“Too small to farm, too big to mow”:
The impact of large-lot zoning on the exurban landscape

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RUTGERS New Jersey Agricultural Experiment Station

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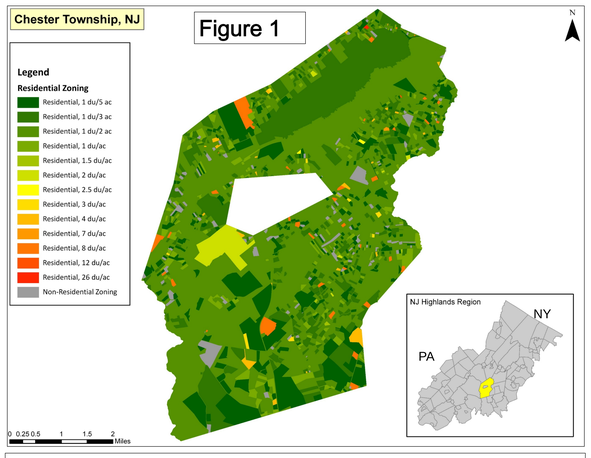
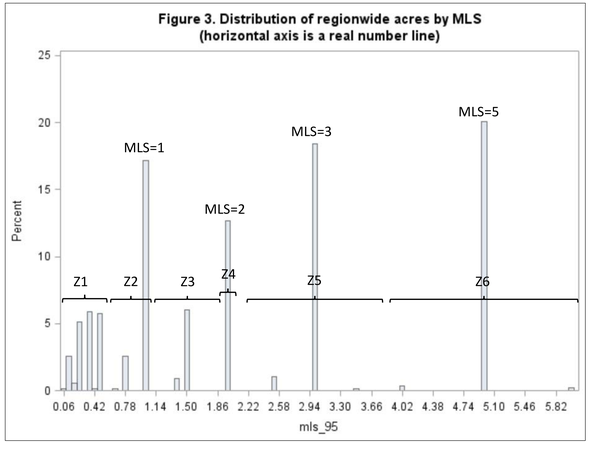
Introduction

This study looks for one unintended consequence of large-lot zoning: the possibility that it will increase the amount of land converted from rural land cover to suburban lawn, even as it reduces the number of homes that are built in a community. This is one definition of “urban sprawl.”

Few zoning studies consider selection bias in the choice of the zoning treatment. When the dependent variable measures parcel development (0 or 1) or land cover change (% of land converted), controls for selection bias are even less common, because these models employ nonlinear link functions.[1]

The present study uses inverse propensity score weighting to control for selection bias across six zoning classes in a study of the percentage of land cover change in northwestern New Jersey from 1995 to 2002.





Hypotheses and Data

- Our dependent variable, the percentage of undeveloped land that converts to residential land cover, must eventually decline as minimum lot size (MLS) gets very large. One reason is that the size of front and backyards stabilizes.[2]
- At low levels of MLS, however, land conversion could increase with increasing MLS, provided that the expected decline in the number of housing units with respect to increasing MLS is inelastic.[2,3] We therefore look for two possible relationships between land cover change and increasing MLS: *strictly declining* or *concave*.
- The study area consists of 83 municipalities in the New Jersey Highlands (see figure 1, inset). The data of interest are based on GIS overlays of digitized zoning maps (figure 1, left) and land use-land cover maps prepared regularly by the New Jersey Department of Environmental Protection (figure 2, right).
- The statistical units of analysis are 252 unique combinations of municipality and MLS-defined zone, for land that was undeveloped in 1995.
- For a number of reasons, MLS is treated as a categorical rather than a continuous variable. Similar MLS are aggregated into a manageable number of zoning groups (figure 3, below left). Internal variance within each group is minimal because only a handful of the thirty observed MLS dominate the study area (figure 3).

Methods

- Because the dependent variable is the percentage of land in each zoning group that developed between 1995 and 2002, the outcome equation is modelled using fractional logit.
- The propensity score equation models selection into zoning groups Z1 through Z6 as a function of covariates likely to affect either the zoning treatment or the development outcome (table 1). This model employs generalized logit.[4]
- In both propensity score and outcome equations, the square root of zone size serves as a regression weight. Square root of zone size is combined multiplicatively with the inverse propensity score as a weight in the outcome equation.[4]

Results

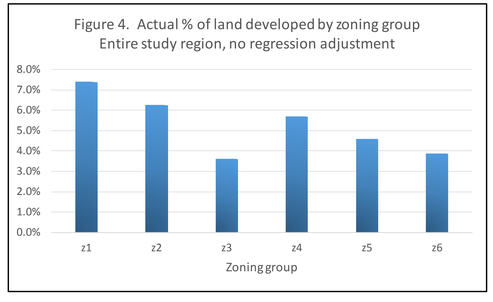
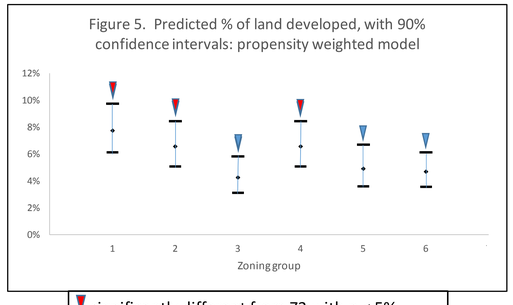


Table 1. Covariates are reasonably well balanced before applying a propensity score[5]

Covariate	Normalized difference in covariate means: Zoning group Z6 minus zoning group Z1
Percentage of land in zone that was farmed in 1995	0.109
Existence of any highway (0,1)	-0.055
Average farm size in 1992	0.014
Percent farm occupations in 1990	0.099
Median household income in 1989	0.028
Distance to New York City	0.113
Population density	-0.110
Percent land considered prime agricultural soil	0.116
Percentage change in residential parcel value 1980-1990	-0.006
Percent land in steep slopes	0.025
Violent crime rate	-0.067
Percent open space permanently preserved	-0.062

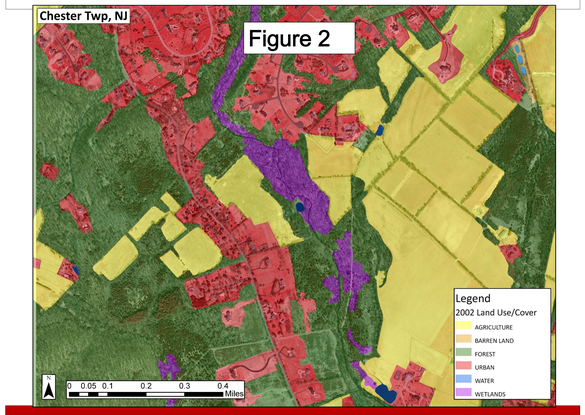
Means are weighted by size of zone. All but the first variable are municipal level.



Falsification tests (pseudo-outcome analysis on three covariates) show little or no evidence of confoundedness.

Conclusion

- A comparison of PS-adjusted and unadjusted results (figures 4 and 5) suggests that selection bias is not severe in this dataset. This is also implied by table 1.
- Zoning group Z3 appears anomalous within a generally inverse relationship between % land converted and MLS (figure 5). This could be because the real estate market “prefers” MLS=2 to MLS=1.5. Relative to zoned capacity, more lots may be developed at the higher of the two restrictions, leading to greater landscape change.
- Group Z3 aside, *statistically significant declines in land cover change relative to group Z1 do not kick in until MLS>2* (figure 5). A larger sample size could sharpen this result.



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2) Gottlieb, P.D. 2013. Agricultural preservation, large-lot zoning, and real estate development in New Jersey, USA. Presented at the annual meetings of the European Regional Science Association, Palermo, Italy, August 29.
3) Gottlieb, P.D., A. O’Donnell, T. Rudel, K. O;Neill, and M. McDermott. 2012. Determinants of local housing growth in a multi-jurisdictional region, along with a test for nonmarket zoning. *Journal of Housing Economics* 21: 296-309.
4) Our multinomial treatment setup, including the use of two separate regression weights in the outcome equation, is virtually identical to the following biomedical application: Leslie, S., and P. Thiebaud. 2007.Using propensity scores to adjust for treatment selection bias. *SAS Global Forum, Statistics and Data Analysis Paper* 184-2007.
5) The use of normalized means for analyzing covariate balance (as opposed to t-tests) is recommended in the recent text by Imbens, G., and D. Rubin. 2015. *Causal inference for statistical, social, and biomedical sciences.* New York: Cambridge University Press.

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