Lot Sizes, Welfare and Urban Form: A View from the United States

James Macek

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- Lot size regulation appears to be mediating the burden of high housing prices on low income families, causing considerable residential sorting on income and race (Kulka, 2019) (Song, 2021).
- No previous work in measuring the welfare impacts in general equilibrium.

In this paper

1. Income sorting has important implications for the *aggregate* welfare consequences of regulation, building on Hsieh and Moretti (2019):
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    - Exacerbated when local amenities are endogenous
    - Ensuing externalities, e.g. Hamilton (1976).

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   - Exacerbated when local amenities are endogenous
   - Ensuing externalities, e.g. Hamilton (1976).
2. Evidence that *heterogeneous* regulation has altered *urban form* in expensive cities. Crucial for assessing welfare consequences for two reasons:
   - Households can move *within* cities to avoid large lots
   - Within-city income sorting is an important margin bolstering welfare inequality

How?

- Build and calibrate a structural GE model with heterogenous households, cities and neighborhoods across the contiguous United States
  - (Heterogenous) regulations cause income sorting, and income sorting shapes the pattern of neighborhood amenities
  - ...and also shape patterns of urban density in a way that matches observation

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- Counterfactual: What if we decreased the lot size restrictions we observe in the suburbs of expensive cities?
- Housing regulation is hard to measure, but recent advances...
  - Song (2021) shows that a structural break detection algorithm works well for minimum lot sizes
  - I hope to leverage assessment data with nation-wide coverage

Literature

- Macroeconomics of housing regulation (Hsieh and Moretti, 2019) (Duranton and Puga, 2019) (Parkhomenko, 2020) (Bunten, 2017) (Herkenhoff et al., 2018) (Ganong and Shoag, 2017) (Gyourko et al., 2013)
- Lot Size/Unit density regulation (Kulka, 2019) (Song, 2021) (Kulka et al., 2022) (Zabel and Dalton, 2011) (Gyourko et al., 2021) (Grieson and White, 1981) (Gyourko and Voith, 1997) (Davidoff et al., 2022)
- Housing Regulation + Supply + Affordability (Baum-Snow and Han, 2021) (Saiz, 2010) (Asquith et al., 2021) (Mast, 2020) (Albouy et al., 2016) (Bertaud and Brueckner, 2005) (Mills, 2005) (Brueckner and Singh, 2020) (Brueckner et al., 2017) (Acosta, 2021) (Martynov, 2022) (Turner et al., 2014) (Gyourko and Molloy, 2015)
- Urban spatial sorting (Diamond, 2016) (Couture and Handbury, 2020) (Su, 2022) (Baum-Snow and Hartley, 2020) (Couture et al., 2019) (Amalgro and Dominguez-Iino, 2021) (Brueckner et al., 1999) (Glaeser et al., 2008) (Brueckner and Rosenthal, 2009) Lee and Lin (2017)
- Inequality in cities (Baum-Snow and Pavan, 2013) (Eeckhout et al., 2014) (Fogli and Guerrieri, 2019)
- Exclusionary Zoning (Hamilton, 1975) (Calabrese et al., 2007) (Fernandez and Rogerson, 1997) (Calabrese et al., 2011) (Barseghyan and Coate, 2016) (Brueckner, 2021)

Motivating evidence

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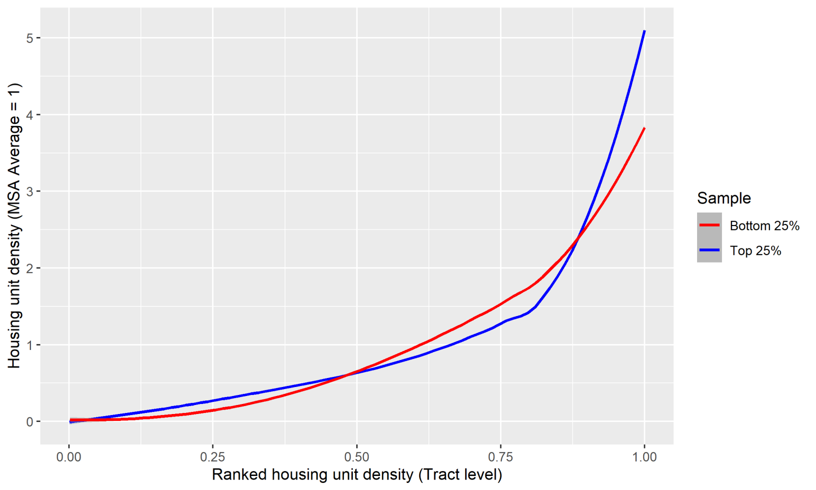
- Superstars are MSAs in the top quartile of (unadjusted) housing prices, Non-superstars in the bottom quartile
- Housing unit density is normalized to be on average 1 across tracts within each MSA. Controls for MSA fixed effects.

Fact 1: Density Gradients Differ in Expensive Cities



Fact 1: Why might lot size regulation be generating these patterns?

1. Decompose Housing Unit Density into a *Single Family* margin and an *Other Structures* margin Go!

2. Further decompose Single Family margin into *Land* and *Density* margins, using assessment data Go!

3. Fact 1 does *not* replicate in contemporary French cities Go!

4. TBD: Does Fact 1 replicate in the early 20th century US?

Fact 2: Strong Income Sorting on Density in Expensive Cities

Model and Calibration

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- Unless otherwise stated, all data are from the 2010 Census or the 2008-2012 ACS, where applicable.
- Each tract i has land $T(i)$ available for residential development.

Developer's Problem

- Start with a standard Cobb-Douglas production function for housing, yielding housing supply per unit of land

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- Minimum lot sizes $l(i)$ incentivize developers to build above a *minimum housing stock per housing unit*

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$$A^{\star}(i) = \left[\frac{P(i)}{\lambda(i)}\right]^{\epsilon(i)} l(i) \tag{2}$$

- Note: $P(i)A^{\star}(i)$ is increasing in $P(i)$.

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$$\max_{A,g} b(i, z) A^{\beta} g^{1-\beta} \tag{3}$$

subject to $A \geq A^{\star}(i)$ and $P(i)A + g \leq w(i)z$.

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- Let $V\left[P(i), w(i), z, A^{\star}(i)\right] := V(i, z)$ be the indirect utility associated with this problem.

Neighborhood Choice

- Frechet shocks over neighborhoods, allowing for within-city correlation ρ. Labour supply for type z households are

$$L(i,z) = \left[\frac{W(C(i),z)}{\boldsymbol{W}(z)}\right]^{\theta}\left[\frac{V(i,z)}{W(C(i),z)}\right]^{\frac{\theta}{1-\rho}}\bar{L}(z) \qquad (4)$$

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and

$$\boldsymbol{W}(z) = \left[\sum_{c \in C} W(c,z)^{\theta}\right]^{\frac{1}{\theta}}$$

Endogenous Amenities

- Let $\tau(i)$ be the commuting time in i. I allow amenity values $b(i,z)$ to respond to neighborhood income per capita via the equation:

$$\log\left[b(i,z)\right] = -\kappa\tau(i) + \Omega\log\left[\frac{\sum_{z'\in Z} w(i)z'L(i,z')}{\sum_{z'\in Z} L(i,z')}\right] + \epsilon(i,z) \tag{5}$$

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  1. Local, non-traded Dixit-Stiglitz market (Couture et al., 2019) (Amalgro and Dominguez-Iino, 2021) + local disutility of density (Kulka et al., 2022)
  2. Local, congested public good financed through property taxes (Calabrese et al., 2007) (Calabrese et al., 2011)

Wages

- Numeraire good is produced using only units of labour under *external increasing returns*.

- Inverse labour demand given by

$$w(c) = \sigma(c)\left[\sum_{z \in Z} \sum_{i \in N(c)} zL(i, z')\right]^{\alpha} \tag{6}$$

for $\alpha > 0$.

- Past literature estimates α as a population elasticity, but with heterogenous households this interpretation is lost.

- Apparently, hard to separately identify agglomeration effects on output and population, See Combes and Gobillon (2015) Section 3.1.

Calibration and Identification

Minimum Lot Sizes

- Follows a structural break algorithm in Song (2021).
  - Idea: Zoning variances are present, but rare
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- I generalize this procedure to multifamily homes (duplexes, triplexes and fourplexes)
- Problem: Lot size policy may vary within census tracts.
  - If multiple minimum lot sizes overlap on a tract, consider the smallest one
  - Assign the measured minimum lot size to a tract if the observed number of housing units does not exceed the *implied* maximum under regulation.

Regional Production Functions

- Follows Baum-Snow and Han (2021) closely, with some differences
  1. Use assessment data to construct high quality measures of housing prices $P(i)$ via a hedonic regression
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- Given stock measures $A(i)$, prices $P(i)$ and elasticities $\epsilon(i)$ from Baum-Snow and Han (2021), supply shifters $\lambda(i)$ are uniquely identified ...

- and so is the minimum housing stock per unit $A^{\star}(i)$

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- For now: choose a value of θ and ρ from the literature
  1. Hornbeck and Moretti (2018) measure $\theta \approx \frac{10}{3}$
  2. Herzog (2022) estimates $\frac{\theta}{1-\rho} = 7.21$ in a closed city model of commuting, implying $\rho \approx 0.5377$

Estimation of Ω

- Recall the estimating equation:

$$\log\left[b(i,z)\right] = -\kappa\tau(i) + \Omega\log\left[\frac{\sum_{z'\in Z} w(i)z'L(i,z')}{\sum_{z'\in Z} L(i,z')}\right] + \epsilon(i,z)$$

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- Two sources preventing identification:
  1. Simultaneity bias, analogous to Couture et al. (2019) and Diamond (2016).
  2. Exogenous, unobserved features that cause amenities and income sorting, but do not respond to changes in local incomes.

Estimation of Ω

- I propose an instrument – tract level terrain slopes. There are two competing interpretations of its validity:
  - Saiz (2010): Slopes primarily affect housing prices through *supply constraints*. Validates the instrument.
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- For most amenities variables v_i and average slope s_i, I construct an additional control $v_i s_i$
  - Accounts for supermodularities between slopes and natural features
  - Example: can have an ocean view from farther away if terrain is sloped

Estimation of Ω: First Stage

	(1)	(2)	(3)
VARIABLES	Log(Average Income)	Log(Average Income)	Log(Average Income)
Average Slope	0.022***	0.024***	0.010
	(0.002)	(0.004)	(0.012)
Observations	58,498	58,350	58,350
R-squared	0.038	0.007	0.000
KP F-Stat	100.397	35.884	.588
MSA FE	Yes	Yes	Yes
MSA Clustering	Yes	Yes	Yes
Amenity Controls	No	Yes	Yes incl. slope x max july temperature

Robust standard errors in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Figure 1: Amenity Controls: A set of approximately 240 variables, merging data from Lee and Lin (2017) and measures of forest and perennial snow cover from the NLCD. Lee and Lin (2017) controls include distance to various bodies of water, temperature, precipitation, different types of community names (i.e. "gulch", "shores"). Includes most interactions of these variables with average slopes.

Conclusion

- I provide observational evidence that *heterogeneous* lot size regulation has altered urban form – both the shape of cities and how households of various incomes sort into them.
- Income sorting in the face of lot size regulation has important implications for aggregate welfare.
  - A channel that has been (sadly) ignored.
- This motivates a structural model that can simultaneously capture all these forces.
- Thank you for all the help this year!

Appendix

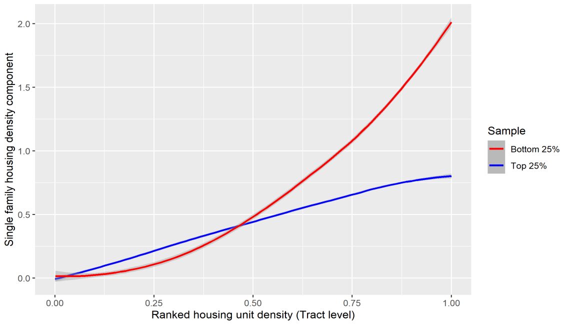
Appendix: Single Family Margin vs Other Structures

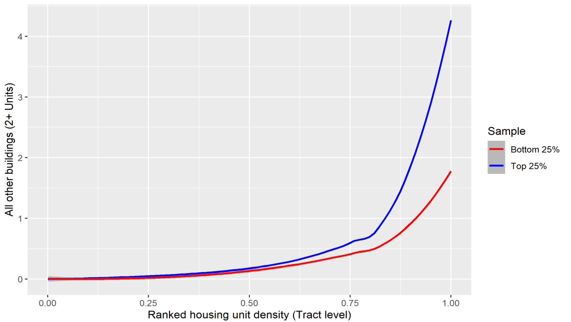
- The shape of the distribution *may not* be driven the presence of structures that tend to be heavily regulated.
- Linearly decompose housing unit density $D_{H,im}$ into two margins:

$$D_{H,im} = D_{S,im} + D_{L,im} \tag{7}$$

- where $D_{S,im}$ is the number of single family homes in MSA m and tract i divided by the total land mass of the tract.
- $D_{L,im}$ are defined analogously for all other structures.
- Single family home shares are from the 2008-2012 ACS.
- Repeat the regression for each component separately. Justified because the conditional expectation is additive.

Appendix: Single Family and Other Structures margins Return!





Appendix: Single Family Density and Land margins

- Log-linearly decompose the single family component into *density* and *land* margins, respectively:

$$log(D_{S,im}) = log(\tilde{D}_{S,im}) + log(L_{S,im}) \tag{8}$$

- where $\tilde{D}_{S,im}$ is the number of single family homes divided by the total land used for single family housing, and $L_{S,im}$ is the fraction of tract land used for single family housing.

- Repeat the regression for each component separately.

- Use 2015 assessment data on single family homes to measure average land use per housing unit, with unit counts from the ACS/Census.

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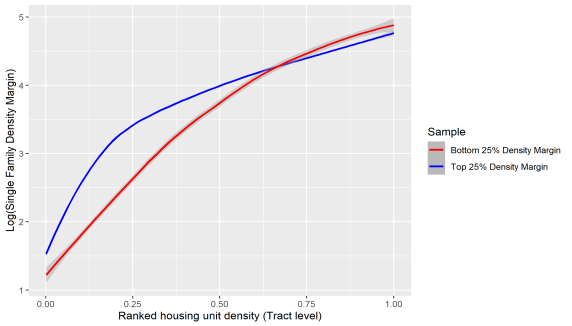
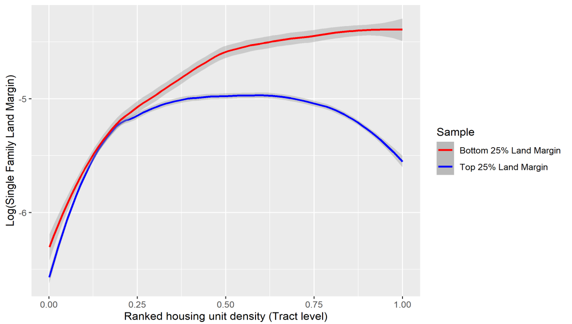
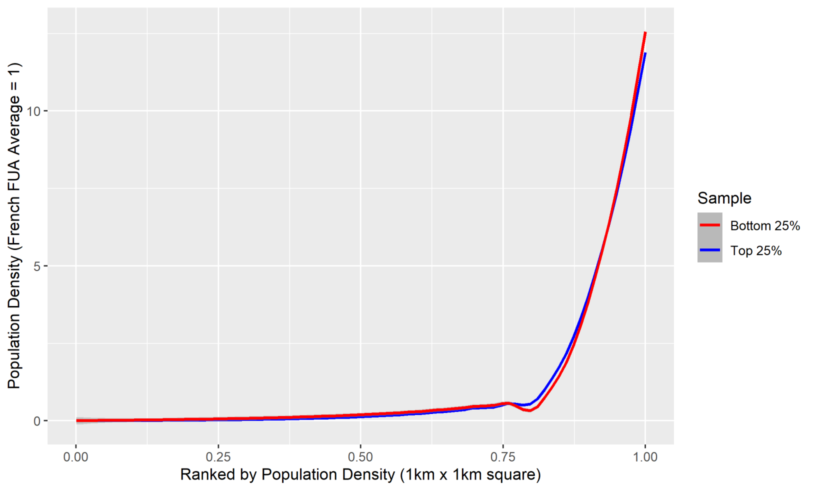




Appendix: Fact 1 replication with French Data

Return!



References

Acosta, C. (2021, April). The Incidence of Land Use Regulations. Documentos de Trabajo CIEF 019223, Universidad EAFIT.

Ahlfeldt, G. M., S. J. Redding, D. M. Sturm, and N. Wolf (2015). The economics of density: Evidence from the berlin wall. *Econometrica 83*(6), 2127–2189.

Albouy, D., G. Ehrlich, and Y. Liu (2016, November). Housing demand, cost-of-living inequality, and the affordability crisis. Working Paper 22816, National Bureau of Economic Research.

Amalgro, M. and T. Dominguez-Iino (2021, 12). Location sorting and endogenous amenities: Evidence from amsterdam. *Working paper*.

Asquith, B. J., E. Mast, and D. Reed (2021, 05). Local Effects of Large New Apartment Buildings in Low-Income Areas. *The Review of Economics and Statistics*, 1–46.

Barseghyan, L. and S. Coate (2016, August). Property taxation, zoning, and efficiency in a dynamic tiebout model. *American Economic Journal: Economic Policy 8*(3), 1–38.

Baum-Snow, N. and L. Han (2021, 05). The microgeography of housing supply. *Working paper*.

Baum-Snow, N. and D. Hartley (2020). Accounting for central neighborhood change, 1980–2010. *Journal of Urban Economics 117*, 103228.

Baum-Snow, N. and R. Pavan (2013, 12). Inequality and City Size. *The Review of Economics and Statistics 95*(5), 1535–1548.

Bertaud, A. and J. K. Brueckner (2005). Analyzing building-height restrictions: predicted impacts and welfare costs. *Regional Science and Urban Economics 35*(2), 109–125.

Brueckner, J. K. (2021). Jue insight: Zoning and property taxation revisited—was hamilton right? *Journal of Urban Economics*, 103393.

Brueckner, J. K., S. Fu, Y. Gu, and J. Zhang (2017, 10). Measuring the Stringency of Land Use Regulation: The Case of China's Building Height Limits. *The Review of Economics and Statistics 99*(4), 663–677.

Brueckner, J. K. and S. S. Rosenthal (2009, 11). Gentrification and Neighborhood Housing Cycles: Will America's Future Downtowns Be Rich? *The Review of Economics and Statistics 91*(4), 725–743.

Brueckner, J. K. and R. Singh (2020). Stringency of land-use regulation: Building heights in us cities. *Journal of Urban Economics 116*, 103239.

Brueckner, J. K., J.-F. Thisse, and Y. Zenou (1999). Why is central paris rich and downtown detroit poor?: An amenity-based theory. *European Economic Review 43*(1), 91–107.

Bunten, D. M. (2017, 6). Is the rent too high? aggregate implications of local land-use regulation. Working Paper 2017-064, Board of Governors of the Federal Reserve System.

Calabrese, S., D. Epple, and R. Romano (2007). On the political economy of zoning. *Journal of Public Economics 91*(1-2), 25–49.

Calabrese, S. M., D. N. Epple, and R. E. Romano (2011, 12). Inefficiencies from Metropolitan Political and Fiscal Decentralization: Failures of Tiebout Competition. *The Review of Economic Studies 79*(3), 1081–1111.

Combes, P.-P. and L. Gobillon (2015). The Empirics of Agglomeration Economies. In G. Duranton, J. V. Henderson, and W. C. Strange (Eds.), *Handbook of Regional and Urban Economics*, Volume 5 of *Handbook of Regional and Urban Economics*, Chapter 0, pp. 247–348. Elsevier.

Couture, V., C. Gaubert, J. Handbury, and E. Hurst (2019, 08).

Income growth and the distributional effects of urban spatial sorting. Working Paper 26142, National Bureau of Economic Research.

Couture, V. and J. Handbury (2020). Urban revival in america. *Journal of Urban Economics 119*, 103267.

Davidoff, T., A. Pavlov, and T. Somerville (2022). Not in my neighbour's back yard? laneway homes and neighbours' property values. *Journal of Urban Economics 128*, 103405.

Diamond, R. (2016, March). The determinants and welfare implications of us workers' diverging location choices by skill: 1980-2000. *American Economic Review 106*(3), 479–524.

Duranton, G. and D. Puga (2019, December). Urban growth and its aggregate implications. Working Paper 26591, National Bureau of Economic Research.

Eeckhout, J., R. Pinheiro, and K. Schmidheiny (2014). Spatial sorting. *Journal of Political Economy 122*(3), 554–620.

Fernandez, R. and R. Rogerson (1997). Keeping people out: Income distribution, zoning, and the quality of public education. *International Economic Review 38*(1), 23–42.

Fogli, A. and V. Guerrieri (2019, 08). The end of the american dream? inequality and segregation in us cities. Working Paper 26143, National Bureau of Economic Research.

Ganong, P. and D. Shoag (2017). Why has regional income convergence in the u.s. declined? *Journal of Urban Economics 102*, 76–90.

Glaeser, E. L., M. E. Kahn, and J. Rappaport (2008). Why do the poor live in cities? the role of public transportation. *Journal of Urban Economics 63*(1), 1–24.

Grieson, R. E. and J. R. White (1981). The effects of zoning on structure and land markets. *Journal of Urban Economics 10*(3), 271–285.

Gyourko, J., J. S. Hartley, and J. Krimmel (2021). The local residential land use regulatory environment across u.s. housing markets: Evidence from a new wharton index. *Journal of Urban Economics 124*, 103337.

Gyourko, J., C. Mayer, and T. Sinai (2013, 11). Superstar cities. *American Economic Journal: Economic Policy 5*(4), 167–99.

Gyourko, J. and R. Molloy (2015). Chapter 19 - regulation and housing supply. In G. Duranton, J. V. Henderson, and W. C. Strange (Eds.), *Handbook of Regional and Urban Economics*, Volume 5 of *Handbook of Regional and Urban Economics*, pp. 1289–1337. Elsevier.

Gyourko, J. and R. Voith (1997). Does the U.S. tax treatment of housing promote suburbanization and central city decline? Technical report.

Hamilton, B. W. (1975). Zoning and property taxation in a system of local governments. *Urban Studies 12*(2), 205–211.

Hamilton, B. W. (1976). Capitalization of intrajurisdictional differences in local tax prices. *The American Economic Review 66*(5), 743–753.

Herkenhoff, K. F., L. E. Ohanian, and E. C. Prescott (2018). Tarnishing the golden and empire states: Land-use restrictions and the u.s. economic slowdown. *Journal of Monetary Economics 93*, 89–109. Carnegie-Rochester-NYU Conference on Public Policy held at the Stern School of Business at New York University.

Herzog, I. (2022). The city-wide effects of tolling downtown drivers: Evidence from london's congestion charge. *Working paper*.

Hornbeck, R. and E. Moretti (2018, May). Who benefits from productivity growth? direct and indirect effects of local tfp growth on wages, rents, and inequality. Working Paper 24661, National Bureau of Economic Research.

Hsieh, C.-T. and E. Moretti (2019, April). Housing constraints and spatial misallocation. *American Economic Journal: Macroeconomics 11*(2), 1–39.

Kulka, A. (2019, 12). Sorting into neighborhoods: The role of minimum lot sizes. *Working paper*.

Kulka, A., A. Sood, and N. Chiumenti (2022, 1). How to reduce housing costs? understanding local deterrents to building multifamily housing. *Working paper*.

Lee, S. and J. Lin (2017, 03). Natural Amenities, Neighbourhood

Dynamics, and Persistence in the Spatial Distribution of Income. *The Review of Economic Studies 85*(1), 663–694.

Martynov, P. (2022). Welfare effects of zoning: Density restrictions and heterogenous spillovers. *Working paper*.

Mast, E. (2020, July). Warding off development: Local control, housing supply, and nimbys. Working Paper 20-330, Upjohn Institute for Employment Research.

Mills, E. S. (2005). Why do we have urban density controls? *Real Estate Economics 33*(3), 571–585.

Parkhomenko, A. (2020, 09). Local causes and aggregate implications of land use regulation. *Working paper*.

Saiz, A. (2010, 08). The Geographic Determinants of Housing Supply*. *The Quarterly Journal of Economics 125*(3), 1253–1296.

Song, J. (2021, 11). The effects of residential zoning in u.s. housing markets. *Working paper*.

Su, Y. (2022, February). The rising value of time and the origin of urban gentrification. *American Economic Journal: Economic Policy 14*(1), 402–39.

Turner, M. A., A. Haughwout, and W. van der Klaauw (2014). Land use regulation and welfare. *Econometrica 82*(4), 1341–1403.

Zabel, J. and M. Dalton (2011). The impact of minimum lot size regulations on house prices in eastern massachusetts. *Regional Science and Urban Economics 41*(6), 571–583.