development are significantly more concentrated than the social benefits, with the difference reaching a relative maximum around 10-15 minutes away in walking time. Finally, I describe how the model and data can be used to simulate various policies which have been proposed to either strengthen or curtail the level of local control.

2 Decentralized Zoning

The focus of this paper is on the phenomenon of *decentralized zoning*, where small jurisdictions and local interest groups have significant influence over zoning decisions. Though this is a widespread phenomenon that has garnered increasing national attention, the empirical analysis of this paper is focused on Chicago. This city is a useful context to study due to the particular political structure that can be exploited for identification. But it is also relevant because the Chicago metropolitan area is of average regulatory restrictiveness, and most large cities have similar forms of decentralized zoning determination.

2.1 National Variation in Zoning Restrictiveness

The Wharton Residential Land Use Regulation Index (wrluri), the most comprehensive national survey of municipalities on land use regulation, provides clear evidence of the existence of local influence over zoning decisions. (Gyourko, Saiz and Summers, 2008) A number of sub-indexes such as the Local Political Pressure Index (LPPI), the Local Zoning Approval Index (LZAI), the Local Project Approval Index (LPAI), and the Local Assembly Index (LAI) measure the extent of community involvement and number of hurdles a zoning decision must overcome in order to succeed. They find that the most highly regulated locations, as measured by the full index value (WRLURI), tend to have high scores in these sub-indexes. This indicates the potentially significant effect local factors may have on average regulatory restrictiveness. Further, the majority of cities surveyed report that local officials and local community groups are involved in zoning decisions to a level above '3', on a scale of 1 to 5 where 1 is 'not at all involved' and 5 is 'very involved.' See Figure 4.

However, Gyourko, Saiz and Summers (2008) also find that the Local Zoning Approval Index (LZAI), which asks whether a local zoning board is tasked with reviewing zoning decisions, is slightly negatively correlated with average regulatory restrictiveness. This suggests that while local control and influence generally adds hurdles to zoning changes, decentralization of zoning authority to local zoning boards may, in fact, allow for less regulatory restrictiveness overall.

The Chicago MSA's WRLURI score is 0.06, reflecting roughly average restrictiveness in land-use regulation relative to the average; the WRLURI index is standardized to a mean of 0 and standard deviation of 1. However, the City of Chicago's WRLURI score is -1.17, more than one standard deviation below average–and far below even Houston, which famously lacks any zoning code. This is despite the City of Chicago reporting values of '5', or 'Very Involved', for both Local Community Involvement and Local Pressure Involvement. As demonstrated in the empirical analysis, there is evidence of substantial zoning restrictiveness in Chicago that is difficult to reconcile with such a low index value.

More importantly, the WRLURI value for any individual city is fairly idiosyncratic, being based on often-subjective responses by a planning official. Based on the component values of the City of Chicago's survey response, Chicago's low WRLURI score is a result of the City having reported few official zoning restrictions and requirements, such as unit limits, open space requirements, or affordability restrictions. While some of these responses were technically true at the time, there are many unofficial requirements that are demanded by Aldermen and neighborhood groups. Notably, in their survey response, Chicago officials reported 1,000 zoning change requests in the past year, 850 of which were approved. This is by far the highest number of changes requested and approved in the survey sample, and likely reflects the reality of parcel-by-parcel zoning in Chicago, rather than a generally unrestrictive zoning regime.

2.2 Chicago and Aldermanic Privilege

Chicago passed its first zoning code in 1923, one of the first large cities to do so in the United States. Generally, the primary functions of the zoning code are, one, to control the *type* of development in a particular location, i.e. whether residential or manufacturing; and two, to control the *size* of development. The first is often referred to as the 'separation of uses' rationale for zoning, motivated by the need to address the myriad externalities which are naturally associated with dense, urban environments. The second was initially motivated, at least nominally, by concerns over public safety due to what were considered extremely cramped living conditions.

My empirical strategy exploits Chicago's system of Aldermanic Privilege to study the effects of local determination of land-use regulation. As discussed, some form of zoning decentralization is the norm across the country, with Chicago being no exception. However, there is suggestive evidence that Chicago is unique in its *level* of decentralization and in how who holds zoning authority is sharply-defined through Aldermanic Privilege.[2]

The *Encyclopedia of Chicago* defines Aldermanic Privilege as "the power of Chicago city council members (aldermen) to initiate or block city council or city government actions concerning their own wards." (Thale, 2005) It is a tradition "widely recognized by scholars as one of the most significant and constant themes in Chicago local politics." Zhang (2011) Aldermen have even been referred to as "little mayors" ruling their Wards as fiefdoms. (Einhorn, 1991)

Chicago's battles over zoning and Alderman-driven process are well-known. Becker et al. (2008) is a well-publicized Chicago Tribune investigation into the zoning re-classification process that focused on the perceived corruption among aldermen in approving new developments in order to obtain favors from real estate developers. Most notably, they document several cases of large campaign contributions following re-zoning approvals, which provides an explanation for why aldermen may not always bend to the will of anti-development constituents. This evidence on the very political process motivates my identification strategy, which relies on the fact that the decision to re-zone is made by Aldermen based on political pressure from constituents mainly within their respective wards.

The main written aspect of this power, with respect to zoning, is the power of Aldermen to initiate zoning changes within their Wards. (See Section 10.1 for more detail) But it is the unwritten aspects that accord Alderman much more power. Despite no official role in re-zoning and permit approval beyond a single vote in City Council, some application forms nonetheless have a line for the local Alderman to sign. (**?**) Zhang (2011) quotes an Alderman at length who says that aldermanic prerogative "means

[2]For example, New York City officially allows community and borough boards to hold hearings and submit recommendations on requested zoning changes, but final approval is determined by the City's Department of City Planning–making it impossible to empirically distinguish how much influence communities have relative to the City.

simply you respect your colleagues' rights to do things that they want to in their wards, and you could do what you want to in your wards. If the aldermen deny something in their own wards, their colleagues would never bring it up again. Very few things happen that the aldermen don't want to happen for their particular wards."

But does Aldermanic Privilege genuinely have an influence on zoning? To answer this question, I use zoning re-classification data from 2002-2016—summarized in Table 1—which are independent instances of a specific development project obtaining regulatory approval from the respective Ward Alderman to build beyond the previously-allowed density. These data provide clear evidence that zoning is variable over short periods of time and space. And I have found strong evidence of local community influence over this zoning re-classification process; these reduced-form results demonstrate that locally-determined land-use regulation is a factor that is significant and relevant in this context. And, as zoning is determined on a Ward-by-Ward basis, I aim to exploit changes in the Ward boundaries as a source of variation in the determinants of zoning restrictiveness.

2.3 Potential Welfare Consequences of Decentralization

The substantial literature on agglomeration documents the existence of externalities associated with density. To the extent that the spillover effects of density are not internalized by those who determine zoning, which implicitly serves as a limit on density, there is potential for zoning to be inefficiently restrictive.

As an illustrative example of the forms of agglomeration spillovers on amenities and productivity that I consider in this paper and how they interact with zoning, consider the following case: Neighborhood i' population of residents consumes local amenities B_i, and the entire population of residents commutes to work in a Central Business District (CBD) called neighborhood j, wherein they earn wages w_j. See Figure 1

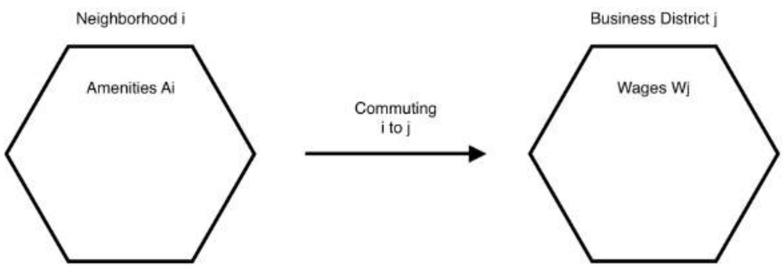

Figure 1: Consequences of Decentralization – Illustration (1)

Then, suppose a developer finds that it would be profitable to develop a given parcel of land within neighborhood i at a greater density than current zoning allows, requiring a zoning change. In order to determine whether to allow the zoning change, the neighborhood's residents–through their elected representative–must weigh the costs and benefits associated with this zoning change.

Among the *benefits* to the neighborhood of allowing greater density is the increase in *local* neighborhood amenities, such as lower crime and better restaurants. Also, because the new residents who would live in the neighborhood would also commute to the same CBD, the greater concentration of employment would generate improvements in worker productivity, yielding an increase in wages for residents of the neighborhood. Among the *costs* of greater density are reduced amenities due to congestion (in roads, parks, schools, etc.), construction, and pecuniary externalities on homeowners and landowners as a result of increased housing supply. See Figure 2

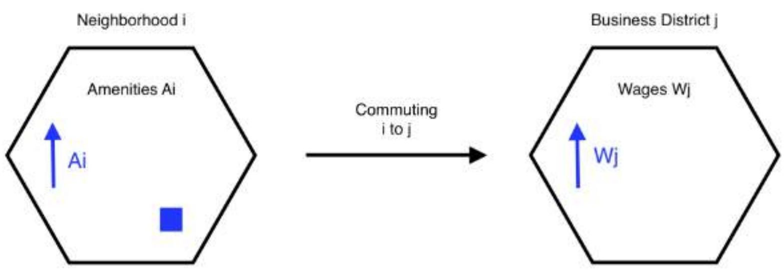

Figure 2: Consequences of Decentralization – Illustration (2)

If the change in local amenities and productivity is sufficiently positive, then the community approves a zoning change up to a limit, beyond which the negative externalities associated with increased density outweigh the benefits. To the extent that the neighborhood has internalized all of the spillovers associated with the zoning change, the zoning change is plausibly efficient.

However, consider the existence of an adjacent neighborhood k, whose residents commute to the same CBD. This neighborhood's residents are also affected by the increase in productivity in the CBD resulting from the zoning change, and are also affected to some degree by the change in amenities resulting from the zoning change.

Crucially, the residents of neighborhood i, who made the original zoning decision, may not internalize the full effects of these spillovers on k. And if the negative externalities associated with development are sufficiently convex or more heavily concentrated relative to the benefits, then neighborhood i's residents may set zoning at an inefficiently restrictive level. For example, if a large development would generate congestion that is heavily localized, but support retail businesses and employment that can be more widely enjoyed, local residents may be less inclined to support the project than those who live further away. See Figure 3

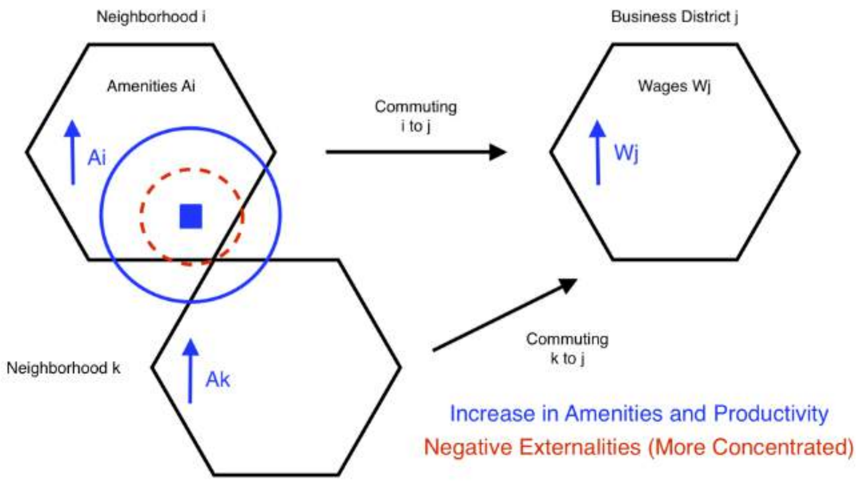

Figure 3: Consequences of Decentralization – Illustration (3)

This example summarizes the basic intuition of the paper. Depending on the level of decentralization and the spatial extent of agglomeration externalities, locally-determined land-use regulation may have important welfare consequences. Therefore, in this paper I aim to demonstrate that zoning is indeed locally-controlled; identify the local determinants of zoning restrictiveness; develop a model that captures the relevant causes and consequences of locally-determined zoning given agglomeration externalities; and estimate the size and spatial extent of externalities in order to guide zoning policy.

3 Model

The model builds on a class of quantitative spatial models which have recently made significant advances.[3] It follows most closely the influential work of Ahlfeldt et al. (2015)—which has been subsequently adapted to various contexts, including evaluating the effects of transportation infrastructure in Bogotá (Tsivanidis, 2018) and Los Angeles (Severen, 2018), and the long-run effects of pollution by Lin (2018). However,

[3]See Redding and Rossi-Hansberg (2017) for a review of developments in this area.

the reality of variable and endogenous zoning is omitted in these papers.[4] The most closely related work to mine is a working paper by Allen, Arkolakis and Li (2015), which uses a similar gravity model to evaluate the welfare effects of changing zoning in Chicago; however, they simulate zoning as exogenously controlled by a central planner and only study the optimal mix of residential to commercial space. To the best of my knowledge, my work is the first attempt to endogenize zoning in this class of quantitative spatial models of city structure.

The model includes a housing productivity term that varies by location, capturing local variation in the ease of development–mainly, variation in zoning restrictiveness. The remaining features of the model follow the literature closely. Households sort over which tracts in which they choose to live and work, and firms producing a final good according to a Cobb-Douglas production technology using workers and commercial floorspace. Crucially, there are spillover effects of density. Workplace productivity and residential amenities are increasing in the density of employment and residents, respectively; several structural parameters govern the size and spatial extent of these density externalities. In Section 6, I describe how these structural parameters may be recovered using my empirical framework.

3.1 Households

Household of type $h \in \{r, o\}$ consumes consumption index $\mathbb{C}_{ijh}$ by choosing to live in tract i and work in tract j. The household receives amenities B_i, wages w_j, and pays floor prices Q_i for floorspace l_i.

Homeownership extension: Households also receive an endogenous homeownership amenity a_{ih}, which is increasing in the concentration of homeownership, but owners incur an additional user-cost of housing μ_{io} while the user-cost of housing for renters is $\mu_{ir} = 1$. Finally, local residential land rents $\Pi_i = Q_i R_{Ri}$ are distributed to local residents by the fraction of homeowners residing there, $\frac{H_o}{H}$, giving a non-wage income of $\pi_{io} = \frac{H_o}{H}\Pi_i(1-\theta)$.

$$\max_{c_{ij}, l_i} \mathbb{C}_{ijh} = \frac{B_i a_{ih} z_{ijh}}{d_{ij}} \left(\frac{c_{ij}}{\beta}\right)^{\beta} \left(\frac{l_i}{1-\beta}\right)^{1-\beta}, 0 < \beta < 1$$

s.t.

$$c_{ij} + \frac{Q_i}{\mu_{ih}} l_i \leq w_j + \pi_{io}$$

They have idiosyncratic preferences with the idiosyncratic component of utility z_{ijh} distributed Fréchet

$$F(z_{ijo}) = e^{-T_i E_j z_{ijh}^{-\epsilon}}, T_i, E_j > 0, \epsilon > 1$$

[4] Ahlfeldt et al. (2015) assumes housing productivity does not vary by location; Tsivanidis (2018) assumes the supply of floor space is fixed; Severen (2018) assumes zoning does not change over time.

$T_i > 0$ and $E_j > 0$ are scale parameters determine the average utility of living in tract i and working in tract j. The Fréchet shape parameter $\epsilon > 1$ controls the dispersion of utility, with a higher value reflecting lower heterogeneity in the utility households derive from a given pair of tracts in which to live and work. Therefore, the indirect utility of household o, conditional on living in tract i and commuting to work in tract j, can be solved for as

$$u_{o|ij} = z_{ijo} B_i a_{ih} \left(\frac{Q_i}{\mu_{ih}}\right)^{\beta-1} \frac{W_{ij}}{d_{ij}}$$

Conditional on tenure status h, the probability that a worker lives in tract i and commutes to tract j is therefore

$$\pi_{ij|h} = \frac{T_i E_j (d_{ij}(Q_i \mu_{ih}^{-1})^{1-\beta})^{-\epsilon}(B_i a_{ih} w_j)^{\epsilon}}{\sum_{r=1}^{S}\sum_{s=1}^{S} T_r E_s (d_{rs}(Q_r \mu_{ih}^{-1})^{1-\beta})^{-\epsilon}(B_r a_{rh} w_r)^{\epsilon}}$$

Homeowners pay an annualized cost of housing P_i. In equilibrium, $Q_i = \mu_i P_i$. Therefore, the price-to-rent ratio is $\frac{P_i}{Q_i} = \frac{1}{d_i}$, where d_i is the user-cost of housing.

3.2 Production and Wages

Firms produce a final, tradable good using the production technology $Y_j = A_j H_{Mj}^{\alpha} R_{Mj}^{1-\alpha}$

H_{Mj} is a measure of workplace employment and R_{Mj} a measure of commercial floorspace used in production. Assuming perfect competition, workers are paid their marginal product,

$$W_j = \alpha A_i \left(\frac{H_{Mj}}{R_{Mj}}\right)^{\alpha-1}$$

3.3 Real Estate Production

Developers produce floor space R_i using capital K and and land L

$$R_i = K_i^{\mu} L_i^{1-\mu}$$

Let $K_i = \left(\theta V_i^{\psi} + (1-\theta) M_i^{\psi}\right)^{1-\mu}$, where the price of value-adding materials is p_v and the price of structural materials is p_m. Then, given optimal capital intensity K_0, the developer solves

$$\min_{V_i, M_i} p_v V_i + p_m M_i$$

s.t. $K_0 = \left(\theta V_i^{\psi} + (1-\theta) M_i^{\psi}\right)^{1-\mu}$.

The developer's cost-minimizing marginal cost of capital is

$$K^* \left(\frac{p_v \left(\frac{p_v}{\theta}\right)^{\frac{1}{\psi-1}} + p_m \left(\frac{p_m}{1-\theta}\right)^{\frac{1}{\psi-1}}}{\left(\theta\left(\frac{p_v}{\theta}\right) + (1-\theta)\left(\frac{p_m}{1-\theta}\right)\right)^{\frac{1}{\psi}}} \right)$$

If land-use regulation imposes a limit on structural capital per unit of land, FAR, such that $M_i^* > \bar{M}_i$, the developer re-optimizes by maximizing profit subject to a set input of structural material $\bar{M}_i$

$$Q_i R_i^{\bar{M}} - \mathbb{P}K_i - \mathbb{R}_i L_i$$

where $R_i^{\bar{M}} = \left[\theta V_i^{\psi} + (1-\theta)\bar{M_i}^{\psi}\right] L_i^{1-\mu} = C_i \tilde{K_i}^{\mu} L_i^{1-\mu}$

Developers produce floor space R_i using capital $\tilde{K}$ and and land L

$$R_i = \tilde{K}_i^{\mu} L_i^{1-\mu}$$

Let $\tilde{K}_i = \left(\theta V_i^{\psi} + (1-\theta)M_i^{\psi}\right)^{1-\mu}$, where the price of value-adding materials is p_v and the price of structural materials is p_m. Then, given optimal capital intensity $\tilde{K}_0$, the developer solves

$$\min_{V_i, M_i} p_v V_i + p_m M_i$$

s.t. $\tilde{K}_0 = \left(\theta V_i^{\psi} + (1-\theta)M_i^{\psi}\right)^{1-\mu}$.

The developer's cost-minimizing marginal cost of capital is

$$\tilde{K}^* \left(\frac{p_v \left(\frac{p_v}{\theta}\right)^{\frac{1}{\psi-1}} + p_m \left(\frac{p_m}{1-\theta}\right)^{\frac{1}{\psi-1}}}{\left(\theta\left(\frac{p_v}{\theta}\right) + (1-\theta)\left(\frac{p_m}{1-\theta}\right)\right)^{\frac{1}{\psi}}} \right)$$

If land-use regulation imposes a limit on structural capital per unit of land, FAR, such that $M_i^* > \bar{M}_i$, the developer re-optimizes by maximizing profit subject to a set input of structural material $\bar{M}_i$

$$Q_i R_i^{\bar{M}} - \mathbb{P}\tilde{K}_i - \mathbb{R}_i L_i$$

where $R_i^{\bar{M}} = \left[\theta V_i^{\psi} + (1-\theta)\bar{M_i}^{\psi}\right]^{\mu} L_i^{1-\mu} = \left[\theta V_i^{\psi} + \tilde{C}_i\right]^{\mu} L_i^{1-\mu} = C_i K_i^{\mu} L_i^{1-\mu}$

Thus, the production function under a binding zoning constraint is

$$R_i = C_i K_i^{\mu} L_i^{1-\mu}$$

where C_i captures variation in each location's land-use regulation.[5] The developer's profit is

[5]Severen (2018) similarly incorporates housing productivity into the Ahlfeldt et al. (2015) structural model, but assumes zoning does not vary over time. See Albouy and Ehrlich (2018) for a more general treatment of how zoning influences

$$Q_i R_i - \mathbb{P} K_i - \mathbb{R}_i L_i$$

The first-order conditions with respect to the factors of production give

$$Q_i = \frac{\mathbb{P}}{\mu C_i}\left(\frac{K_i}{L_i}\right)^{1-\mu} = \frac{\mathbb{R}_i}{(1-\mu)C_i}\left(\frac{K_i}{L_i}\right)^{\mu}$$

The dual cost function is $\mathbb{Q}_i = C_i^{-1}\mu^{-\mu}(1-\mu)^{-(1-\mu)}\mathbb{P}^{\mu}\mathbb{R}_i^{1-\mu} = \chi C_i^{-1}\mathbb{R}_i^{1-\mu}$.

Housing productivity reflects both unobserved determinants of land-use regulation, and the various homeownership-driven factors that affect it. I parameterize it as $C_i = \bar{C}_i\left(\sum_{s=1}^{S} e^{-\delta\tau_{ij}}\frac{H_s^o}{H_s^r}\right)^{-\Gamma}$

Therefore, housing prices can be written as a function of a component that varies with homeownership-concentration

$$Q_i = \tilde{\gamma}\mathbb{R}_i^{1-\mu}\left(\sum_{s=1}^{S} e^{-\delta\tau_{ij}}\frac{H_s^o}{H_s^r}\right)^{\Gamma} = \bar{Q}_i Z_i^{\Gamma}$$

3.4 Endogenous Land-Use Regulation

Land-use regulation enters the model through the housing productivity term C_i. Below, I describe how changes in a zoning limit on the Floor-to-Area ratio influence average housing productivity.

Normalizing land input, $L_i = 1$, zoning mandates a maximum Floor-to-Area Ratio for each location i such that housing productivity is effectively zero past the legal density limit (as additional capital input will have zero productive value, by law)

$$\overline{\text{FAR}}_i \equiv C_i K_i^{\mu} \quad ; \quad C_i = \begin{cases} 1 & \text{if } FAR_i \leq \overline{FAR}_i \\ \tilde{C}_i & \text{if } FAR_i > \overline{FAR}_i \end{cases}$$

However, the developer lobbies for zoning change if the optimal density exceeds the zoning limit, $FAR_i^* > \overline{FAR}_i$. The local planning official makes a decision $\mathbb{Z}_i$ to maximize the political objective function

$$\max_{\mathbb{Z}_i \in \{0,1\}} v(\mathbb{Z}_i, \sum_{o \in \mathcal{W}} u_o, b_i)$$

where $\mathcal{W}$ is the set of locations i *within* the planner's jurisdiction, u_o is the utility of household o, and b_i is a side-payment from the developer. The main assumption is that only effects on the official's own constituents and own jurisdiction matter—the spillover effects of changing zoning on other jurisdictions' residents are disregarded. This generates an inefficiency, but the direction is not theoretically obvious

housing productivity.

as it depends not only on the magnitude of the spillover but also on whether the benefits are relatively more diffuse than the costs. (See Figure 11)

In an alternative specification, I parameterize the price of housing as composed of a component that varies by the concentration of within-Ward homeownership, with the elasticity Γ_i representing the sensitivity of prices to local *political* influence over land-use regulation.

$$Q_i = \bar{Q}_i \left(\sum_{s=1}^{S} e^{-\delta \tau_{ij}} \frac{H_s^o}{H_s^r} \right)^{\Gamma}$$

3.5 Externalities

Both productivity and amenities include a fundamental level that varies by location, and a component that is increasing in local employment and residential density, respectively.

- Production: $A_j = a_j \gamma_j^{\lambda}$, γ_j a function of employment density
- Residential Amenities: $B_i = b_{ih} \Omega_i^{\eta}$, Ω_i a function of travel-time weighted residential density

$$\gamma_j \equiv \sum_{s=1}^{S} e^{-\delta \tau_{ij}} \left(\frac{H_{Ms}}{L_s} \right)$$

$$\Omega_i \equiv \sum_{s=1}^{S} e^{-\rho \tau_{ij}} \left(\frac{H_{Rs}}{L_s} \right)$$

Additionally, there is the local homeowner amenity measure $a_{ih} = \bar{a_{ih}} \left(\frac{L_{io}}{L_i} \right)^{\zeta_h}$, where $\frac{L_{io}}{L_i}$ is the fraction of households in the Census tract who are homeowners. Both types of households prefer living near homeowners due to the endogeneous amenities which homeowners, as opposed to renters, tend to provide. However, the parameter ζ_h is allowed to vary between groups.

4 Reduced-Form Analysis: Re-Zonings

4.1 Data

The data on zoning re-classifications were hand-collected by coding information from thousands of individual City Council ordinances approving the changes from 2010 to 2016 and through a FOIA request of changes to the zoning map from 2002-2016. Additional data include floor prices from Zillow and CoreLogic housing transactions. Census products used include block-to-block commuting flow data from LEHD Origin-Destination Employment Statistics (LODES); the 200 Decennial Census; and the Census Transportation Planning Products (CTPP).

Figure 6 illustrates the number of re-zoned parcels by year in my full sample. In much of the reduced-form analysis at the parcel-level that follows, a more restricted sample from 2010-2016 is used due to greater data availability; re-zoning data from this period was collected directly from City Ordinances, yielding additional information, and building permit data was only available from 2011 onward. However, in the reduced-form analysis at a more aggregated level as well as the structural estimation later in the paper, the full sample of re-zonings from 2002-2016.

Section 10.1 provides additional background and supporting information on Chicago's zoning code, and the process through with re-zoning operates.

4.2 Density Measures

The data provide several measures which capture different aspects of size and density of development. The primary measure is the Floor-to-Area Ratio (FAR), which sets an upper-limit on the amount of floor space of the new development given the total area of the parcel upon which it is built. For example, a 1,000 square foot parcel with a FAR of 1 can have a total of 1,000 square feet of developed space. Thus, the FAR also has the useful feature of allowing me to calculate an upper-limit on the square-footage of new developments. Most relevant to my analysis, the percentage change in the Floor-to-Area Ratio as a result of re-zoning is equivalent to the percentage change in total square footage of the development; this measure serves as my primary outcome variable in my analysis. See Figure 8.

An alternative measure of density - related to congestion-related effects of new developments rather than size - is the Lot Area per Unit (LAPU). The LAPU sets a limit on the number of housing *units*; for example, a 1,000 square foot lot with a LAPU of 500 can have a maximum of 2 housing units. In conjunction with the FAR and parcel size the LAPU allows me to calculate the maximum allowable square footage per unit of new developments.

Tables 12 and 13 list the 67 different zoning levels and their respective FAR and LAPU requirements.

4.3 Determinants of Re-Zonings

The baseline analysis is over the set of re-zonings from 2010 to 2016, for which a match to parcels and building permits was possible. The goal of this analysis is to identify the determinants of these zoning changes, based on observable characteristics of the Ward and Precinct associated with each zoning change.

Most re-zonings change the Floor-to-Area Ratio of the relevant parcel(s); I regress these changes on determinants of density using the following regression model:[6]

$$\Delta FAR_i\% = \alpha + \beta_1 Rent_i + \beta_2 \theta_i + \beta_3 \psi_p + \beta_4 OnWardBoundary(x)_i + \epsilon_i \quad (1)$$

[6] $Rent_i$ is local rental price per square foot, θ_i is a vector or parcel characteristics (e.g., size, location, etc.), ψ_p is a vector of demographic characteristics for the political jurisdiction in which the project is located (e.g., homeownership rates, income, race, etc.), and $OnWardBoundary(x)_i = 1$ if the project is within 250 feet of the Ward boundary and $OnWardBoundary(x)_i = 0$ otherwise.

Controlling for home prices and other determinants of density, I find that re-zonings are 10% smaller near political boundaries (Table 3), with the effect attenuating with distance (Figure 10). This strongly suggests that Aldermen are not internalizing the spillover benefits of development which accrue to other Wards' constituents; as the benefits of development are likely to be more diffuse and the costs more concentrated, developments near Ward boundaries will be less politically beneficial. (Figure 11)

The identifying assumption is that only *within*-Ward characteristics will plausibly affect variation in zoning restrictiveness, as measured by changes in FAR. To test this, the same regression is run on local demographics measured at varying geographies–some political, and some non-political. As shown in Table 10, there are several different geographies ranging from Census Blocks to Wards and Community Areas (denoted "Neighborhood"). Precincts are subsets of Wards, but Census Tracts and Community Areas do not reflect distinct political groupings (with the latter generally crossing many Ward boundaries). As the results in Table 3 show, the effect of homeownership rates on zoning disappears at non-political groupings.

I also find robust estimates of the 'elusive' effect of homeownership on the restrictiveness of zoning.[7] A one percent increase in the local concentration of homeowners is associated with a 8-10 percentage point smaller change in the density constraint. (Table 2) This effect is robust to various controls, and a significantly stronger determinant than race and income. Thus, I exploit changes in homeownership concentration that result from Ward re-districting as a source of identification, described in the following section.

Further evidence of this comes from a type of *association effect*, where an area's mere association with a relatively high homeownership Ward significantly predicts the size of re-zoning in that area–even controlling for local characteristics.

To test this effect, the residuals from the following regression on all re-zonings are collected, where the change in density is regressed on a constant, straight-line distance to the CBD, and a Census Tract indicator:

$$\Delta Density_p\% = \alpha + \beta_1 dCBD_p + \theta Tract_p + \epsilon$$

Residuals are then plotted against distance to the nearest Ward boundary, and multiplied by 1 if the parcel is in a high homeownership rate Ward or multiplied by -1 if the parcel is in a low homeownership rate Ward. As shown in Figure 13, Wards with homeownership rates above the median have significantly smaller changes in zoning than Wards with below-median homeownership rates, even controlling for tract fixed-effects and distance to the CBD.

[7] Since *The Homevoter Hypothesis* (Fischel, 2004), it has been theorized that homeownership may predict zoning. But, according to Gyourko and Molloy (2015), "...there is little empirical evidence."

4.4 Block and Tract-level Changes

Aggregating zoning changes up to the Census Block allows for tracking how blocks' density evolves over time–especially as the blocks are re-assigned to different Aldermen and different Wards through elections and Ward re-districting.

$$\Delta FAR_{bt}\% = \alpha + \beta_1 HomeownershipWard_{bt} + Alderman_{bt} + Tract_{bt} + Ward_{bt} + Demographics_{bt} + \epsilon_{bt} \quad (2)$$

Table 4 reports the results of a panel regression of average, annual block-level changes in FAR (via re-zonings) on Ward homeownership rates, allowing with a substantial set of controls including population, race and average household size. The effect of homeownership is significantly negative, and even stronger with Alderman and Tract fixed effects. This suggests that the effect of homeownership on zoning restrictiveness exists beyond the political preferences of elected officials and time-invariant Census Tract characteristics.

Because most Census Blocks in Chicago did not experience a zoning change during my sample period, a large number of zeroes are necessarily excluded from the analysis. Further, simulating the spatial connections between over 46,000 city blocks is computationally challenging. For these reasons, the zoning changes were also aggregated to the Census Tract level for the following analysis, as well as the structural estimation below.

Because the observed changes in FAR are plausibly endogenous to homeownership and other block characteristics, I construct an instrument for the effect of homeownership on changes in zoning. Letting S denote the set of all Census Tracts in the city, and S_{Tt} the set of Census Tracts which are within the same Ward as Tract T at time t. Then z.all is the distance-weighted average concentration of homeownership for each Census Tract T, where the parameter ρ is a spatial decay parameter set at $\kappa\epsilon = 0.029$.

$$\text{z.all}_{Tt} = \sum_{S} \frac{e^{-\rho \delta_{Ts}} H^o_{st}/H^r_{st}}{\sum_s e^{-\rho \delta_{Ts}}}$$

The measure z.WW is similarly calculated but restricted to the set of tracts S_{Tt} which are within the same Ward as tract T.

$$\text{z.WW}_{Tt} = \sum_{S_T} \frac{e^{-\rho \delta_{Ts}} H^o_{st}/H^r_{st}}{\sum_s e^{-\rho \delta_{Ts}}}$$

Finally, z.diff is the log difference between the two measures. The measure z.all reflects the concentration of homeownership around a given Census Tract that affects the resulting rate of zoning change through both supply and demand channels. But z.WW reflects the concentration of homeowners who are more able to influence zoning through the regulatory channel via lobbying their elected official. I use the difference between these measures, z.diff, as an instrument for z.all in the following regression

$$\Delta FAR_{Tt}\% = \alpha + \beta_1 ln\text{z.all}_{Tt} + \beta_3 Rent_{Tt} + \beta_4 Demographics_{Tt} + \epsilon_{Tt} \quad (3)$$

Table 5 reports the results of this regression. The coefficient on z.all is negative and both economically and statistically significant, with a 1% increase in local homeownership concentration associated with 0.27% fewer zoning changes and 0.26% smaller zoning changes when there is a re-zoning in the tract.

Since this instrument is also correlated with where a tract is located within a Ward–i.e., whether it is on the edge or near the center–I construct the variable $Isolation_{Tt}$ which reflects how distant a tract is from the other tracts within the same Ward.

$$\text{Isolation}_{Tt} = -\sum_{S_T} e^{-\rho\delta_{Ts}}$$

This measure is negatively associated with both the number and size of re-zonings, as reported in Table 5. If a tract is on is distant from the rest of the Ward, we would expect fewer of the amenities that tract generates to be internalized by the residents of the Ward. This is consistent with the general intuition that the negative externalities associated with development are more concentrated than the costs.

4.5 Spatial Patterns in Re-Zoning

The first question is whether re-zoning patterns follow a clear pattern that is related to economic fundamentals, rather than a totally arbitrary political process. I test whether the pattern of re-zonings is related to the traditional determinant of city structure and density: distance to the CBD. [8]

In Table 11 I use an approach similar to McMillen (1996), where land values in Chicago are used to test the explanatory power of the monocentric city model, to instead test the fit to building *densities* as measured by their Floor-to-Area Ratio (FAR). This involves a low-order polynomial of straight-line distance to the CBD, distance to Lake Michigan, and distance to O'Hare and Midway Airports[9]. I also report estimates with additional measures N and E, where the distance North and distance East from the CBD are each interacted with the other distance measures; these interaction terms allow me to construct a much richer picture of where the developments lie in space, as well as help capture the interactive effects of these locations.

Table 11 shows that the monocentric city model describes the variation in current density - in my sample of re-zonings - remarkably well. Interestingly, the model is less able to explain the variation in densities *prior* to re-zoning, as measured by the difference in the regressions' respective R^2 values. This

[8] This simple monocentric city model describes Chicago's structure well; however, due to its limitations in describing fine variation at a local level in density, the structural spatial equilibrium model developed above will be used to better model this phenomenon.

[9] There is evidence for such a polynomial fit for Chicago from various other studies as well, e.g. Bowman and McDonald (1979)

result provides evidence that zoning re-classifications are indeed instances where a developer is at least partially overcoming a regulatory constraint and moving the density of a building in a particular location closer to the market-demanded (i.e., monocentric city model-predicted) density for that location.

In Figure 9 I graph FAR as a polynomial function of distance to the CBD using the estimated coefficients from Column 2 in Table 11. Density falls dramatically with distance from the CBD and begins to flatten between 5 and 7 kilometers away. This is roughly the distance of Lincoln Park, Wicker Park and Bronzeville, which are neighborhoods that are often recognized as noticeably more residential and suburban than areas even just slightly closer to the Loop. The curve additionally shows a slightly higher density 15 to 20 kilometers from the CBD; this likely corresponds to the existence of various commuter suburbs located roughly that distance from the CBD, such as Evanston, Skokie, Oak Park and Oak Lawn.

In summary, the Monocentric-city distance measures explain a significant amount of the spatial variation in density, suggesting that re-zonings are related to the fundamental economic drivers of density. Further, because homeownership - the variable of interest - also varies spatially in a systematic way (e.g. becomes more common further from the CBD), these distance measures ensure that variation in density is not erroneously attributed to variation in homeownership.

4.6 Surrounding Density and Zoning

While the analysis above has controlled for the population density of the area surrounding a particular development, there are reasons to believe that the *zoning* of the neighborhood plays an important role in determining the likelihood of a successful re-zoning. For example, it is likely easier to increase the zoning-defined FAR of a parcel when neighboring parcels have relatively high FARs themselves.

This may be the case because of preferences for neighborhood homogeneity in the size and type of housing. But there are legal reasons as well; 'spot zoning', or the practice of local governments imposing arbitrary zoning requirements absent a clear rationale for why it is in the public interest, has been repeatedly criticized by the courts and opens the City to a strong legal challenge. Therefore, if preceding a re-zoning a parcel is 'under-zoned' relative to its neighbors then denial of re-zoning can be legally challenged by the developer; and if a parcel would 'over-zoned' relative to its neighbors following a re-zoning then neighboring residents have a stronger legal basis to oppose the zoning change.

There are numerous measures one could produce to represent the zoning or density of the area surrounding a parcel being considered for re-zoning, but it is difficult to define the "neighborhood". The Census tract is often used throughout the urban economics literature as a proxy for neighborhoods, but Census tracts increasingly bisect what would be recognized as true neighborhood boundaries. Further, as discussed in Section 5, developments near Ward boundaries may have a portion of the negative externality they impose on the neighborhood politically 'censored'.

The rules relating to the re-zoning process provide us with a natural and intuitive geographic boundary. As part of the application process, the developer must send a letter to all properties within 250 feet of the parcel where development is to occur of the intended application for re-zoning[10]. Therefore, I identify all parcels within 250 feet of the centroid of the parcel where development is to occur and record their relevant characteristics: area of the parcel, FAR and total square footage. Figure 14 depicts an example of this process.

Three main measures of interest are calculated and added to the baseline regression. The first is the average FAR of neighboring parcels, denoted $NeighAvgFAR_i$, weighted by the size of the parcel. The purpose of weighting is to reflect the greater influence a large neighboring development would have relative to a smaller one. Nonetheless, it may be that all neighboring developments have similar influence, which motivates the inclusion of the second measure, $NumParcels_i$, or the number of neighboring parcels within 250 feet. This measure reflects the greater transaction costs associated with having to negotiate with more neighbors and, in conjunction with the first measure, allows us to capture how even a small neighbor can influence the re-zoning decision. Finally, I include a measure of the total square footage of buildings in the surrounding area, $NeighTotalSqFt_i$, to capture the effect that a larger existing supply of housing has on new development.

The results of this analysis are reported in Table 3. The most notable finding is that the average neighboring FAR has a large and negative influence on the size of re-zoning; a one-unit higher average FAR in the neighborhood, equivalent to an extra two floors on a building whose footprint occupies half the area of the parcel on which it sits, is associated with a 5% smaller change in the FAR of the new development.

The inclusion of these measures also allows more precise estimation of the other coefficients. In particular, the effect of $\%Families_{pi}$ is very precisely estimated and economically significant, with a 10 percent increase in the number of families in the precinct associated with a nearly 5% smaller change in the re-zoning. However, the main coefficient of interest, on $logHomeowners_{pi}$, is mostly unaffected by the inclusion of these additional controls.

Figure 15 illustrates an intriguing finding from this analysis. I plot each re-zoning colored by the difference between its new FAR and its neighbors' average FAR, to get a sense of the spatial variation in how incongruent these new developments are with their surrounding areas. I find that new developments in the Loop tend to be larger than their neighbors, but there is a sharp drop as we move further out. Just outside the Loop and near the Lake the developments tend to be of lower density than their neighbors. Then, it is once we get even further from the city center that we see a much greater proportion of "up-zonings". (Note: yellow, green and blue represent negative values)

The fact that near the center of the City we are observing a de-densification is surprising, yet sup-

[10]See Appendix Figure 24 for an example notification letter

ported by other evidence as well. For example, between the 2000 and 2010 Census, many of the most desirable areas in the North Side of Chicago actually saw a fall in population, despite dramatically increasing rent prices. This finding is more evidence that the zoning constraint is binding in much of the city.

4.7 Congestion-related Opposition

Throughout this paper I have emphasized homeownership as it relates to the homeowners' incentives to block new development in order to protect their homes against devaluation due to an increase in the supply of housing. But the effects of new development on existing residents include what may be considered the quintessential urban externality: congestion. New development may lead to increased road traffic, more noise, less privacy, and more congested public amenities.

Although there is not much reason to believe that these congestion-related externalities affect homeowners differently than renters, at least when controlling for income and family-status, there is nonetheless reason to investigate in the effect these externalities have on the supply of housing through the re-zoning approval process in order to more carefully craft policies to address them.

In Table 3 I report the results of three regressions in which I, beginning with the baseline model, incrementally include various transportation-related measures to capture some of these congestion-related effects. The first covariate is $Walkscore_i$, which is a 'walkability' index ranging from 0-100, or 'Car-Dependent' (almost all errands require a vehicle) to 'Walker's Paradise' (daily errands do not require a car)[11]. The estimated coefficient for Walk Score is positive, with a one point increase associated with a 0.5% increase in density of new development when controlling for the other congestion-related covariates. This result suggests that when incumbent residents expect newcomers to rely relatively more on walking rather than driving they are more willing to allow a given increase in the supply of housing.

The accessibility of public transportation is another factor which may help mitigate residents' concerns about new development. In Column 2 I introduce two indicator variables for whether a development is within 1/2 mile or 1/4 mile of a CTA 'L' station[12] . The motivation for these measures is the City of Chicago's Transit-Oriented Development Ordinance which reduces off-street parking and affordable housing requirements as well as greater FAR and lower LAPU for developments located near 'L' stations; the 1/2 and 1/4 mile indicators roughly measure whether a given development is eligible for the program if located at that distance on a pedestrian-designated or regular arterial streets, respectively.

Interestingly, the estimated coefficients on the TOD indicators are quite dramatically different: being located within between 1/2 and 1/4 of a mile from a CTA station is associated with 11% larger size, but being within 1/4 mile is associated with a 21% *decline* in density. This suggests that perhaps residents

[11] www.walkscore.com; Walk Score constructs an index by awarding points to nearby amenities based on distance, with zero points to anything beyond a thirty-minute walk.

[12] The 'L' is Chicago's partially-elevated light rail system which radiates from the city center, where it 'loops'.

do not share the same beliefs as lawmakers that the residents of developments located near ‘L’ stations are likely to rely much more on public transportation over driving, particularly since these are usually highly desirable locations and new developments are probably intended for wealthier residents - who are likely to drive more often than others.

Column 3 additionally controls for whether a development is located on an arterial or collector street and whether it is within a city-block’s distance of an expressway ramp. Arterials are major, high-volume roadways which generally allow for driving over longer stretches of the city, particularly to the CBD. Collectors, on the other hand, are large streets intended more for local commuting. The negative signs on the coefficients for Arterial and Collector are counter-intuitive in that we might generally expect more dense development located on major roadways. Instead, these results suggest that the prospect of increased traffic may be too much for local residents, particularly on arterial streets which must necessarily move quickly in order to allow for efficient commutes.

Finally, I find that the coefficient on $\log Homeowners_{pi}$ slightly declines in magnitude with the inclusion of the congestion-related covariates. This suggests that while my original baseline estimates may also be capturing these effects, for the most part the baseline estimates do not reflect the congestion-related concerns of local residents.

5 Political Factors

My identification strategy relies on the idea that ward-specific factors ought to explain the variation in the size of new development, controlling for market-demand. This is based on the concept of ‘Aldermanic Prerogative’, or the informal agreement between Chicago aldermen and the Mayor that an alderman has the right to control decisions over issues specific to his ward without interference - particularly over zoning. Assuming that aldermen are rational and motivated by the desire to maintain their positions, they must consider the expected benefits of approving new developments - namely, campaign donations from developers and votes from constituents who approve of the project - with the expected costs of approval - the loss of votes and protests from angry constituents.

As mentioned previously, the ward boundaries were re-drawn in 2012 behind closed doors in City Hall over the period of a month, and went into effect in 2015. According to reports, aldermen negotiated and horse-traded over where wards would be drawn on a block-by-block basis, in many cases; this is borne out by the resulting map of ward boundaries which depicts extremely gerrymandered wards across the city. Although the residents of the city may suffer due to the nature of overly-political boundaries, my analysis benefits from the practical exogeneity of the ward boundaries, with respect to homeownership and density.

I consider the effect of this change in ward boundaries in Table 3 with the inclusion of indicator variable

$WardRedrawn_i$, which is 1 if the development occurred between the time the new ward boundaries were drawn but before they went into effect *and* the development then ended up in a new ward. The purpose of this is to see whether the aldermen discounted the concerns of local residents who opposed new development because they were practically disenfranchised, as their alderman knew they would no longer be his constituents in the future. The estimated coefficient for this indicator is negative and statistically insignificant.

I then consider this *externality* interpretation of the effects of new development more carefully. In particular, I am interested in testing the intuition that the non-internalized benefits of new development, such as increased population and retail density and economic activity, are more diffuse than the non-internalized costs of new development such as lower home values in the immediate area due to a housing supply effect as well as increased congestion.

Consider a simple example: a new development located in Ward 1 has a net neutral effect on the surrounding community, i.e. the benefits exactly equal the costs. However, suppose the benefits are more diffuse than the costs, affecting a uniform area of radius r_B around the development, while the costs are more concentrated in a uniform area of r_C, as in Figure 11.

If we assume that population density is uniform around the development and that lobbying is costly, so that residents' level of support or protest is proportional to their individual experience of the externalities, we would expect the opposition to be louder and more effective than the supporters. But going further, if the circle that represents the area of the positive externality is intersected by a ward boundary, we would expect the voices of those who are caught on the other side to be at least somewhat censored since the have no *direct* political influence on matters in another ward - though they may still be able to influence some voters within the affected Ward.

And as can be seen by Figure 11, the intersection of the ward boundary disproportionately censors the positive voices over the negative ones, assuming the benefits are more diffuse. So, even in the case where the total benefits are equal to the total cost, as illustrated in Figure 12, the politically relevant costs would exceed the politically relevant benefits.

In Table 3 I report the estimated coefficient for $OnWardBoundary_i$, which is 1 if development i is located within 250 feet of the nearest ward boundary, and zero otherwise. I choose 250 feet as the re-zoning application process requires developers to notify all residents living within 250 feet of the new development of the intended zoning change at least 30 days before application; see Figure 24 for an example letter sent to neighbors. I find the effect to be both statistically and economically significant, with a negative 11% change in the size of new developments. This result is a strong confirmation that the benefits of new development are indeed more diffuse than the costs.

As a robustness check, I modify the $OnWardBoundary_i$ indicator to consider every discrete distance from the nearest boundary from 1 to 300 meters, and estimate a separate regression for each. In Figure

?? I graph the estimated coefficients from these regressions; as can be seen, my choice of 250 feet (represented by the dashed vertical line) is robust to alternative reasonable specifications. As can be seen from the figure, the effect virtually disappears at a distance of 150 meters, which may serve as an estimate of the general radius of the positive externalities, assuming the structure discussed above.

The next measure I consider relates to political participation. For each development I calculate the ratio of registered voters over population in 2010 in the respective precinct as a proxy for political participation rates. If a resident is registered to vote it is reasonable to believe that she is also more likely to pay attention to developments in her community and use political pressure to influence her alderman's behavior. Indeed, I find a very strong positive effect of political participation; a one percentage point increase in the participation rate is associated with a roughly 3% increase in the size of new developments.

Note that I am still controlling for homeownership, which means that this political participation effect may reflect the beliefs and preferences of residents in general. This is a disconcerting result in that it suggests that most residents may believe new development is a positive for the community, but do not do enough to encourage it. Since I am measuring *ward*-level participation rates, this means that those who may be somewhat distantly located from the proposed development may disproportionately experience the benefits rather than the costs and, thus, the more they are involved in community affairs the more support they likely lend to new development.

Finally, I consider the effect of political competitiveness on development. I construct an indicator, for competitive elections which is 1 if the relevant Alderman for the precinct in which development i is located had 40-60% of the vote share, and 0 otherwise. Such a vote share for the precinct means that it is competitive; if the vote share were near 0 or 100 the Alderman may simply ignore the precinct and focus on others in order to win the Ward. I find a very strong effect; developments located in competitive precincts are over 6% larger, controlling for other factors. Nonetheless, it is difficult to interpret the meaning of this estimate. Because this is a precinct-based measure, it is unlikely this estimate represents the effect of Alderman loosing zoning to obtain developer contributions; instead, it may be that more Aldermanic candidates are drawn to compete in such Wards and Precincts due to the potential of developer-provided benefits. Future work should delve more deeply into this selection process and the political incentives of local officials.

6 Structural Estimation

6.1 Calibration

Following Ahlfeldt, et al. (2015) Solve for adjusted wages ω_{jt} by tract using labor market clearing condition

$$H_{Mjt} = \sum_{i=1}^{S} \frac{\omega_{jt}/e^{\nu\tau_{ijt}}}{\sum_{s=1}^{S} \omega_{st}/e^{\nu\tau_{ist}}} H_{Rit}$$

We can solve for variation in adjusted productivity and amenities relative to their geometric means by

$$\ln\left(\frac{\tilde{A}_{it}}{\bar{\tilde{A}}_t}\right) = (1-\alpha)\ln\left(\frac{Q_{it}}{\bar{Q}_t}\right) + (1-\alpha)\Gamma\ln\left(\frac{Z_{it}}{\bar{Z}_t}\right) + \frac{\alpha}{\epsilon}\ln\left(\frac{\omega_{it}}{\bar{\omega}_t}\right)$$

and

$$\ln\left(\frac{\tilde{B}_{it}}{\bar{\tilde{B}}_t}\right) = \frac{1}{\epsilon}\ln\left(\frac{H_{Rit}}{\bar{H}_{Rt}}\right) + (1-\beta)\ln\left(\frac{Q_{it}}{\bar{Q}_t}\right) + (1-\beta)\left(\Gamma\ln\left(\frac{Z_{it}}{\bar{Z}_t}\right)\right) - \frac{1}{\epsilon}\ln\left(\frac{W_{it}}{\bar{W}_t}\right)$$

Intuitively, high commercial floor prices must be explained by high productivity, high wages or intense land-use regulation. Similarly, high residential house prices must be explained by amenities, commuting market access (CMA), or intense land-use regulation.

Spatial variation in productivity and amenities for 2010 are illustrated in Figure 18. Productivity is heavily centered around the Central Business District–the Loop and surrounding neighborhoods where employment is concentrated. Amenities are more diffuse, but the distinction between downtown and the wealthier North side near the Lake and the relatively poorer and predominantly African-American South and West sides is stark.

Changes in productivity and amenities from 2010 to 2015 are shown in Figures 19 and 20. There is no obvious pattern for the changes in adjusted productivity except for relative growth outside of downtown, which corresponds with observations of increasing diffusion of commercial activity outside of the CBD. Changing amenities, on the other hand, follow a clear pattern of a booming downtown and deteriorating conditions in the South and West sides–reflecting the massive increase in residential employment downtown alongside significant population loss in relatively crime-prone neighborhoods.

6.2 Gravity Equation

Estimating semi-elasticity of commuting prob. to travel time ν

$$\ln \pi_{ij} = -\kappa\epsilon\tau_{ij} + \vartheta_i + \varsigma_j \tag{4}$$

The estimate of $\kappa\epsilon$ is reported in Table 9. The estimate of 0.029 implies an increase in travel time of 1 minute between two tracts leads to a 3% decrease in commuting flows between them.

6.3 Preference Heterogeneity Parameter

The preference heterogeneity parameter ϵ is identified by minimizing the difference between the variance of log adjusted wages by workplace in the model, $\tilde{w}_j$, and the observed variance of log wages by workplace in the data for 2015, $\sigma_{\ln w_j} = 0.097$. The estimate of $\epsilon = 4.763$ reflects lower preference heterogeneity than estimated by Severen (2018) (1.83) for Los Angeles but greater than Ahlfeldt et al. (2015) (6.83) for Berlin. Notably, Allen, Arkolakis and Li (2015) estimates the Fréchet scale parameter at 0.7 for Chicago.

As shown in Figure 21, the variance of wages by workplace across tracts is quite low relative to the variance of wages by residence across tracts.

6.4 Structural Elasticities

Identification of the structural elasticities requires a source of variation that causes a change in the patterns of density that is uncorrelated with unobserved changes in local fundamentals. I argue that the redistricting of Wards and subsequent change in the concentration of homeownership provides just such a plausibly exogenous source of variation, as the change in Ward constituencies translates into a change in housing productivity. I consider the following measures:

Let $\mathbb{S}$ be the set of all Census tracts, and $S_i \subset \mathbb{S}$ denote the set of Census tracts in the Ward to which i belongs. I construct an instrument $z_i^{W'}$, which is the distance-weighted concentration of homeowners to renters in *neighboring* Wards, i.e. for all tracts $s \in S_i^{'} = \mathbb{S} \setminus S_i$

$$z_i^{W'} = \sum_{S_i^{'}} \frac{e^{-\rho\delta_{is}} H_s^o / H_s^r}{\sum_s e^{-\rho\delta_{is}}}$$

I also construct an analogous measure of the concentration of homeownership within the *same* Ward as tract i, i.e., over all tracts $s \in S_i$, denoted z_i^W. The re-districting of Ward caused an instantaneous and mechanical change in these measures that is purely political and has no 'real' economic effects except through the political channel.

As shown in Table 8, $\Delta z_i^{W'}$ is strongly correlated with a large decrease in adjusted amenities and a reduction in density, reflecting how a higher ratio of homeowners in *neighboring* Wards may have negative spillover effects. Meanwhile, Δz_i^W has a relatively precise zero correlation with changes in amenities and density of development, reflecting how endogenously-determined zoning can make it difficult to estimate agglomeration effects. I use $z_i^{W'}$ as an instrument in the GMM estimation below, as it should be correlated with local changes in housing productivity. The identification assumption for recovering the structural elasticities is that the instrument is uncorrelated with changes in the economic fundamentals a_i and b_i.

$$\mathbb{E}[\Delta z_i^{W'} \times \Delta \ln(\tilde{a_{it}}/\overline{\tilde{a_t}})] = 0 \quad ; \quad \mathbb{E}[\Delta z_i^{W'} \times \Delta \ln(\tilde{b_{it}}/\overline{\tilde{b_t}})] = 0$$

The interpretation of these assumptions is that the redistricting which changed the relative concentration of homeowners was not performed in a way that reflected changes in the fundamental productivity and amenities of each tract. This is a fairly weak assumption, as it does not demand that re-districting be random; rather, it simply requires that it not be the case that, for example, tracts which are increasing in fundamental amenities be systematically assigned to be surrounded by high-homeownership Wards.[13]

The GMM estimates are reported in Table 9. The productivity elasticity λ is consistent with the literature at 0.07. Notably, the amenity elasticity of 0.03 is significantly smaller than literature estimates, albeit statistically insignificant. As I have argued, this could be a reflection of how an estimation approach which disregards endogenous and variable zoning will produce upward-biased estimates of these elasticities. Notably, the amenity decay parameter is significantly larger than the productivity decay parameter. This is consistent with the idea that local amenities tend to be enjoyed more by residents of the surrounding area, whereas employment centers tend to draw from a larger employment-shed.

6.5 Concentrated Costs and Diffuse Benefits

A major element of the motivation of this paper is the general sense that the social cost associated with additional development–e.g., congestion, pollution–are spatially concentrated relative to the social benefits–e.g., tax revenue, restaurants. However, the analysis above estimates a single parameter for the elasticity of productivity and amenities, respectively, with respect to density. Therefore, these parameters reflect the *net* effects of density, both positive and negative. Similarly, the decay parameters reflect how spatially diffuse these *net* externalities may be.

To attempt to separate out the costs and benefits, I consider an alternative form of the agglomeration externalities for amenities where there is still one constant elasticity of net amenities with respect to density, but the positive and negative spillovers have differing decay rates. Let ρ^b and ρ^c denote the spatial decay parameters for positive (benefits) and negative (costs) amenities, respectively.

$$B_i = b_i \Omega_i^{\beta} \Psi_i^{-\alpha}$$

$$= b_i \left[\sum^{S} (\frac{H_{Rs}}{L_s}) e^{-\rho^b \tau_{js}} \right]^{\beta} \left[\sum^{S} (\frac{H_{Rs}}{L_s}) e^{-\rho^c \tau_{js}} \right]^{-\alpha}$$

$$= b_i \left(\sum_{s=1}^{S} \left(\frac{H_{Rs}}{L_s} \right) \right)^{\eta} \left[e^{(-\rho^c \alpha - \rho^b \beta) \tau_{js}} \right]$$

[13]As Ward re-districting occurs in private by City Council members, the exact motivations and process are hidden; however, the resultant map reflects how there are few discernable patterns in how Wards are changed. (Figure 16) Media coverage of the process focuses on political motivations to explain observed gerrymandering. (Dardick, 2013)

$$\rho = \rho^b \beta - \rho^c \alpha$$

This, the total amenity spillovers decay at rate ρ, which is the weighted sum of decay rates of positive and negative spillover decay rates. The parameters α and β are unobserved, but if we assume that they are equal–meaning, that there is one constant elasticity of amenities with respect to density for both positive and negative amenities–then

$$rho = \rho^b - \rho^c$$

Using the results of the regression of zoning changes on distance to the Ward boundary graphed in Figure 10, the rate of increase in zoning restrictiveness with proximity to the Ward boundary can be estimated. Assuming that this observed increase in restrictiveness is due to the relatively high concentration of costs relative to benefits close to a development, we interpret the point at which the boundary effect disappears as the point where the negative externalities are no longer dominating. This solves the problem

$$\max e^{-\rho^b \tau} - e^{-\rho^c \tau}$$

As illustrated in Figure 22, this equation reaches its max at roughly 15 minutes walking time. Very close to the development the costs and benefits are quite similar; five minutes away and more than 40% of the negative externalities are eliminated, while nearly 80% of the positive externalities remain. At 10 minutes away more than half of the negative externalities have decayed, and thus we approach the relative maximum of costs and benefits associated with development. This graph somewhat reflects the intuition of 'NIMBYism', or Not In My Backyard, as clearly the relative benefits of development are greatest at least some distance away.

6.6 Counterfactual Simulation

The effects of policy reforms to the level of community control over land-use regulation are complex. A centralized planning authority could be more or less restrictive than decentralized authorities depending on the nature of the spillovers and sorting. Therefore, the first counterfactual scenario I consider is centralizing urban planning at City Hall, such that all externalities of development are internalized. In effect, this assumes that relative changes in tenure rates within the city due to re-districting are irrelevant with respect to re-zoning decisions. Defining $\ln(\tilde{\varphi_{it}}/\overline{\varphi_t})$ as the relative density of development, we can define the identification assumption

$$\mathbb{E}[\Delta z_i^{W'} \times \Delta \ln(\tilde{\varphi_{it}}/\overline{\varphi_t})] = 0$$

and perform the GMM estimation as above.

Additional simulations which this framework makes possible are testing the effects of greater Transit-Oriented Development incentives and density 'bonuses.' Further, the endogenous responses to investments in transportation infrastructure may be estimated, as there is much debate over whether such investments are worthwhile in the absence of elastic housing and commercial real estate supply.

7 Conclusion

It has long been recognized in public choice theory that in the context of concentrated benefits and diffuse costs, policy may over-represent the interests of special interest groups over the welfare of society as a whole. In the case of constrained development due to land-use regulation, we observe that the benefits of increasing land-use regulation follow a similar pattern. Or, reframing in terms of the effects of development, we observe the opposite–concentrated *costs* and diffuse *benefits*.

This phenomenon may exist regardless of whether land-use regulation authority is explicitly decentralized by law. If voting is costly, residents who are disproportionately impacted will be more likely to exercise that right. If the intensity of lobbying is variable, those who are disproportionately impacted will lobby more intensely. Similarly, if there is heterogeneity in the impact on residents by type, such as homeowners who are less mobile and have a financial stake in the quality and rents of their neighborhood, then we will observe heterogeneity in political influence along those dimensions as well.

This paper provides evidence about how the spillover effects of density vary by tenure status, demonstrating that homeowners are empirically more sensitive to increases in the density of development. Further, I show that the spatial distribution of the effects of density is relatively concentrated, with most agglomeration effects on amenities attenuating within several miles–emphasizing the importance of crafting zoning and development policy at a finer scale. Finally, I show that the negative externalities of development are significantly more concentrated than the benefits, which points toward the importance of creating mechanisms to redress these effects at a very local level, e.g. investment in transportation infrastructure or public amenities.

These results also emphasize the importance of recognizing *intra*-city variation in land-use regulation intensity. On some measures, the variation in zoning restrictiveness I observe between neighborhoods in the City of Chicago rivals the variation observed nationally between metropolitan areas. And as agglomeration effects are extremely localized, the welfare consequences of addressing overly-restrictive land-use in particular locations within cities, e.g. near transit, may have greater consequences than attempts at reform at the metropolitan, State or Federal level.

In future work, my goal is to further explore these counterfactual outcomes with a policy-relevant approach. In preliminary work, I explore the effects of targeted re-zonings near transit and other major infrastructure, and "impact fees" that are redistributed to particular areas similar to a Tax Increment Financing structure. In addition, there are other characteristics on which residents of a city sort and determine land-use regulation, namely income and race. While I find the effects of income sorting are not found to be as strong as homeownership, there is anecdotal evidence that racial preferences are a significant driver of land-use regulation, even if it primarily operates through the homeownership channel. Finally, more work on the nature of amenity spillovers at a local level is needed. A rich literature investigates the size and form of productivity spillovers from agglomeration, but we have a poorer understanding of how the net agglomeration amenities we observe may be decomposed, e.g. into congestion, safety, pollution, and retail amenities. With this and future work, my hope is to help build more productive, attractive and affordable cities.

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8 Tables

Table 1: Summary Statistics on Re-Zonings

Statistic	N	Mean	St. Dev.	Min	Max
Original FAR	2,096	2.344	2.684	0.500	19.000
New FAR	2,096	2.393	1.923	0.500	16.000
Original Lot Area Per Unit	1,580	1,767.168	1,178.683	100	6,250
New Lot Area Per Unit	2,029	1,183.095	1,079.031	100	6,250
Residential District	2,096	0.374	0.484	0	1
Business District	2,096	0.383	0.486	0	1
Commercial District	2,096	0.170	0.376	0	1
Downtown Distric	2,096	0.041	0.198	0	1
Planned Development District	2,096	0.032	0.176	0	1

Note: Zoning re-classifications from November 2010 to August 2016. Data collected from copies of City of Chicago ordinances, obtained from the Office of the City Clerk. 'FAR' reflects the maximum floor-to-area ratio; 'Lot Area per Unit' reflects the maximum number of residential units for a given parcel; and the 'District' designations reflect the type of development allowed.

Table 2: Baseline Rezoning Regressions Equation 1) - Explaining Re-Zonings Using Observables

	Dependent Variable: Observed Change in Density, $\Delta FAR\%$			
	(1)	(2)	(3)	(4)
Panel A: Baseline Regression Using Within-Ward Measures				
$\log Homeowners_{pi}$	-11.569^{***}	-10.302^{***}	-10.039^{***}	-9.882^{***}
	(3.119)	(3.154)	(3.227)	(3.223)
$Income_{wi}$		-0.340^{**}	-0.384^{**}	-0.740^{***}
		(0.145)	(0.167)	(0.226)
$\%Families_{pi}$			-0.176	-0.177
			(0.186)	(0.188)
$\%White_{wi}$				0.325^{*}
				(0.184)
Observations	2,096	2,096	2,096	2,096
R^2	0.223	0.226	0.227	0.228
Adjusted R^2	0.217	0.220	0.220	0.221
F Statistic	37.257^{***}	35.702^{***}	33.810^{***}	32.256^{***}
Panel B: Baseline Regression Using Different [Non-Political] Geographies				
$\log Homeowners_{Xi}$	-9.882^{***}	0.265	1.548	-11.937
	(3.223)	(4.814)	(14.877)	(25.999)
$Income_{Xi}$	-0.740^{***}	-0.0004^{***}	-1.001^{***}	-0.001^{***}
	(0.226)	(0.0001)	(0.242)	(0.0002)
$\%Families_{Xi}$	-0.177	-0.117	-0.448	-0.463^{***}
	(0.188)	(0.180)	(0.332)	(0.112)
$\%White_{Xi}$	0.325^{*}	0.157	0.431^{***}	0.466^{***}
	(0.184)	(0.128)	(0.155)	(0.132)
Geography Used	Precinct	Tract	Ward	Community

Note: Regression of re-zonings, measured by change in Floor-to-Area Ratio ($\Delta FAR\%$), on determinants per model described in Equation 1. Distance measures in km; Population and Income in 1000s; Rent in price per square foot. Standard errors clustered by Census tract. Subscript *pi* corresponds to the precinct-parcel pair and *wi* corresponds to the ward-parcel pair of each re-zoning, respectively. Panel B repeats Column 4 regression from Panel A, using observed demographics from aggregated to different geographies. *p<0.1; **p<0.05; ***p<0.01

Table 3: Auxiliary Regressions to Baseline Model: Other Factors in Re-Zoning

Panel A		Panel B		Panel C	
Local RE Market	ΔFAR_i	**Transportation**	ΔFAR_i	**Politics**	ΔFAR_i
log $Homeowners_{pi}$	-8.642^{***}	log $Homeowners_{pi}$	-8.991^{***}	log $Homeowners_{pi}$	-9.061^{***}
	(2.253)		(3.321)		(3.244)
Neighboring Avg. FAR	-4.930^{***}	$\mathcal{I}$[Dist. CTA < 1/2 Mile]	11.484^{*}	$\mathcal{I}$[Dist. Ward Boundary < 250 ft.]	-10.685^{***}
	(0.758)		(6.922)		(3.918)
Neighboring Total Sq. Ft.	−0.022	$\mathcal{I}$[Dist. CTA < 1/4 Mile]	-21.432^{**}	$\mathcal{I}$[Competitive Election]	6.529^{*}
	(0.040)		(8.656)		(3.886)
# Neighbors	0.033	Dist. Arterial (m.)	-14.413^{***}	Registered Voters in Precinct (2010)	0.028^{**}
	(0.166)		(3.915)		(0.014)
		Dist. Collector (m.)	-6.931^{*}	$WardRedrawn_i$	−0.246
			(4.005)		(4.857)
		Dist. Expressway (m.)	0.938		
			(4.566)		
		"WalkScore"	0.462^{*}		
			(0.260)		
Observations	2,081		2,096		2,094
R^2	0.229		0.239		0.231
Adjusted R^2	0.222		0.229		0.223

Baseline re-zoning by parcel regressions with additional covariates. Dependent variable is change in density, measured by Floor-to-Area Ratio (FAR). Panel A includes measures of neighboring real estate within a 250 ft. radius of the re-zoned parcel. Measures are the average FAR of these neighbors; the total square footage of these neighbors; and the number of neighboring parcels. Panel B includes measures of distance to various forms of transportation. Two distance indicators for Chicago Transit Authority 'L', or heavy rail, stations; distance measures to closest arterial road, collector road, and expressway; and "WalkScore" measures, which capture how 'walkable' the surrounding area is to local amenities and commuting network. Panel C includes various political measures. First indicator variable is 1 if the re-zoned parcel is within 250 ft. of the nearest Ward boundary. Second indicator is 1 if the most recent Aldermanic election had an outcome where the winner had between 40-60% of the vote. The third covariate is the count of registered voters at the associated voting Precinct in 2010. Standard errors are in parentheses, clustered at the Census tract level. *p<0.1; **p<0.05; ***p<0.01

Table 4: Average Block-Level Changes in FAR

	Dependent variable: $\log \Delta FAR_b$			
$Homeownership_{Ward}$	-0.104^{***}	-0.101^{***}	-0.157^{***}	-0.977
	(0.019)	(0.037)	(0.043)	(2.427)
Alderman FE	-	Y	Y	Y
Tract FE	-	-	Y	Y
Ward FE	-	-	-	Y
Observations	4,145	4,145	4,145	4,145
R^2	0.007	0.1215	0.3367	0.3456

Note: Dependent variable is average log change in zoning density at the Census Block level, based on aggregated re-zonings. Demographic controls include population, race and average household size.

Table 5: Tract-Level Changes in Zoning

	$\ln Rezonings_{it}$		ΔFAR_{it}	
	(1)	(2)	(3)	(4)
log Homeownership Concentration	-0.266^{***}	-0.269^{***}	-0.265^{***}	-0.264^{***}
	(0.065)	(0.065)	(0.064)	(0.064)
log Measure of Tract Isolation	-0.191^{***}	-0.194^{***}	-0.265^{***}	-0.264^{***}
	(0.068)	(0.068)	(0.067)	(0.067)
Instrument	z.diff	z.HDR	z.diff	z.HDR
Observations	3,706	3,706	2,055	2,055
R^2	0.010	0.010	0.068	0.068

Regression of Tract-level zoning changes on distance-weighted, within-Ward homeownership rate and measure of isolation. All controls from baseline model included. Instruments are re-districting induced change in homeownership and housing demand instrument. *p<0.1; **p<0.05; ***p<0.01

Table 6: Panel IV Estimates of Re-Zoning (Upzoning) Effect on Local Floorprices

	log Tract Floorprices			
	(1)	(2)	(3)	(4)
log Average Increase in FAR	−3.337	−2.414*	−1.902***	−1.607***
	(3.475)	(1.311)	(0.585)	(0.408)
log Tract Income		−0.138	−0.364	−0.295
		(0.259)	(0.244)	(0.213)
log Tract Population		0.916*	0.791	0.803*
		(0.550)	(0.484)	(0.420)
log Tract Homeownership Rate		0.886*	0.618*	0.722**
		(0.510)	(0.355)	(0.316)
Local Demographics	N	Y	Y	Y
Ward FE	N	N	Y	Y
Alderman FE	N	N	N	Y
Observations	2,055	2,055	2,055	2,055
R^2	0.003	0.005	0.008	0.012

Panel regression of Tract floorprices on Tract-level increases in FAR (upzonings), with upzonings instrumented by housing demand instrument z_i^{HDR}.
*p<0.1; **p<0.05; ***p<0.01

Table 7: Predictors of Ward Redistricting: Changes in Homeownership and Population

Panel A:	(1)	(2)
Dependent Variable: Tract Re-Districted to New Ward (Indicator)		
Log Change in Ward's	0.488	
Homeownership Rate (2000 to 2010)	(0.530)	
Log Change in Ward's		4.805***
Population (2000 to 2010)		(0.739)
Observations	786	786
Log Likelihood	−445.380	−423.488
Akaike Inf. Crit.	894.759	850.977

Panel B:	(1)	(2)
Dependent Variable: Log Change in Within-Ward Concentration of Homeownership (IV)		
Log Change in Ward's	−0.071	
Homeownership Rate (2000 to 2010)	(0.152)	
Log Change in Ward's		0.026
Population (2000 to 2010)		(0.211)
Observations	786	786
R^2	0.0003	0.00002
Adjusted R^2	−0.001	−0.001
Residual Std. Error (df = 784)	0.651	0.651
F Statistic (df = 1; 784)	0.216	0.015

Note: Ward re-districting in 2012 assigned many Blocks and Tracts to different Wards, in order to equalize populations between Wards based on 2010 Census data. Panel A shows that the probability a tract was re-assigned to a new Ward is uncorrelated with the change in the Ward's actual homeownership rate (i.e., holding Ward boundaries fixed), as per Census data. Rather, population growth in a Ward significantly predicts the likelihood of a tract being re-assigned. Panel B shows that the Change in Political Concentration of Homeownership IV, which measures the re-districting induced change in within-Ward homeownership concentration, is uncorrelated with changes in actual homeownership and population, holding Ward boundaries fixed. Independent variables are based on Decennial Census data for 2000 and 2010. *p<0.1; **p<0.05; ***p<0.01

Table 8: Correlation of Instruments to Productivity, Amenities and Density of Development

	Dependent variable:					
	ΔA_i	ΔB_i	$\Delta \varphi_i$	ΔA_i	ΔB_i	$\Delta \varphi_i$
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta z_i^{W'}$	-1.171	-0.452^{***}	-0.167^{**}			
	(0.788)	(0.135)	(0.070)			
Δz_i^{W}				0.016	0.009^{***}	0.003^{**}
				(0.016)	(0.003)	(0.001)
N	802	802	802	801	801	801
R^2	0.036	0.193	0.042	0.039	0.231	0.045

Note: Productivity (A_i), Amenities (B_i) and the density of development (φ_i) recovered by calibrating the model to data from 2010 and 2015; changes in these fundamentals reflect change over that period. Δ refers to log change. $z_i^{W'}$ is the distance-weighted change in the concentration of homeownership in tracts *outside* the Ward to which tract i belongs. z_i^{W} is the change *within* tract i's Ward. *p<0.1; **p<0.05; ***p<0.01

Table 9: Estimates of Structural Elasticities

Elasticity	Regression Estimate	Two-Step GMM Estimate
Commuting Time (min.) Semi-elasticity $\kappa\epsilon$	0.029^{***}	-
	(0.0009)	
Productivity Elasticity λ		0.082061^{***}
		(0.011902)
Productivity Decay δ		0.20944^{***}
		(0.0001982)
Amenity Elasticity η		0.015109
		(0.0053765)
Amenity Decay ρ		0.51543^{***}
		(0.0022881)

Note: Estimates of structural elasticities, following notation in Ahlfeldt et al. (2015). Commuting time semi-elasticity $\kappa\epsilon$ estimated by regression of log commuting flows between tracts on travel time and residence and workplace fixed effects. Remaining elasticities estimated using two-step GMM, using moment conditions described in Section 6 for identification. Elasticities describe percentage change in productivity and amenities, respectively, given a 1% increase in employment and residential density. Decay parameters describe how these spillovers attenuate at a rate of $e^{-\rho\tau}$ and $e^{-\delta\tau}$, respectively, with travel time in minutes τ. *p<0.1; **p<0.05; ***p<0.01

9 Figures

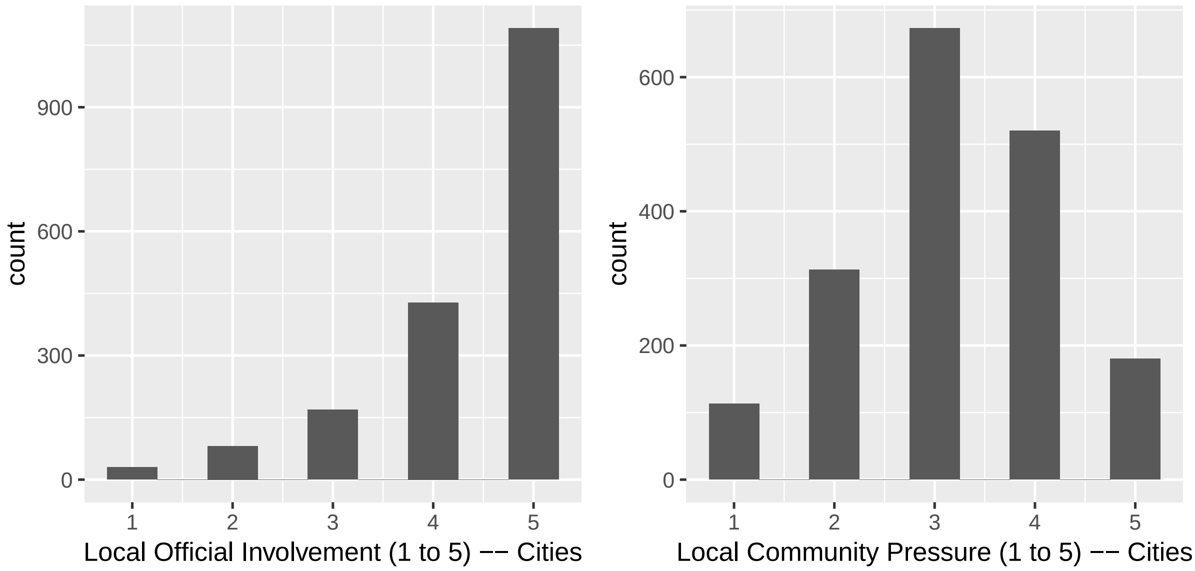


Figure 4: WRLURI Responses by 'Cities' on Local Political Pressure Index Sub-questions: Local Community Involvement and Local Official Involvement. 1='Not At All Involved'; 5='Very Involved'. Gyourko, Saiz and Summers (2008)

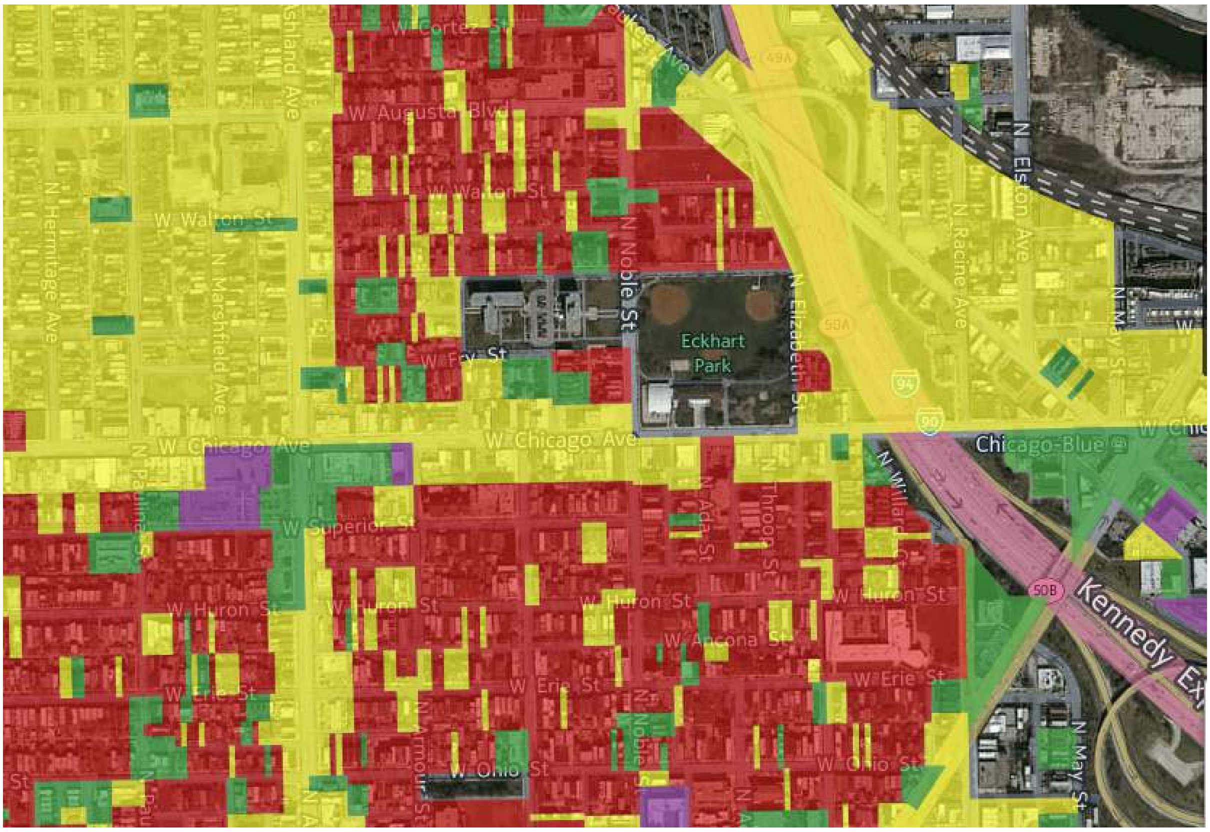


Figure 5: Parcel-by-Parcel Zoning in Chicago. Colors correspond to varying Floor-to-Area ratio maximums. Source: Second City Zoning

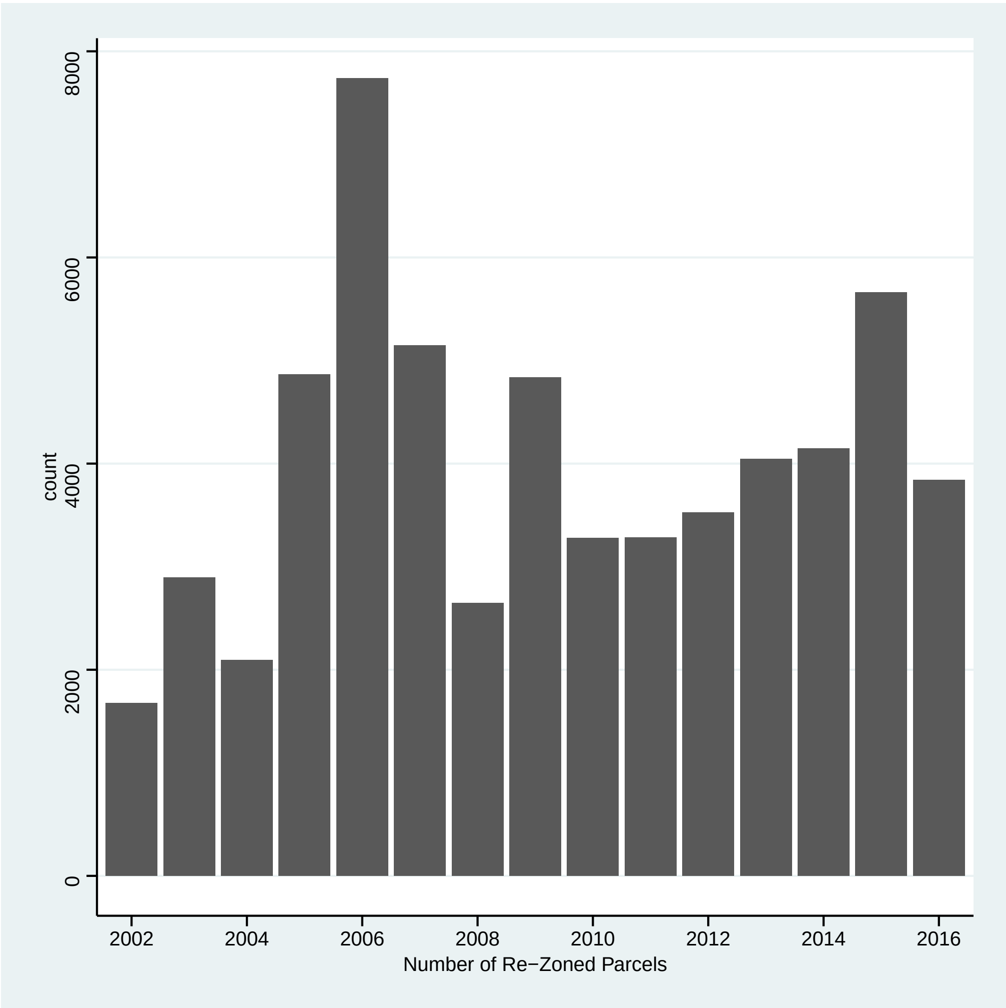


Figure 6: Histogram of Re-Zoned Parcels Per Year (Full Sample)

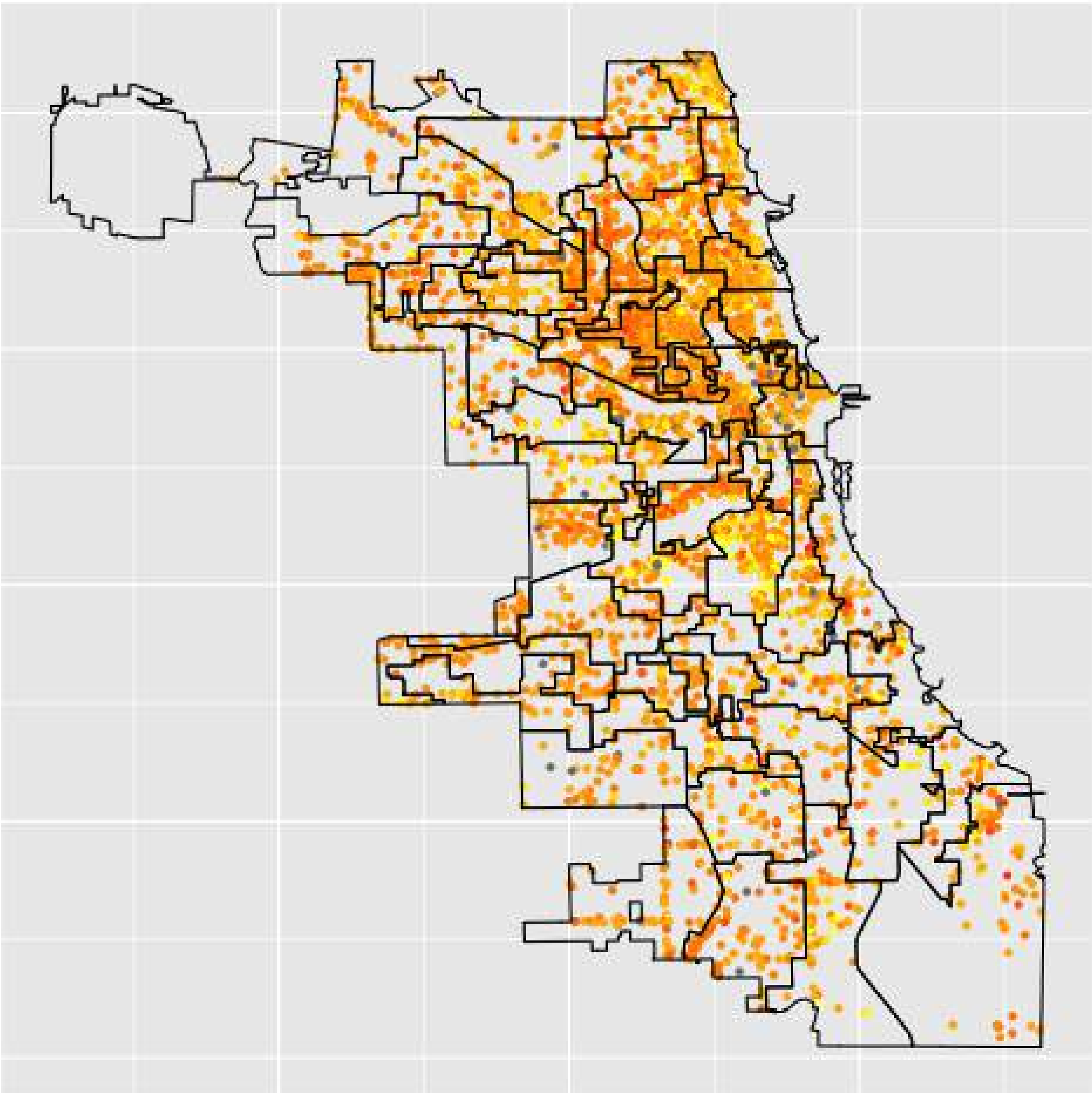


Figure 7: Re-Zonings in Chicago, 2010-2016. Color reflects the intensity of development, with denser developments 'hotter'.

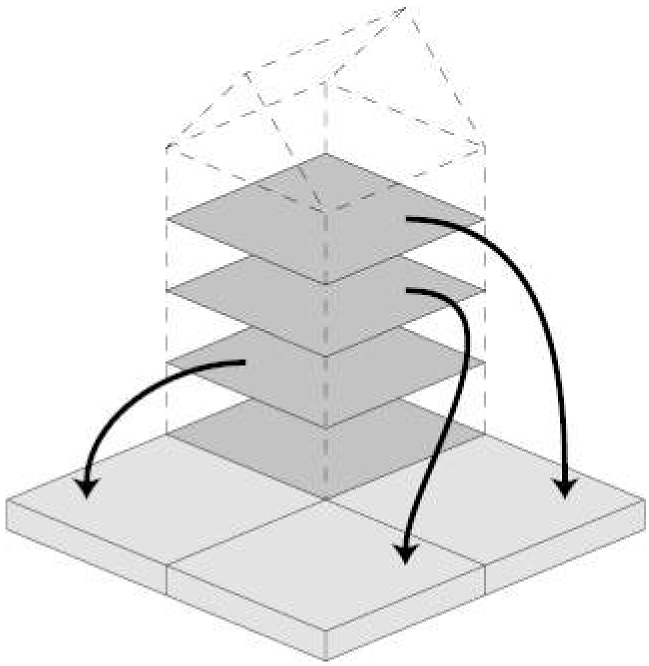


Figure 8: Building with Floor-to-Area Ratio (FAR) of 1. (Source: Second City Zoning)

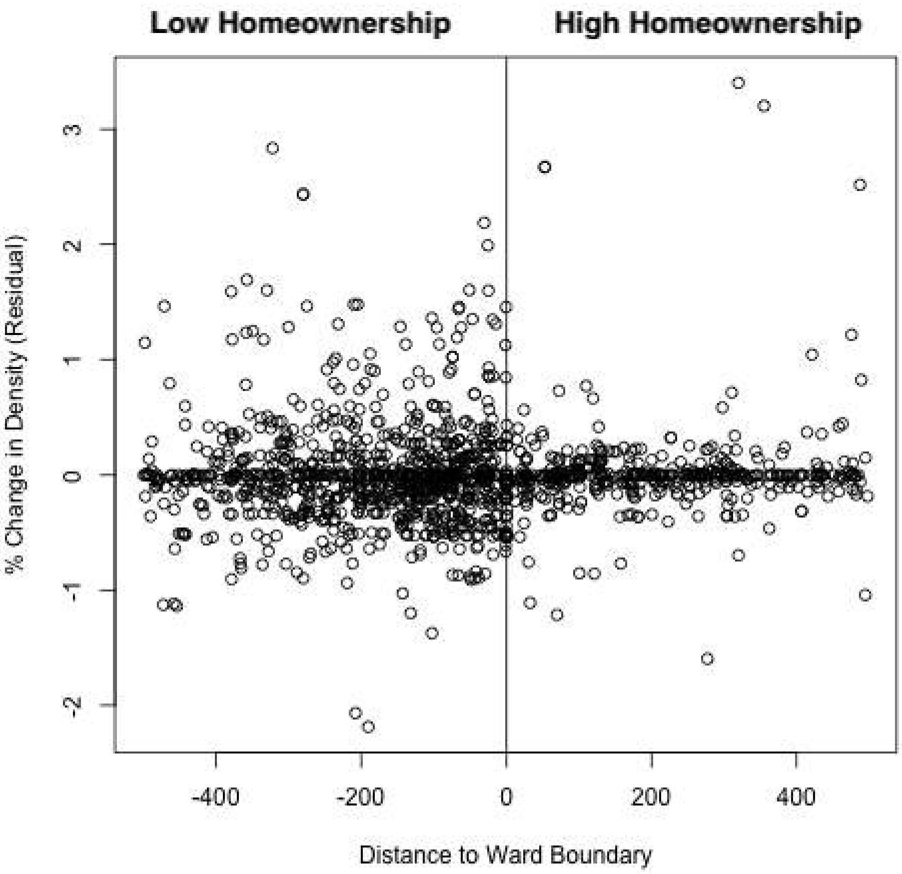


Figure 13: Ward Distance Plot

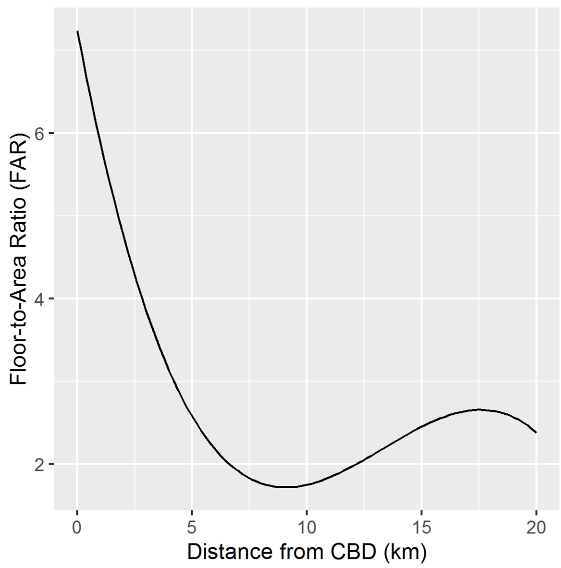
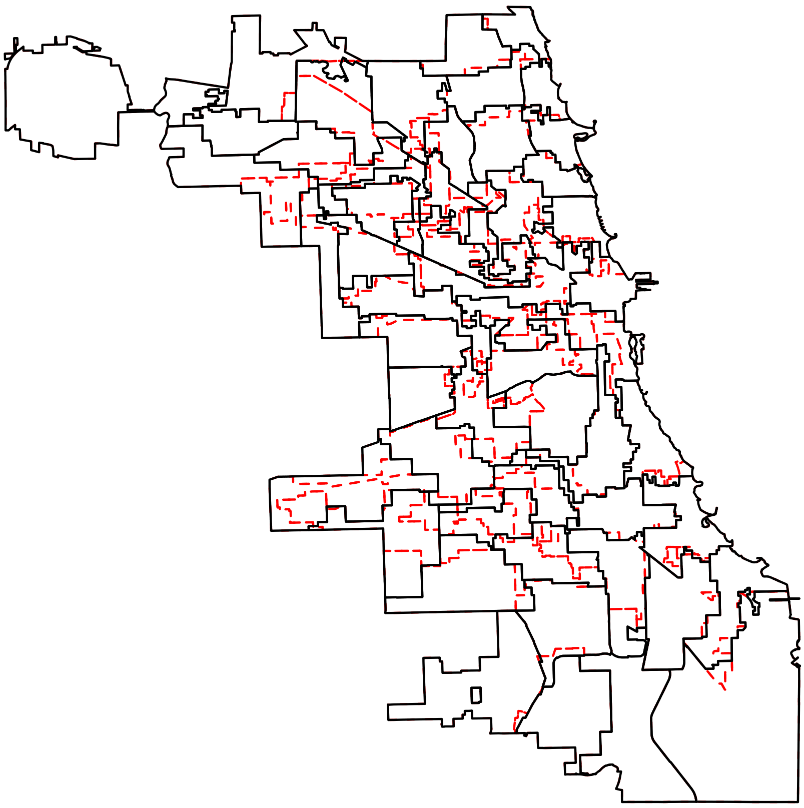


Figure 9: Fitted Density by Distance from CBD

Figure 16: Re-districting of Ward Boundaries; 2003 (black), 2012 (red-dashed)



Note: Ward boundary data from City of Chicago. Re-drawn map was approved early 2012, and went into effect 2015. Nearly every Ward had a change in its boundaries, and 32% of Census Tracts in the City were assigned to new Wards.

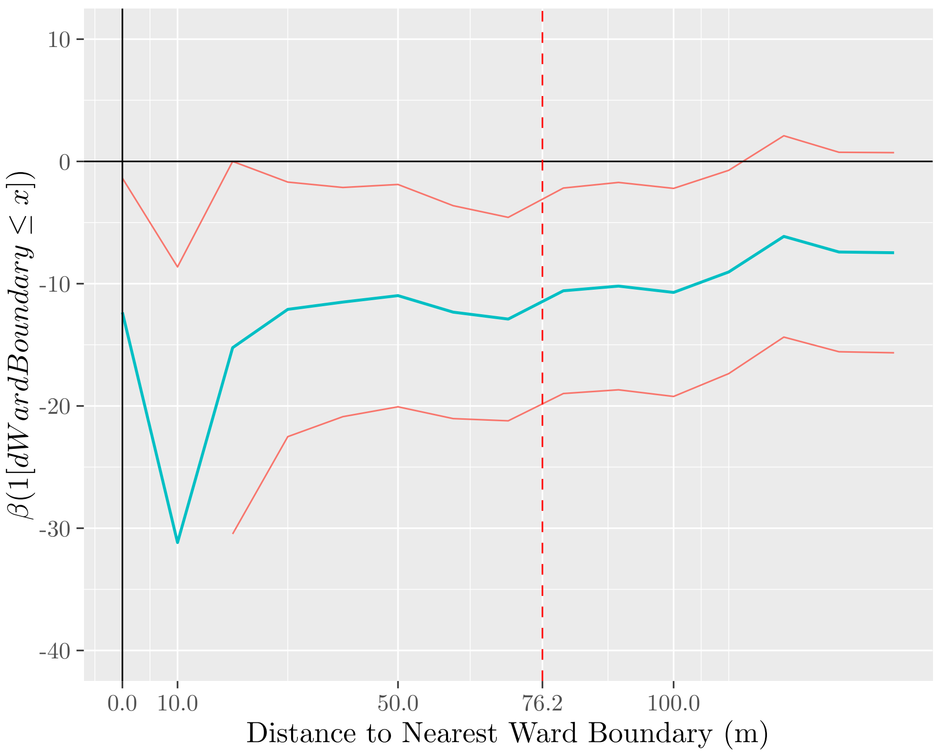


Figure 10: Graph of the fixed-effect of distance to the nearest Ward boundary, with each point reflecting the estimate for an individual regression using that distance x. Specifically, it is the coefficient of $OnWardBoundary(x)_i$ from the regression in Equation 1, for different values of x. The dashed line represents a distance of 250 feet; by law, developers requesting a re-zoning must notify all neighbors within 250 feet of the request.

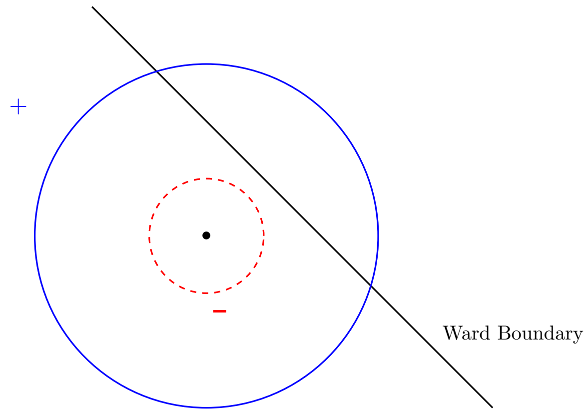


Figure 11: Asymmetric Censoring of Externalities. If the spillover benefits (blue) are more diffuse than the costs (red), a project near a political (e.g., Ward) boundary will have its benefits disproportionately censored and not internalized by the local planning authority (e.g., community groups, Aldermen).

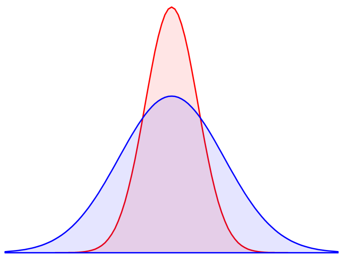
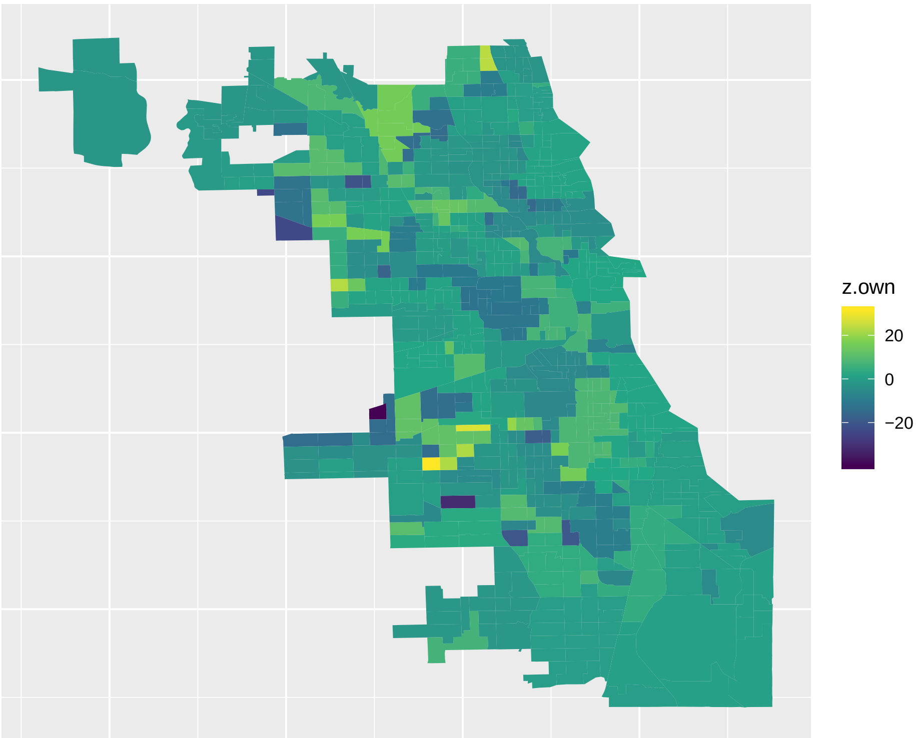


Figure 12: Diffuse Mass of Benefits and Concentrated Costs

Figure 17: Redistricting-induced Change in Tract-Ward Homeownership Rate



Note: “z.own” is the change in the Decennial Census 2010 Census Tract homeownership rate of the Ward to which each Census tract belongs, holding the tract’s own rate constant. A value above 20 (yellow) means a tract was re-assigned to a Ward with a 20 p.p. higher homeownership rate than its previous Ward; a value below -20 means a tract was assigned to a Ward with a 20 p.p. lower rate than its previous Ward.

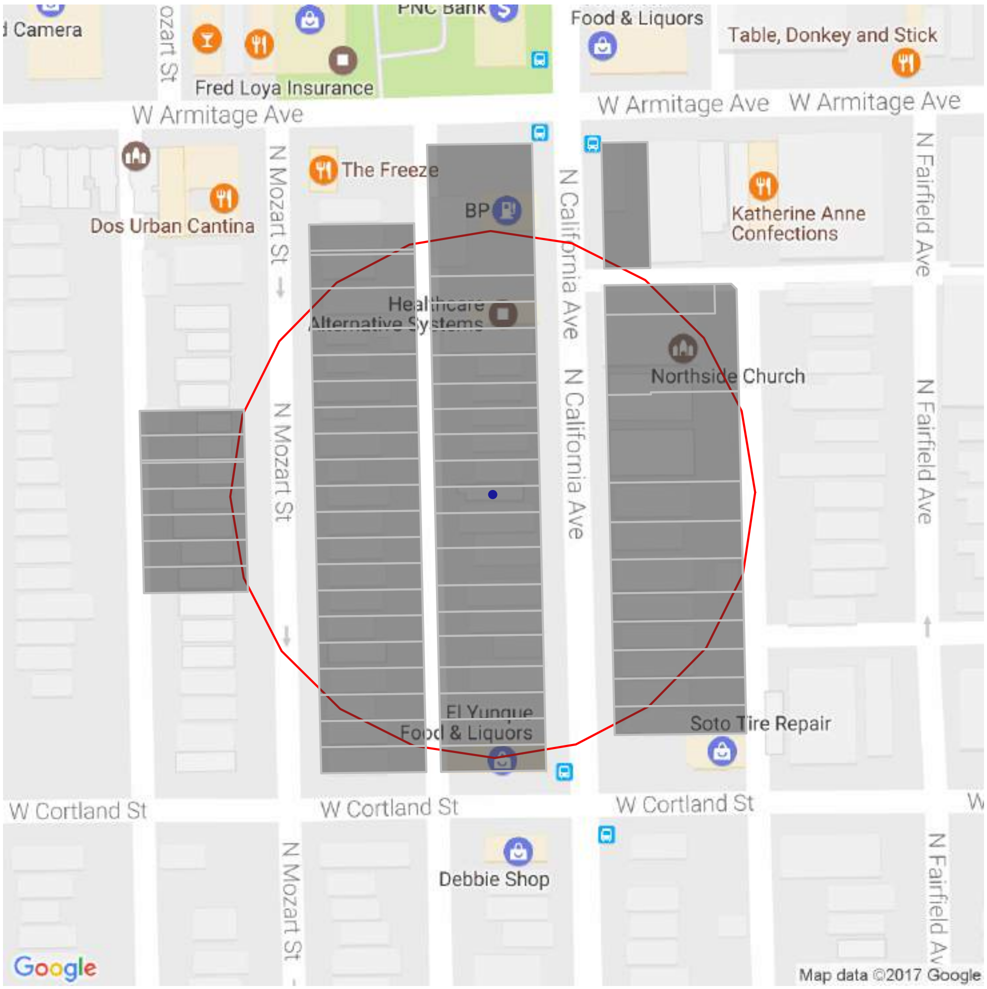


Figure 14: Parcels within 250 ft. of Proposed Development

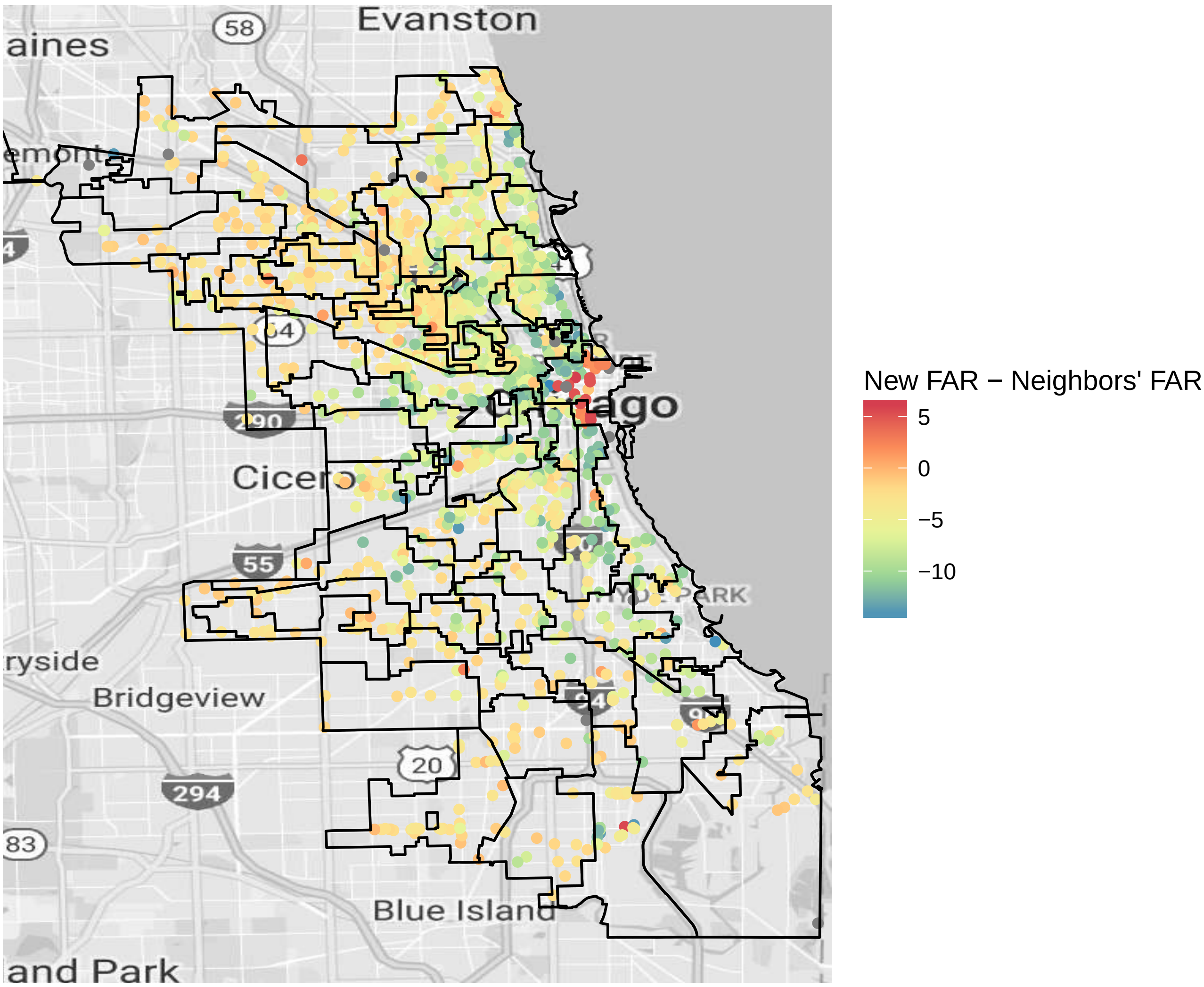


Figure 15: Difference in Development's FAR and Avg Neighbor FAR

Figure 18: Calibration - Productivity and Amenities

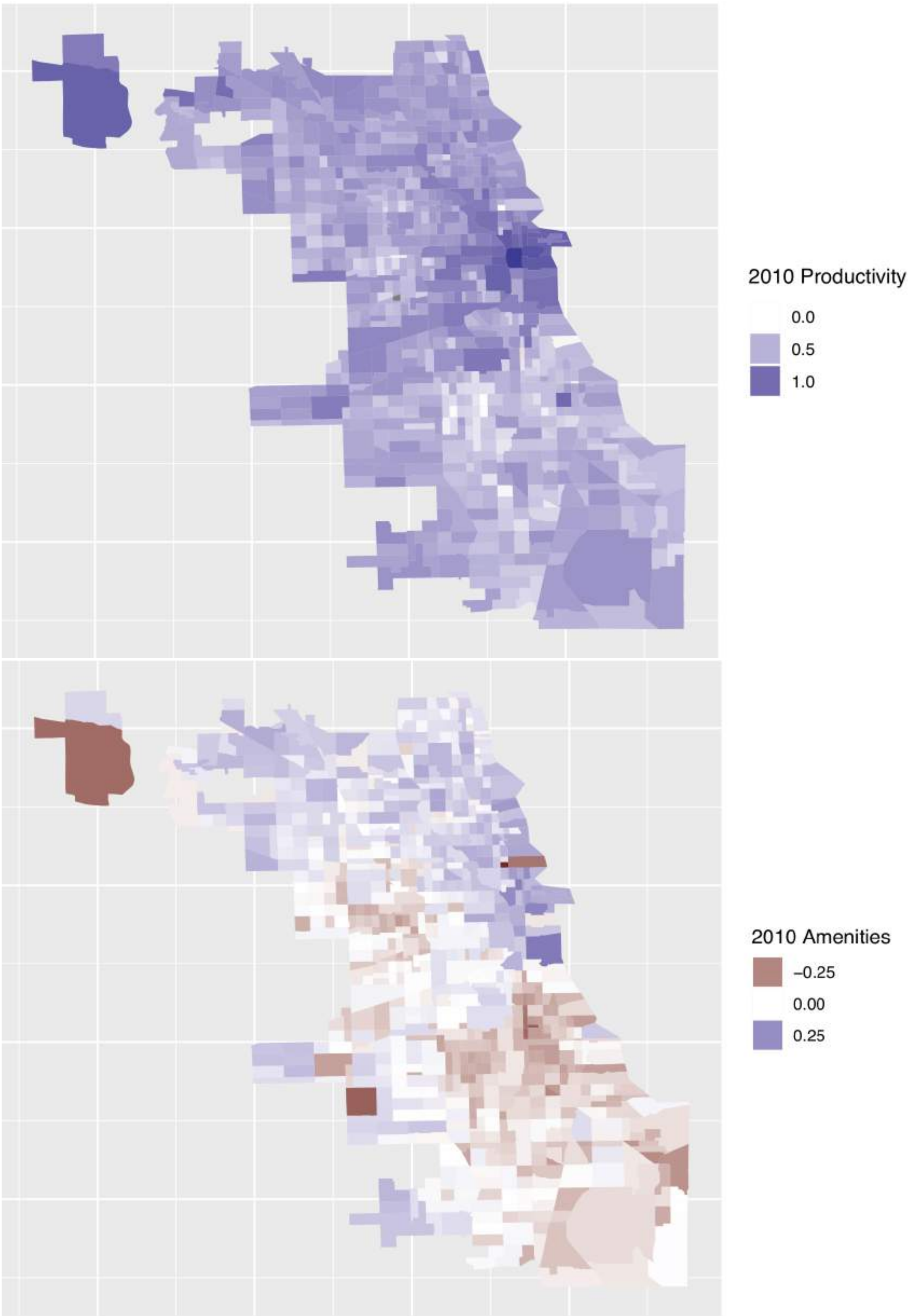
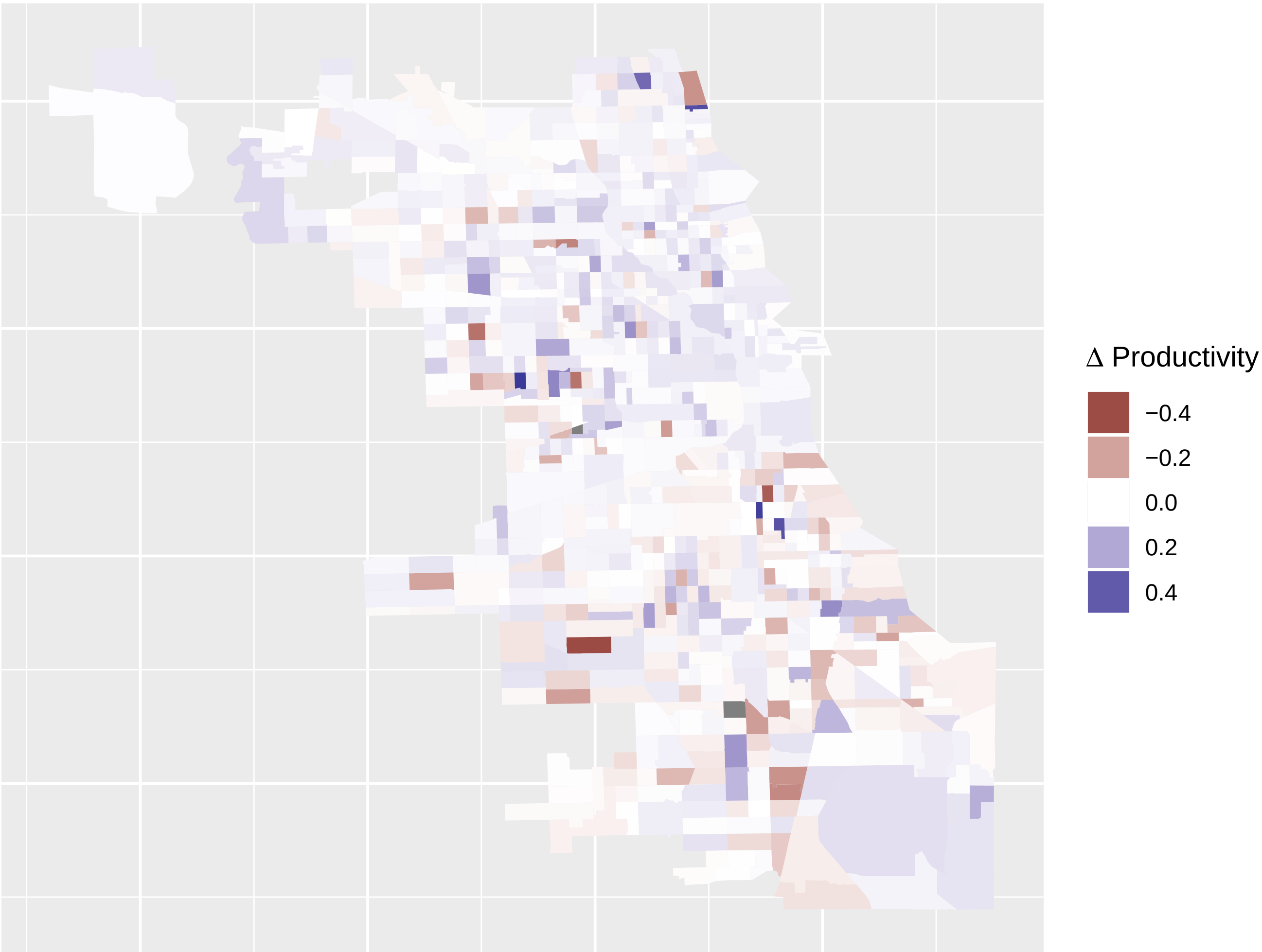


Figure 19: Change in Fundamental Productivity 2010-2015



10 Appendix

Figure 20: Change in Fundamental Amenities 2010-2015

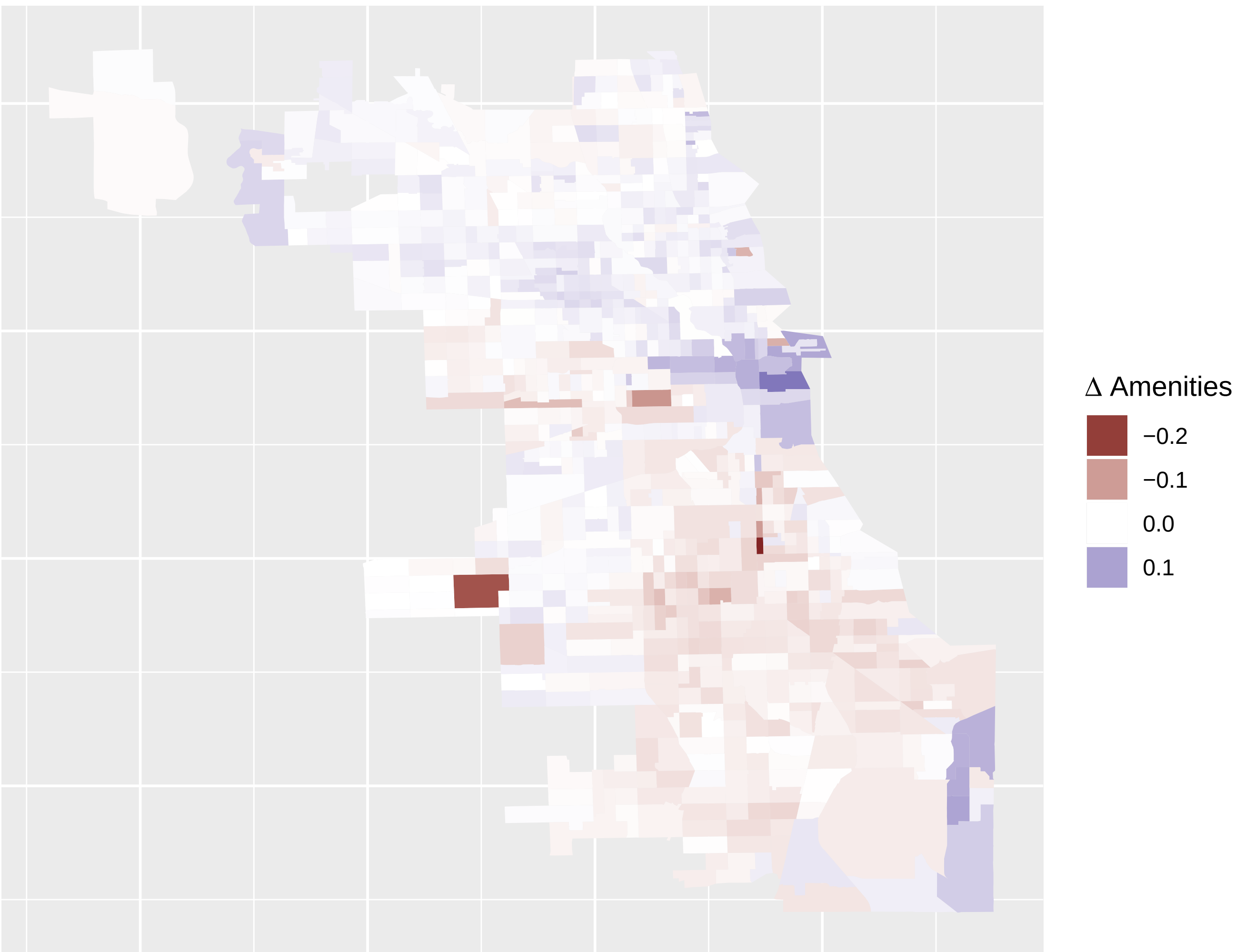
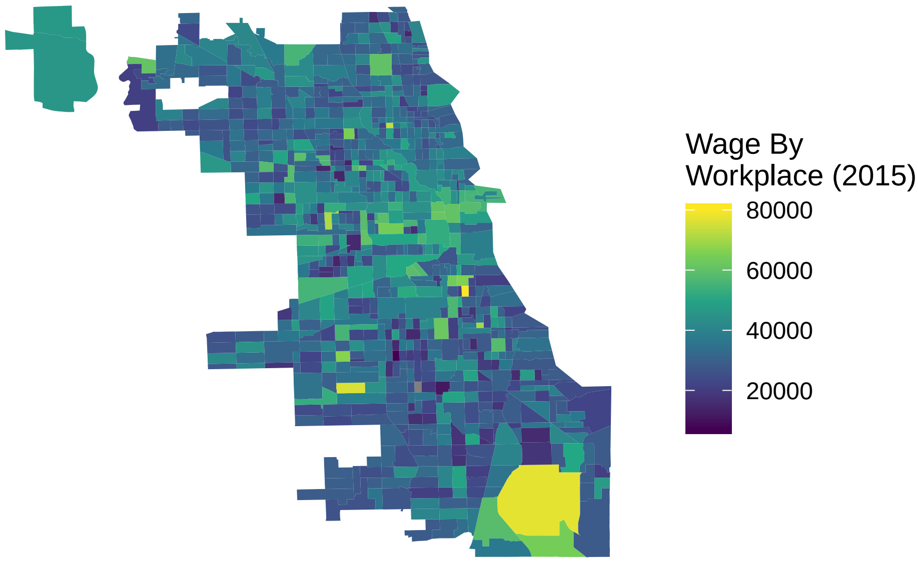
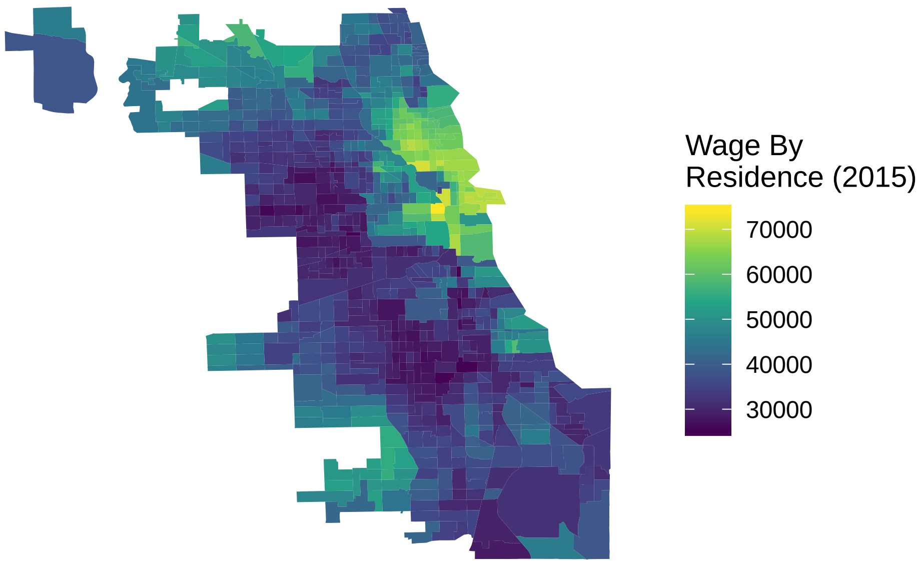


Figure 21: Wages by Residence and by Workplace (2015)





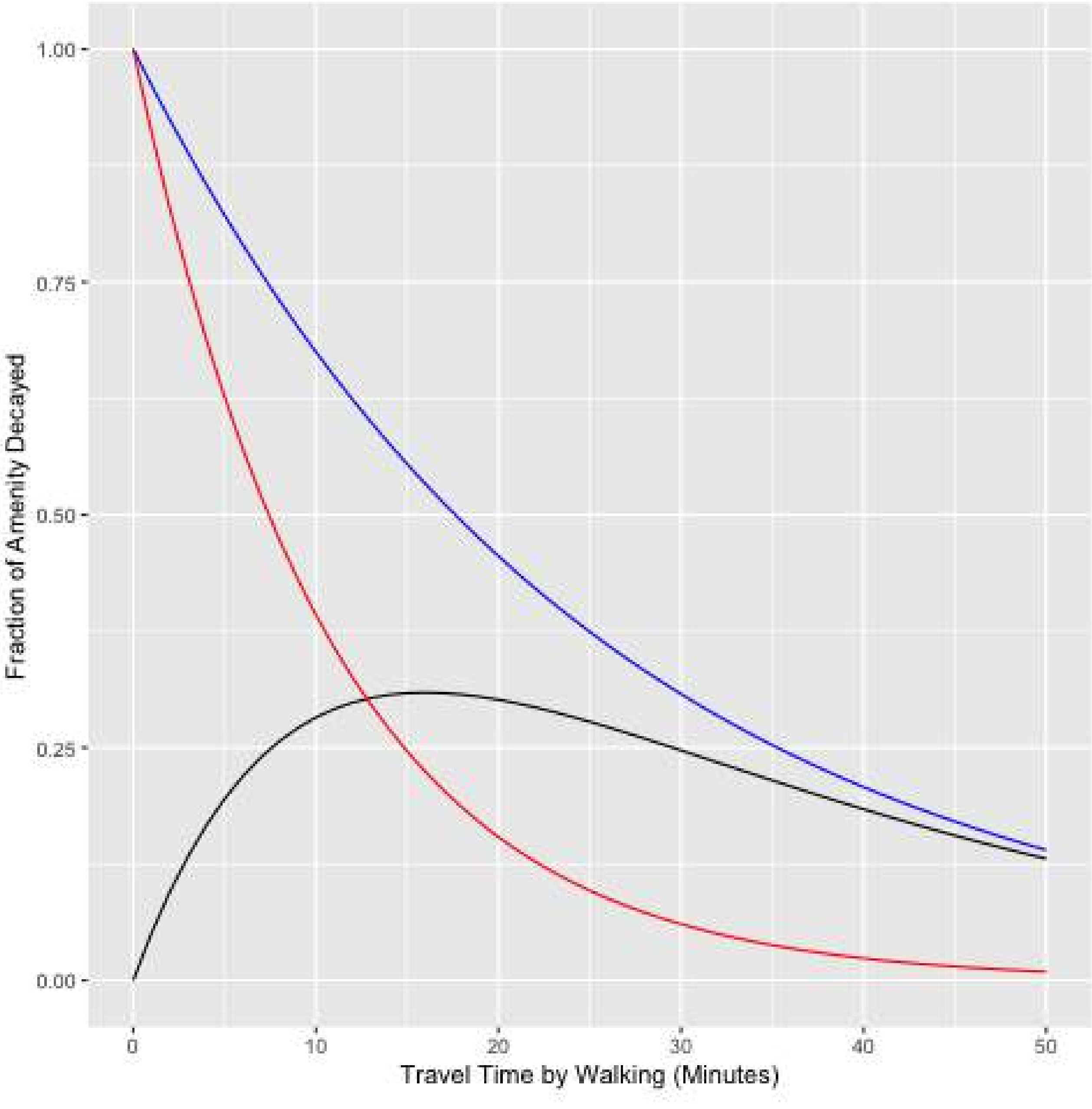


Figure 22: Relative Distribution of Positive and Negative Externalities
Red–Negative Externalities; Blue–Positive Externalities; Black–Positive Minus Negative

Table 10: Geographies

	Block	Precinct	Tract	Ward	Neighborhood
Population	74	1,360	3,650	55,326	55,957
	(111)	(1,089)	(1,868)	(7,643)	(23,536)
Housing Units	33.2	564	1,532	23,102	24,529
	(58.1)	(463)	(968)	(7,061)	(13,547)
Area (sq. km)	0.01	0.29	0.74	10.4	8.76
	(0.06)	(0.68)	(0.79)	(6.3)	(3.3)
N	46,311	2,448	811	50	77

Table 11: Density per Monocentric City Model

	Dependent variable:			
	FAR_0	FAR_1	FAR_0	FAR_1
	(1)	(2)	(3)	(4)
dLoop	-1.314^{***}	-1.470^{***}	-1.544^{***}	-1.919^{***}
	(0.099)	(0.063)	(0.185)	(0.116)
$dLoop^2/100$	11.341^{***}	12.278^{***}	-17.879^{**}	-0.270
	(0.984)	(0.627)	(7.215)	(4.510)
$dLoop^3/1000$	-2.438^{***}	-3.072^{***}	-0.613	-3.093^{***}
	(0.306)	(0.195)	(0.936)	(0.585)
dLake	-0.437^{***}	-0.088	0.531	0.799^{***}
	(0.092)	(0.058)	(0.469)	(0.293)
$dO'Hare$	-0.137^{***}	-0.001	5.256^{**}	3.763^{***}
	(0.043)	(0.027)	(2.283)	(1.427)
dMidway	-0.174^{***}	0.023	2.887^{***}	1.662^{***}
	(0.056)	(0.036)	(0.827)	(0.517)
N	-	-	1.413	-0.443
			(1.704)	(1.065)
E	-	-	-11.543^{***}	-6.897^{**}
			(4.280)	(2.676)
Spatial Expansion	N	N	Y	Y
Observations	2,096	2,096	2,096	2,096
R^2	0.169	0.342	0.256	0.433
Adjusted R^2	0.167	0.340	0.248	0.428
F Statistic	70.897^{***}	180.758^{***}	35.617^{***}	79.220^{***}
Note:				*p<0.1; **p<0.05; ***p<0.01

10.1 Chicago Zoning Code

Technically, zoning re-classifications fall under the category of "Map Amendments" with respect to the City of Chicago's Zoning Code. After application filing, the application goes to the Zoning Administrator for review, which provides a report with recommendation to the Department of Planning and Development for further review. With a recommendation, there is a public hearing (if necessary) and the application is forwarded to the Committee on Zoning. Finally, the Committee on Zoning makes a decision on the application, and forwards the application to the City Council which can act on a simple majority vote. See Figure 23 for an example of the resulting ordinance.

It is generally understood that the relevant Alderman is consulted throughout the process described above. Many Aldermen even have instructions on their own Ward webpages, sometimes with their own forms on applying for re-zoning through them, even though they are not officially part of the process except through the City Council vote. And I do cite several news articles on the concept of “Aldermanic prerogative” with respect to zoning. Nonetheless, it is impossible to know for sure how much influence Aldermen truly have over the decision, but I believe it is a reasonable assumption for the vast majority of developments.

An alternative method to effecting changing zoning without a zoning re-classification is to obtain a ”variance”. According to the Chicago Zoning Ordinance section 17-13-1100, variations can be granted by the Zoning Board of Appeals for a specific set of rules. These concern mostly setbacks, minimum parking requirements, lighting, signage, etc. There are also some specific circumstances in which height or density restrictions can be adjusted for commercial and other uses. With respect to residential use, a maximum expansion of 15% of the FAR can be granted for the following districts: RS-3, RT-3.5, RT-4, RM-4.5, or RM-5.

However, the Code specifies that the Zoning Board of Appeals unless it finds, among other things, that applying the rules as is would prevent a property from earning a reasonable return, that the circumstances are unique (e.g. topographic issues), and the purpose of the variation is not to make more money out of the property. Further, variances are handled directly by the Zoning Board of Appeals and are not considered by City Council or the local Alderman. Due to their limited power and use primarily for existing structures, I do not consider variances in my analysis.

Nonetheless, variances play an important role in development, and a basic sampling of the zoning re-classifications in my sample suggests a significant portion of them also involved variances. In every case I came across, however, the variances involved setback requirements or other similar issues rather than density. Further, a review of the meeting minutes for the Zoning Board of Appeals’ meetings in 2017, only one of over 100 variation applications considered involved an increase in FAR. This one variation application involved an increase in the FAR to allow an addition to an existing church. The rest mostly involved setbacks and special permits to allow commercial use in residential areas (barbershops, nail salons, etc.).

Figure 23: Example Re-Zoning Ordinance. Re-Zoning Ordinances require passage by a vote of City Council, composed of all 50 Ward Aldermen and the Mayor of Chicago.

#19082
INTRO DATE
01-25-17

ORDINANCE

BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF CHICAGO:

SECTION 1. Title 17 of the Municipal Code of Chicago, the Chicago Zoning Ordinance, Is hereby amended by changing all the RS3 Residential Single-Unit (Detached House) District symbols and indications as shown on Map No.20-B in the area bounded by

> a line 178.12 feet south of and parallel to East 85^{th} Street; South Manistee Avenue; a line 208.12 feet south of and parallel to East 85^{th} Street; and the alley next west of and parallel South Manistee Avenue,

to those of a RT4 Residential Two-Flat, Townhouse and Multi-Unit District is hereby established in the area above described.

SECTION 2. This ordinance shall be in force and effect from and after its passage and due publication.

Common address of property: 8518 South Manistee Avenue

Figure 24: Example Re-Zoning Notification. Those requesting a zoning change are required by City Ordinance to notify all residents within 250 feet of the relevant parcel of the requested zoning change.

KOLPAK, LERNER & GRCIC
A PARTNERSHIP INCLUDING A PROFESSIONAL CORPORATION
ATTORNEYS AT LAW
SUITE 202
6767 NORTH MILWAUKEE AVENUE
NILES, ILLINOIS 60714

TELEPHONE
(847) 647 - 0336
FACSIMILE
(847) 647 - 8107

January 16, 2017

To Property Owner:

In accordance with requirements for an Amendment to the Chicago Zoning Ordinance, specifically Section 17-13-0107, please be informed that on or about January 17, 2017, the undersigned will file an application for a change in zoning from RS-3 to RT-4 on behalf the applicant, Maryland Group, Inc. for the property located at 8518 South Manistee, Chicago, IL 60617.
The applicant seeks to put a 4,359 square feet single family home with a detached two car garage into compliance with the City of Chicago Zoning Ordinance.

The applicant/owner of the property is Maryland Group, Inc. and their address is 605 East 63rd Street, Chicago, Illinois, 60637. The contact person for this application is Attorney Paul A. Kolpak, Kolpak and Lerner, 6767 N. Milwaukee Avenue, Suite 202, Niles, IL 60714. You can reach Paul Kolpak at 847-647-0336.

Please note the applicant is not seeking to rezone or purchase your property. The applicant is required by law to send this notice because you own property within 250 feet of the property to be rezoned.

Sincerely,

Paul A. Kolpak
PAK/

Table 12: Zoning Districts

#	Name	Class	Floor-to-Area Ratio	Lot Area Per Unit
1	RS-1	Residential	0.5	6250
2	RS-2	Residential	0.65	5000
3	RS-3	Residential	0.9	2500
4	RT-3.5	Residential	1.05	1250
5	RT-4	Residential	1.2	1000
6	RT-4A	Residential	1.5	1000
7	RM-4.5	Residential	1.7	700
8	RM-5	Residential	2	400
9	RM-5.5	Residential	2.5	400
10	RM-6	Residential	4.4	300
11	RM-6.5	Residential	6.6	300
12	B1-1	Business	1.2	2500
13	B1-1.5	Business	1.5	1350
14	B1-2	Business	2.2	1000
15	B1-3	Business	3	400
16	B1-5	Business	5	200
17	B2-1	Business	1.2	2500
18	B2-1.5	Business	1.5	1350
19	B2-2	Business	2.2	1000
20	B2-3	Business	3	400
21	B2-5	Business	5	200
22	B3-1	Business	1.2	2500
23	B3-1.5	Business	1.5	1350
24	B3-2	Business	2.2	1000
25	B3-3	Business	3	400
26	B3-5	Business	5	200
27	C1-1	Commercial	1.2	2500
28	C1-1.5	Commercial	1.5	1350
29	C1-2	Commercial	2.2	1000
30	C1-3	Commercial	3	400
31	C1-5	Commercial	5	200
32	C2-1	Commercial	1.2	2500
33	C2-2	Commercial	2.2	1000
34	C2-3	Commercial	3	400
35	C2-5	Commercial	5	200

Table 13: Zoning Districts cont.

#	Name	Class	Floor-to-Area Ratio	Lot Area Per Unit
36	C3-1	Commercial	1.2	2500
37	C3-2	Commercial	2.2	1000
38	C3-3	Commercial	3	400
39	C3-5	Commercial	5	200
40	DC-12	Downtown	12	115
41	DC-16	Downtown	16	100
42	DR-10	Downtown	10	115
43	DR-3	Downtown	3	400
44	DR-5	Downtown	5	200
45	DR-7	Downtown	7	145
46	DS-3	Downtown	3	400
47	DS-5	Downtown	5	200
48	DX-12	Downtown	12	115
49	DX-16	Downtown	16	100
50	DX-3	Downtown	3	400
51	DX-5	Downtown	5	200
52	DX-7	Downtown	7	145
53	M1-1	Manufacturing	1.2	None
54	M1-2	Manufacturing	2.2	None
55	M1-3	Manufacturing	3	None
56	M2-1	Manufacturing	1.2	None
57	M2-2	Manufacturing	2.2	None
58	M2-3	Manufacturing	3	None
59	M3-1	Manufacturing	1.2	None
60	M3-2	Manufacturing	2.2	None
61	M3-3	Manufacturing	3	None
62	PMD	Planned Manufacturing	Custom	None
63	PD	Planned Developments	Pre-Existing FAR	Pre-Existing LAPU
64	T	Transportation	1.5	Custom
65	POS-1	Parks and Open Space	Custom	Custom
66	POS-2	Parks and Open Space	Custom	Custom
67	POS-3	Parks and Open Space	Custom	Custom