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The Effectiveness of Urban Containment Regimes in Reducing Exurban Sprawl

During the 1990s, the exurban landscape grew faster and added more people than urban, suburban, and rural landscapes. In many respects, exurbanization is the quintessential representation of urban sprawl and the problems it poses. More than 100 metropolitan areas across the US attempt to manage exurbanization through various forms of urban containment at regional or subregional scales. In this article, we assess the extent to which urban containment is effective in managing exurban sprawl in the 35 largest metropolitan areas in the US.

Through simple cross-section analysis, we found that relative to metropolitan areas without urban containment, those pursuing "strong" containment efforts performed best in reducing exurbanization. Strong containment programs are those that direct urban development into areas defined by urban containment boundaries and restrict development outside the boundaries. Metropolitan areas with "natural" containment, i.e., where development is constrained because of oceans, mountains, public ownership, and water supply, did not perform as well but saw less exurbanization than noncontained metropolitan areas. Least effective relative to other forms of containment were metropolitan areas with weak containment efforts, principally because such approaches do not substantially restrict development outside containment boundaries. Strong urban containment appears to be effective in reigning in exurban sprawl but without apparently dampening population growth generally.

Introduction

In 1955, Auguste Spectorsky wrote about *The Exurbanites,* whom he observed while traveling by train from Connecticut and western New Jersey (and even eastern Pennsylvania) to Manhattan. Where they lived was not in the cities, nor in the newly formed suburbs of Long Island and eastern New Jersey, and not really in any rural landscape. They lived beyond the suburbs – the exurbs as he called them.

Half a century later, we find Spectorsky's exurbia to be a complex landscape composed of small towns, very low density subdivisions, estates and manufactured homes, and farms (Davis et al. 1994). We also find a new breed of exurbanites – those willing to commute vast distances in their car whether or not rail service is available. We find that the process of exurbanization has become perhaps the most pernicious form of urban sprawl (Sanchez and Nelson 1997; Nelson and Sanchez 1999). Exurban development converts active farms and forests into low density land uses. It typically generates fewer local government revenues than it costs to serve (Burchell et al. 2002). At the same time, it exacerbates transportation systems since densities are too low for anything but the automobile, especially single occupant vehicle trips. By extension, exurbanization generates perhaps the highest air pollution emissions per capita of any other landscape, although further research is needed to show this.

Despite the problems it poses for open space preservation, public services, fiscal impacts, air quality, and transportation systems, exurbia was one of the fastest growing landscape in the 1980s (Nelson 1992a, b; Nelson and Sanchez 1997). Exurban areas accounted for nearly one-fifth of all new population, second only to large urban counties (such as Los Angeles). At 11.5% growth, exurban counties were second only to suburban counties in the pace of growth.

In the 1990s, however, exurbia burgeoned – growing faster (17.8%) and adding more people (10 million) than any other landscape, and absorbing nearly a third (31.8%) of the new population. By any measure, exurbia now dominates American growth. But not everywhere – even where one would expect it – as will be seen.

This article reviews one way in which exurbanization can be slowed, that is, urban containment, and provides statistical evidence to this effect. The article then concludes with some speculation on the long term benefits of urban containment in slowing exurbanization and also discusses the need for systematic research into the impacts of exurbanization.

Using Urban Containment to Lasso Exurban Sprawl

In response to development patterns leading to what may be termed "urban sprawl," dozens of local, regional, and state governments in the US have embarked on "urban containment." At its heart, urban containment aims to synchronize key public facilities with urban development pressures, preserve open spaces, and facilitate development in ways that preserves public goods, minimizes public costs, and accounts for development impacts by those who cause them (Nelson and Duncan 1995; Nelson and Dawkins 2002). We refer the reader to Nelson and Dawkins (2002) for a review of how urban containment works and how it varies in application across the United States. Of interest here is how it may be used to reign in exurban sprawl.

One of the cornerstones of urban containment is limiting development beyond an urban containment boundary such as an urban growth boundary, urban service limit, or (in the UK) urban growth stopline (see Easley 1992). This development is restricted in one of two principal ways. First and foremost in all containment schemes are preventing the extension of urban facilities into the rural countryside, especially wastewater treatment provided via sanitary sewers. This restriction is sometimes but not always extended to public water systems.

The second and more difficult way is restricting actual density. In the Twin Cities (Minneapolis/St. Paul, Minnesota), minimum lot size restrictions do not discourage low density urban development since lot sizes can range from one to five acres on septic systems with or without public water. Such small acreage development is perhaps the most pernicious of all forms of urban sprawl since it consumes land at a very rapid pace, removes land from a variety of open space uses, signals to farmers impending conversion to development, and exacerbates efficient provision of services (Nelson 1999). We call this "weak" containment. At the other extreme is metropolitan Portland, Oregon, where development outside urban growth boundaries (UGBs) occurs only in "exception" areas (i.e., areas excepted from strict application of farm and forest use policies because they are already built or committed to low density uses) or in farms and forests where needed to manage a commercial-scale operation (which can range from about 20 acres for high-intensity nurseries to 160 acres for timber production). We call this "strong" containment.

Urban containment can also occur because of natural conditions. Honolulu, Hawaii, comes to mind since the city has virtually nowhere to go. On the mainland, perhaps Los Angeles is the best example of natural containment since an ocean, mountain ranges, and federally-owned desert hem development in. Phoenix, Arizona, can also be considered naturally contained because individual water wells are not financially feasible and government agencies own a majority of the land around that metropolitan area.

Thus our general question is: Does urban containment slow the pace of exurban sprawl? More interesting, Do different forms of containment have different effects on exurban development?

Research Design and Method

We apply these questions to the 35 largest metropolitan statistical areas (MSAs) as ranked by the US Census Bureau. We measured exurbanization differently than our prior work that measured changes in development patterns based on counties. The research questions posed here require a finer grain of geographic resolution. After all, how can we measure exurbanization in San Bernardino County, California, which has decidedly urban, suburban, exurban, and rural development – and is larger than most New England states? Our solution is to measure change in census block group population density over time – particularly change in urban classification status. To do this, we first classified all census block groups in selected metropolitan areas as urban, suburban, exurban, or rural based on certain residential density ranges. Consistent with the Census, we classify as "urban" areas that have 1,000 or more people per square mile. Based on prior conceptual work by Lang (1986) and Nelson (1992a, b), we classify as "exurban" census tracts with a density ranging from 300 to 999 persons per square mile. At 2.5 persons per household this implies 120 homes per square mile or an average of slightly more than 5 acres per home – clearly consistent with views on what constitutes urban-oriented rural residential densities (see also Daniels 1999). We consider block groups with densities over 1,000 persons per square mile as "suburban" (combined with urban category) and those with fewer than 300 persons per square mile.

Only about a third of metropolitan areas analyzed utilize some type of urban containment strategy. Los Angeles, Las Vegas, and Phoenix are naturally contained. We say "naturally" because in the case of Los Angeles oceans and mountains rising to more than 10,000 feet hem development into a basin. [1] Las Vegas and Phoenix are naturally contained because of public ownership of vast amounts of land around them, and water that is expensive to acquire, treat, and distribute. Three other metropolitan areas are weakly contained – Orlando, San Francisco, and the Twin Cities – because low density exurban development is not only possible but in some respects facilitated by land use regulation. Five metropolitan areas are strongly contained – Miami, Portland, Sacramento, San Diego, and Seattle – because low density exurban development is simply not allowed outside containment boundaries except in isolated locations. It is interesting to note that among the top 10 fastest growing metropolitan areas (in terms of population size), half have some sort of containment and half do not. Among the bottom 10 in growth rates, only one has some form of containment and all the rest do not. It seems sensible that containment is more likely to be used where growth occurs and not where growth does not.

In any analysis of the sort we are conducting, namely comparing changes in outcomes over time between different regimes of metropolitan growth management, one must be cognizant of ecological fallacy – that is, are changes attributable to something other than that which is being measured? There is little absolute certainty of avoiding this, but we can start with estimating the statistical relationship between growth rate and containment regimes. In the model:

$P = f(N, W, S)$

where	P	*% population change 1990–2000,*
	N	*natural containment,*
	W	*weak containment,*
	S	*strong containment,*

and where the independent variables (binary) are types of containment, the null hypothesis is no statistically significant association between metropolitan population growth and containment type – or at least containment driven by explicit policy. If the null hypothesis is rejected, we might be concerned that containment is influenced by growth or vice versa, and that more complex interactions between growth and policies need to be explored. In the ordinary least squares regression of the model, we find:

$$P = 0.136 + 0.323N(0.088) + 0.057W(0.088) + 0.056S(0.070)$$

where standard errors are in parentheses. The coefficient of determination is modest at 0.24, meaning that 76 percent of the variation in percent population chance is attributable to factors other than those represented in the model. Among the independent variables, only natural containment is statistically significant at conventional levels (for $N = p<0.05$). This simple test suggests that at least among the policy-driven containment variables there is no

MSA/PMSA	Containment	1990 Density (persons/sq.mi.)	2000 Density (persons/sq.mi.)	Percent
Las Vegas	Natural	4,491	5,461	21.6 %
Los Angeles	Natural	7,405	8,164	10.3 %
Orlando	Weak	2,523	2,760	9.4 %
Seattle	Strong	3,576	3,902	9.1 %
Houston	None	3,569	3,856	8.0 %
Portland, OR	Strong	3,516	3,799	8.0 %
San Francisco	Weak	7,359	7,945	8.0 %
Phoenix	Natural	4,036	4,300	6.6 %
San Diego	Strong	4,836	5,152	6.5 %
Atlanta	None	2,316	2,463	6.4 %
Miami	Strong	5,653	6,002	6.2 %
Denver	None	4,274	4,491	5.1 %
New York	None	16,155	16,963	5.0 %
Sacramento	Strong	4,077	4,190	2.8 %
Dallas	None	3,816	3,909	2.4 %
Salt Lake City	None	3,822	3,905	2.2 %
Washington, DC	None	4,075	4,163	2.2 %
Norfolk	None	3,288	3,293	0.1 %
San Antonio	None	3,740	3,721	–0.5 %
Boston	None	4,034	3,896	–3.4 %
Chicago	None	6,384	6,139	–3.8 %
Minneapolis	Weak	3,304	3,168	–4.1 %
Tampa	None	3,155	3,019	–4.3 %
Philadelphia	None	4,456	4,220	–5.3 %
Charlotte	None	2,345	2,207	–5.9 %
Pittsburgh	None	3,419	3,205	–6.3 %
New Orleans	None	4,923	4,591	–6.7 %
Kansas City	None	3,111	2,881	–7.4 %
Columbus	None	3,779	3,482	–7.9 %
Detroit	None	4,072	3,737	–8.2 %
Indianapolis	None	2,998	2,744	–8.5 %
St. Louis	None	3,345	3,059	–8.6 %
Cincinnati	None	3,325	2,995	–9.9 %
Cleveland	None	4,197	3,767	–10.2 %
Milwaukee	None	4,315	3,698	–14.3 %

Tab. 1: Urbanized land density change by rank.

association between growth and containment. Although we do find an association with respect to natural containment, we surmise that while this form of containment may influence growth per se, it is nonetheless not influenced by explicit containment policy.

Urbanized Land Density Change

Table 1 shows change in population density of urbanized land. If containment is effective, we would expect to see higher urbanized land densities over time relative to noncontainment. This appears to be confirmed in Table 1 where among the 10 fastest growing metropolitan areas, 8 are contained somehow and half are contained because of weak or strong policies. By substituting urbanized land density change for population change in the general model above we have the following regression equation:

$$U = -0.03 + 0.16N(0.04) + 0.08W(0.04) + 0.10S(0.03)$$

where U *% urbanized land density change 1990–2000*

and where all forms of containment are statistically significant at conventional levels *(for N, W and S = $p<0.05$)* and the coefficient of determination is 0.49. Put differently, relative to metropolitan areas without containment, urban containment whether natural or driven by policy increases urbanized land density. This simple test suggests that all forms of containment including, notably, policy-driven containment is associated with increasing density of urbanized land over time for the selected metropolitan areas.

Exurbanized Land Change

Only three metros saw an overall reduction in exurbanized land from 1990 to 2000: Miami, Portland, and New Orleans. Two have containment and one does not. Indeed, of the 10 metropolitan areas with the least change in exurbanized land, only four have some form of containment. Is there a statistically significant association between change in exurbanized land over time and the presence of containment? This question is answered in a regression equation by substituting exurbanized land density change for population change in the general model above. The following regression equation results:

$$E = 0.23 + 0.42N(0.12) + 0.01W(0.12) - 0.20S(0.09)$$

where E *% exurbanized land change 1990–2000*

and where natural and strong containment are statistically significant at conventional levels *(for N and S = $p<0.05$)* but weak is not, and the coefficient of determination is 0.39.

These results are interesting. Relative to noncontainment, weak containment is seen to have no statistically significant association with change in exurbanized land but natural containment is positively associated while strong containment is negatively associated. The example of weak containment given above with respect to the Twin Cities can help explain the ambiguous relationship between it and the change in exurbanized land. Natural containment does not include policies that reinforce containment so one could expect no impedance to the conversion of land from rural to exurban uses. In all three cases where natural containment is present, Las Vegas, Los Angeles, and Phoenix, there are few policies regulating development beyond the read of urban services and in fact because those areas are growing so rapidly one may expect a certain amount of development to seek unregulated landscapes even if they may be more expensive to serve for lack of sanitary sewers and public water. In addition, the base of exurbanized land among these metropolitan areas was small in 1990 relative to others – so a small change in the amount of land exurbanized can appear as a largest percentage change. In contrast, relative to noncontainment, strong containment is associated with lower levels of change in exurbanized land. This is consistent with expectations that rigorous regulation of land outside containment boundaries should make exurban land less attractive for development.

Metropolitan Area	Containment	1990 Exurban	2000 Exurban	Percent
Miami	Strong	113.0	77.0	–31.9 %
Portland, OR	Strong	273.9	265.8	–3.0 %
New Orleans	None	178.4	173.3	–2.9 %
St. Louis	None	511.1	521.6	2.1 %
Pittsburgh	None	499.0	518.6	3.9 %
Chicago	None	309.6	329.0	6.3 %
Salt Lake City	None	147.7	160.9	8.9 %
Seattle	Strong	372.6	419.2	12.5 %
New York	None	286.2	323.2	12.9 %
San Francisco	Weak	98.2	111.2	13.2 %
Norfolk	None	235.8	267.5	13.4 %
Sacramento	Strong	207.9	238.4	14.7 %
Philadelphia	None	801.7	924.7	15.3 %
Milwaukee	None	315.0	367.9	16.8 %
Kansas City	None	312.4	366.1	17.2 %
Detroit	None	624.0	733.5	17.5 %
San Diego	Strong	247.4	294.2	18.9 %
Indianapolis	None	321.3	384.9	19.8 %
Columbus	None	267.1	325.6	21.9 %
Boston	None	927.7	1,134.4	22.3 %
Cleveland	None	248.6	304.2	22.4 %
Tampa	None	506.3	624.3	23.3 %
Denver	None	154.5	193.6	25.3 %
Minneapolis	Weak	427.6	536.9	25.6 %
Washington, DC	None	536.5	674.6	25.7 %
Cincinnati	None	314.6	396.7	26.1 %
Los Angeles	Natural	255.0	330.9	29.8 %
Orlando	Weak	194.1	258.4	33.1 %
San Antonio	None	128.2	178.2	39.0 %
Dallas	None	391.8	544.7	39.0 %
Phoenix	Natural	159.8	244.1	52.8 %
Atlanta	None	906.0	1,397.4	54.2 %
Charlotte	None	475.5	741.2	55.9 %
Houston	None	429.3	681.7	58.8 %
Las Vegas	Natural	64.4	135.8	110.9 %

Tab. 2: Exurbanized land change by rank (in square miles).

Exurbanized and Urbanized Land Population Density Change

Indeed, of the 12 metropolitan areas experiencing the greatest increase in combined density, all but two have some form of containment. We estimate the statistical association between containment of all forms and change in combined population density by adapting the general model described above to yield the following regression equation:

$$E + U = -0.04 + 0.10N(0.03) + 0.06W(0.03) + 0.13S(0.03)$$

where all forms of containment are statistically significant at conventional levels *(for N, W and S = $p<0.05$)*, and the coefficient of determination is 0.53.

These results are also interesting. Weak containment is seen to have the smallest coefficient with respect to change in combined population density with natural containment being second. Strong containment has the largest coefficient with respect to combine density change. The outcomes in these regards are consistent with a priori expectations of the magnitude differences in associations.

Review and Implications

Among the 35 metropolitan areas analyzed here, about a third have some form of land use policy containing the outward expansion of growth around them. Three are naturally contained because of oceans, mountains, public ownership, and water constraints. Three others contain urban development but allow low density exurban development outside containment lines. Five contain direct growth into areas contained by boundaries and limit low density exurban growth beyond. The remaining 24 metropolitan areas do not explicitly contain urban development and ostensibly allow if not encourage exurban development.

Statistical analysis shows no significant association between population growth and policy-driven urban containment. This implies that containment per se does not impair growth at least with respect to noncontainment. Indeed, statistical analysis shows that naturally contained metropolitan areas grew faster than noncontained metropolitan areas. We cannot say that containment accelerates growth, but we may be able to say that it does not impede it. This is important because it answers those critics who argue that containment policies will constrain land supply, thus stifling growth and economic development.

Containment of all types appears to

result in higher population density of urbanized land. In other words, relative to noncontainment, containment leads to higher urbanized land population density. Natural containment appears to increase densities the most, but strong containment is close behind followed by weak containment.

The rate of change in exurbanized land between containment types is interesting. We look first at weak containment, noting that there is no statistically significant difference in the rate of land exurbanized during the 1990s between weak containment and noncontainment. This is as we expected. What we did not expect was that exurbanized land change was faster in naturally contained metropolitan areas than noncontained areas. As we noted earlier, we suspect that the combination of a small base of exurbanized land in 1990 and lax regulation of land use beyond the immediate confines of those urbanized areas results in what appears to be a higher rate of exurbanized land change than noncontainment. We note looking at Table 1 that many noncontained metropolitan areas, such as Atlanta, added almost twice the volume of exurbanized land as all naturally contained metropolitan areas combined.

In contrast, strong containment is shown to result in negative rate of growth in exurbanized land change relative to noncontainment. If such containment is effective, this should be the outcome as some formerly exurbanized land becomes urbanized (density moves from fewer to more than 1,000 persons per square mile) while less land becomes exurbanized (density moves from fewer to more than 300 persons per square mile). Further analysis could show these dynamics for the 35 selected metro areas, such as the proportional changes of exurban land converting to urban densities.

We would like to argue that a better measure of land developed for urban uses is land where population density exceeds 300 persons per square mile. This gives a better picture of the true extent of commuting sheds and is a better measure of change in the reach of urbanization over time. We capture this in our measure of change in urbanized and exurbanized land density between 1990 and 2000. In this respect, all forms of containment result in higher changes in density than noncontainment, but there are interesting differences between containment types. The greatest change in density is associated with strong containment, where density rose at close to twice the pace as found in naturally contained metropolitan areas. This is interesting because one would expect naturally contained areas to densify at a faster pace than all other metropolitan areas – contained or otherwise – given limit land supply and growth rate. Instead, we find strongly contained metropolitan areas densified at a faster pace. At the other extreme, weakly contained metropolitan areas densified at a much lower pace than other forms of containment and, based on the coefficient, really not much more than noncontained metropolitan areas. This is reasonable given lack of development controls beyond containment boundaries. The fact that they densified at a higher pace than noncontainment is nonetheless interesting.

These US examples are informative to foreign audiences, despite political and economic differences affecting land use, such as tax and revenue systems. US communities rely heavily on property tax assessments and less so on income taxes – in contrast to many Western European countries where communities rely heavily on income taxes. This means that in the case of the US, incentives that effectively reduced property tax assessments have implications for local government revenues. Low density development (i.e., sprawl) in the US therefore has different fiscal impacts than they do in other countries.

The available evidence suggests that urban containment policies, especially ones that are rigorous in managing development outside development boundaries, are most effective in restraining exurban sprawl in the United States. Urban containment caused by natural constraints and those that weakly manage development beyond urban service limits are also effective but less so. What is not known conclusively, however, is whether urban containment enhances productivity of rural landscapes, reduces public facility costs, reduces transportation dependency on the automobile while also reducing overall travel and associated air pollution, and increases economies of agglomeration resulting in higher per capita incomes. In short, we cannot say presently, given available evidence, that there are measurable benefits derived from containment growth other than slowing exurban sprawl. These are issues that require additional research that also account for other metropolitan characteristics influencing growth and development patterns.

Note

[1] It is not "sprawl" that makes Los Angeles what it is; it is actually the most densely settled metropolitan area in the US.

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