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A Choice-Based Rationale for Land Use and Transportation Alternatives

Evidence from Boston and Atlanta

Jonathan Levine, Aseem Inam, & Gwo-Wei Torng

► An Alternative Rationale for Land Use–Transportation Policies

One of the most controversial issues in transportation policy currently is the usefulness of alternative development practices including new urbanism, jobs-housing balance, transit villages, or “smart growth.” This debate largely revolves around the capacity of these land use alternatives to reduce demand for automotive transport. Planning scholars have differed on this question, with some arguing for such capacity (e.g., Cervero 1996, 1998; Frank and Pivo 1994) and others maintaining that impacts of land use policy on auto use are ambiguous, weak, or absent (e.g., Crane 1996; Giuliano and Small 1993; Gordon, Richardson, and Jun 1991; see reviews by Badoe and Miller 2000; Boarnet and Crane 2001). Implicit to this framing of the debate is an assumption regarding burdens of proof: those who would propose alternatives to auto-oriented development patterns ought to be able to demonstrate payoffs in travel behavior modification. For one side the burden has been shouldered, for the other it has not; but the definition of the problem is largely shared between both sides of this debate.

This problem definition would make sense if alternative land use practices constituted a regulatory intervention into a status quo that is otherwise the product of consumer preferences, aggregated through land development markets to produce metropolitan form. This article challenges this notion and argues that the debate has focused on the wrong question.

The study argues that existing development patterns (at least in some metropolitan areas) fail to offer residential choices that would satisfy the transportation–land use preferences of a substantial minority of the population. This failure is not an outcome of market disinterest but is a product of barriers to the alternative development forms referred to above; significant among these barriers are municipal regulations in the form of zoning, subdivision regulations, roadway design, and parking standards that in aggregate constitute a design template for auto-oriented development. Only in areas where that template is relaxed can land markets produce the alternative development

Abstract

The usefulness of land use and transportation approaches including new urbanism, smart growth, transit villages, and jobs-housing balance is frequently assessed based on the capacity of these innovations to reduce auto use. This study, in contrast, argues that regulatory barriers to these approaches underpin their relative scarcity and that removal of these barriers demands no justification in proof of travel-behavior modification. Rather, such reform can improve the fit between people’s transportation–land use preferences and actual neighborhood choices. This fit is compared here between two distinct U.S. metropolitan areas: Boston and Atlanta. In providing a greater range of neighborhood types, Boston allowed a closer fit between household transportation–land use preference and actual neighborhood choice than did Atlanta. This suggests the potential gains in household choice from removal of barriers to alternative development forms.

Keywords: *sprawl; smart growth; travel behavior*

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forms and satisfy the preferences of people who would seek to choose these alternatives.

By impeding this kind of development, these regulatory barriers have made it more difficult for people who prefer transit- and pedestrian-friendly residential environments to satisfy these preferences. This phenomenon is demonstrated here through a comparison between metropolitan Boston and Atlanta. Boston was selected as a metropolitan area that offers a range of neighborhood types, from auto-oriented to transit- and pedestrian-friendly. This is not a product of superior planning practice but primarily of an artifact of the historical era within which the Boston region developed. In contrast, the housing stock of metropolitan Atlanta is much more dominantly in zones developed for automobile access under a modern suburban zoning regime in the post-World War II era. The study tests the notion that residents of Boston—as an area with a wide variety of neighborhood types—will exhibit a closer fit between their transportation-land use preferences and their actual neighborhood choices than will residents of an area, such as Atlanta, that is developed in a more uniformly automobile-dependent manner.

This notion is hardly self-evident. If nearly all households preferred low-density, auto-oriented neighborhoods even at the cost of high auto use—"the American dream"—an environment that uniformly matches this description would support a tight fit between preferences and choices. The mismatch that is measured here is a product of a divergence between the distribution of housing units across neighborhood types on one hand and the distribution of transportation-land use preferences among the population on the other.

The match between transportation-land use preferences and residential location choices is assessed in three principal steps. First, the territories of metropolitan Atlanta and Boston are each divided into five classes based on transportation and land use characteristics. Second, original survey data of eight hundred households in each area are analyzed to classify residents' transportation-land use preferences along a continuum from pedestrian- and transit-oriented neighborhoods to auto-oriented neighborhoods. Finally, a discrete choice model is estimated to test the sensitivity of respondents' choice of neighborhood type to their transportation and land use preferences. Because of the broader range of neighborhood offerings in Boston, neighborhood choices were much more sensitive to transportation-land use preferences than in Atlanta; simply put, the Bostonians were more able to translate their preferences into actual neighborhood choices than their Atlanta counterparts.

Findings are interpreted in support of transportation-land use policy reform based on satisfying household preferences

rather than modifying travel behavior. A sprawling development pattern is seen by many as the choice of the land development market; under that view, planning comes to compel greater compactness (with justification according to some observers, without sufficient basis according to others). By demonstrating that a relatively uniformly auto-oriented metropolitan area actually fits its residents' transportation-land use preferences worse than does a more richly variegated region, this study suggests that these assumptions about "what the market wants" may be without basis. Markets for pedestrian- and transit-oriented development are unlikely to function where municipal regulation precludes these development forms. For this reason, scientific evidence of travel behavior modification is not the logical prerequisite to planning reform that seeks to remove regulatory barriers to "smart growth." Rather, such reform is best grounded in facilitating the preferences of households that would choose such pedestrian- and transit-friendly environments if they were available.

► Impact of Regulation on Metropolitan Form

Barriers to the development of denser, more accessible, and more mixed-use alternatives come in a number of forms and include banks' lending practices, developers' inclinations to stay with demonstrably successful formulas, and others. This study is principally interested in the barriers that regulatory policy itself may place in the way of such development. Of these, local land use regulation in the form of subdivision regulation, zoning, and negotiated agreements, together with transportation regulation pertaining to minimum roadway and parking standards, may be the most significant (Inam, Levine, and Werbel 2002).

That zoning reduces development density by regulation to submarket levels is not novel. Under the Standard Zoning Enabling Act of 1926, zoning is designed, among other goals, to "prevent the overcrowding of land; avoid undue concentration of population." Urban economists tend to agree that land use regulation compels a lower-density metropolitan form than would arise in its absence; under this view, metropolitan density is promoted (if at all) through regulatory liberalization. Thus, they argue that minimum lot zoning fosters metropolitan sprawl (e.g., Pasha 1996), that municipal land use regulation increases the exclusivity of development patterns (e.g., Wheaton 1993), and that suburban zoning conflicts most frequently take the form of disagreements between residents who prefer low-density land uses and developers interested in building higher-density uses (Bogart 1998, Fischel 1985).

Yet following Tiebout (1956), the economics field has sometimes viewed these effects in a relatively positive light (e.g., Brueckner 2000). This is because the de facto capacity of zoning regulations to exclude on the basis of income is seen as fostering an efficient sorting of the population in terms of demand for public goods. This is thought to lead to more homogeneous jurisdictional units than would otherwise arise, enabling each to offer its unique mix of public services and taxes. (This is not a commentary on the legal propriety of exclusionary zoning practices but an acknowledgement of the capacity of zoning to foster exclusion.) Tiebout's model was in fact predicated on the presence of a growth-limiting factor akin to exclusionary zoning: "The factor may be the limited land area of a suburban community, combined with a set of zoning laws against apartment buildings" (p. 419). The ostensible need for exclusionary zoning within the Tiebout model was made explicit in a broadly accepted article by Hamilton (1975): "Each community is authorized to enact a 'zoning ordinance' which states 'no household may reside in this community unless it consumes some minimum amount of housing' " (p. 206). Without this, "the Tiebout hypothesis seems to be a formula for musical suburbs, with the poor following the rich in a never-ending quest for a tax base" (p. 205).

Moreover, regulatory reduction of development densities is often seen as a response to the negative externalities of higher-density development to begin with and has been viewed as collective assignment of property rights (Fischel 1985). In fact, medium-to-high-density development is frequently zoned out because of perceived externalities of traffic congestion, undesirable visual impact, and more. It was the reformist impulse early in the century to treat the extreme disorder of many cities that led to the land use regulatory system observable today. These negative impacts are clearly within planning's legitimate purview, and this study is not intended as a call for laissez-faire policies in land development. But a sanguine view of the current municipal land use regime—together with its capacity to compel a sprawling development form—ignores its capacity to reduce in aggregate the range of alternatives for households that prefer different transportation–land use environments.

The implicit question of much transportation and land use research—"Do we know enough about travel behavior to intervene on behalf of metropolitan density?"—appears to neglect what the economists hold: we are already intervening, only *against* denser development patterns. Conversely, the sympathetic position of some economists regarding lowering of metropolitan densities by regulation appears to neglect the impediment to choice that this regime imposes on households with preference for pedestrian- or transit-friendly neighborhoods and accessible living generally.

► The Role of Land Use Planning

At first blush, the notion of policy and planning being employed to exclude accessibility-based alternatives may appear surprising. A conventional view seems to equate sprawling metropolitan forms with uncontrolled market forces; the planning function then seeks to encourage alternatives to sprawl. But in general, zoning ordinances limit densities or floor-area ratios to a given maximum rather than setting a floor. In most areas, land use regulation still seeks to separate land uses, limiting mixing of housing with commercial uses or even single-family housing of differing lot sizes. Minimum lot-size requirements are a particularly pervasive form of regulatory control in newly developing areas. Transportation regulations frequently specify wide street widths and minimum parking requirements. In other words, embedded in the regulations of scores of thousands of units of local government is a design template that is largely inimical to the alternative development forms. Only when that regulatory template is *relaxed* can innovative development appear.

Evidence of the restrictive template imposed by the planning function can be found in numerous reports from around the United States of developers seeking to build in a more compact, accessible, or mixed-use fashion than regulations allow and having their designs rejected or modified through the planning process to conform to locally desired low-density patterns. Frequently, the prescription from the planning authorities is to return with a plan for conventional single-family development on the site in question. A small selection of examples follows:

An unusual proposal to plant a mini-village on a country road west of Murfreesboro is dead. Murfreesboro planning commissioners voted Wednesday night to deny a zoning plan that would mix stores, offices and homes on 250 country acres off Florence Road. . . . Commissioners asked developer Roy Waldron to return with a zoning plan for single-family homes. . . . The commission's decision effectively kills a proposal reminiscent of an increasingly popular form of planning. In this kind of planning, the developer creates a village by mixing stores with apartments and homes of various sizes on variously sized lots. (*The Tennessean*, October 8, 1999)

"Smart growth" . . . means building higher density, mixed-use developments closer into town and easily accessible by transit. So MARTA and BellSouth tried to do just that, planning a 50-acre complex of offices, residences and shops that would surround the Lindbergh MARTA station. Is everybody happy then? Nope . . . the Buckhead Neighborhood Planning Unit has voted 19-7 to reject the plan. [A scaled-back version of the transit village was ultimately approved, but a thirty-nine-story condominium complex was eliminated from it.] (*Atlanta Constitution*, October 8, 1999)

The Jefferson County Commission has denied a request by Fribis Engineering for rezoning slightly more than 50 acres at Brennan and Hillsboro Valley Park roads from large-lot residential to smaller-lot residential. The commission agreed with the recommendation of the Planning and Zoning Commission and not with the county Planning Department. (*St. Louis Post-Dispatch*, July 1, 2002)

These stories describe the planning function being used to reject or limit new urbanist-inspired development (in the Tennessee case), transit-village construction (Atlanta), and subdivisions denser than allowed by regulation (St. Louis). In all cases, the agents of densification were not public planners (though the Metropolitan Atlanta Rapid Transit Authority [MARTA] was involved with one proposal) but developers seeking profits from a market they judged to support such dense construction. While the public planners may be in favor of allowing the denser development patterns (as with the St. Louis case), the planning regulatory function may be used to the opposite effect. To the extent that these stories are representative—in fact, a brief search of news databases suggest they are ubiquitous—they suggest that the debate on the accessibility-based development forms has unwittingly turned the planning-versus-the-market argument on its ear. In growing, highly accessible areas, the land development market may tend toward greater density, accessibility, and mixed-use development than planning regulations and practice allow. If this is the case, then analysis of the impact of urban form on travel behavior—while an interesting and valid scientific endeavor—would not be especially relevant as justification for the provision for such alternatives.

The planning function is not always used to exclude density. But while planning can enable such development, it requires private developers who see profits to be made to actually carry it out. Planning can facilitate market forces that tend toward accessible development but can hardly create such development when no market exists for it. An example is found in the following story:

The city [of Westminster] wants to build a “test” development project that includes a mix of residential housing with retail and commercial uses. The idea is called “new urbanism” because it harkens back to the old mixed-use neighborhood. . . . On Monday the city council gave the go-ahead to seek proposals from developers for a mixed-use project. One developer has expressed an interest to do such a project. (*Denver Rocky Mountain News*, October 4, 1999)

Nearly two years later, a related story appeared regarding the same site:

In late April the Westminster City Council agreed to revamp its zoning rules to let Continuum build its brand of denser, more urban-style development. (*Denver Post*, June 10, 2001)

Thus, the city can signal its interest but generally requires involvement by private developers who see profits to be made before the concept can be implemented. The worry about the planning function being used to force high-density development on an unwilling market is chimerical; as Bogart (1998, 212) aptly states, “While a suburb could also conceivably set a minimum capital-land ratio, the immobility of land in the model makes that option unenforceable because capital is free to leave.” To implement its new urbanist vision, the city of Westminster needed to *liberalize* its zoning regulations, as the earlier version would have excluded the proposed development. In this sense, even though the planning authorities adopted an explicit prodensity stance, their actions were ultimately permissive, rather than restrictive in nature.

The argument about planning regulations limiting innovation in land use development is hardly a new one. But it seems barely to have infiltrated the transportation and land use debate surrounding the alternative development forms, whose legitimacy is still broadly construed to hinge on demonstrable travel behavior impacts. It is logically inconsistent to hold that municipal regulatory practices impede innovation in development on one hand but that reforms to permit such innovation need to rest on scientifically proven benefits in travel behavior modification on the other. The science is interesting and important, but the policy question does not hinge on it.

► Residential Location Choice: From Developers and Planners to (Missing) Residents

When planning regulations exclude or limit accessibility-based development forms, they restrict the ability of those households that would have occupied such neighborhoods from getting what they want in a transportation and land use environment. Thus, one can conceive of an action excluding a high-density transit village, for example, as the equivalent of denying several hundred households the opportunity to reside in what would have been their preferred residential environment. In municipal political processes, these households hardly constitute a potent political force, as they are likely not to be current residents of the community in question.

Moreover, these households are not even likely to understand the process by which they had been excluded or to identify themselves as excluded by governmental regulation. The household that would have occupied dense housing near a transit station that was excluded by regulation might find its desired neighborhood unaffordable but would probably opt quietly for lower-cost housing elsewhere; given the paucity of

transit-oriented development, such locations would probably be in automobile-oriented districts. (Having now located in such an area, this household may well find itself opposing proposals for higher-density development in its neighborhood, thus completing the systematic cycle of exclusion of denser, more accessible development forms.) If the processes hypothesized here were highly influential, then households' residential location choices could be constrained to the point that they become a deteriorated indicator of actual preferences. This would limit the capacity of studies of revealed preference to impute the motivation of households for choosing between given zones or housing types from their actual choices.

However, the phenomenon of constrained residential choices would be observable as a weak connection between households' preferences for transportation and land use environments and their actual residence in such environments. Where choices are less constrained, households should be able to forge a better "fit" between their preferences and their choices. Thus, the relative impact of choice-reducing constraints on development of alternative neighborhood forms may be observed as a weaker linkage between preferences and choices in the more constrained area as compared with the less constrained. Where a range of choices of neighborhood types is readily available, households can be expected to sort themselves out according to their preference; where constraints limit the availability of alternative choices, less of this self-directed sorting would go on. This perspective can partially overcome the limitation of revealed preference studies that are restricted by constrained choice sets. The empirical study reported here seeks to operationalize the notion of a fit between transportation-land use preferences and neighborhood choices and to compare this fit between the two metropolitan areas under study.

► Method

The regions studied here include the 10-county area of the Atlanta Regional Council and the 101-town region of Metropolitan Boston, the area of the Boston Metropolitan Planning Organization. The two areas are roughly comparable in population, with 1.1 million households in metropolitan Atlanta and 930,000 in the Boston region, though the land area of the much more densely built Boston is considerably less: 1,400 square miles as opposed to 3,000 for metropolitan Atlanta. The geographical unit of analysis is the traffic analysis zone (TAZ). TAZs are geographical units developed for transportation modeling purposes; they are sized to contain roughly 2,000 residents and/or employees and to serve as a logical neighborhood unit for purposes of transportation analysis. The Atlanta

study area is divided into 928 TAZs, while the Boston region contains 613 such zones.

Clustering Methodology and Results

The hundreds of zones in each region represent neighborhoods or neighborhood agglomerations. For the purposes of this study, these geographic units needed to be combined into larger neighborhood types based on their transportation and land use characteristics. This grouping of neighborhoods into broad classes serves two purposes. First, it was designed to define comparable areas between Boston and Atlanta; hence, neighborhoods classified into a single category ought to demonstrate similar land use and transportation characteristics between the two metropolitan areas. Second, the grouping of hundreds of zones into a limited set of neighborhood types from which households choose is designed to facilitate the tractability and interpretability of the choice model described below.

Neighborhood transportation and land use characteristics as generally measured at the metropolitan scale include attributes of density, road network characteristics, and regional and local accessibility. (A number of finer-grained urban design variables, such as sidewalk provision and street-front characteristics, would have been useful in characterizing the transportation and land use character of a neighborhood but were not available for all neighborhoods throughout the metropolitan areas studied.) As neighborhoods vary across multiple dimensions, a statistical technique was required for their grouping. Cluster analysis is a multivariate technique that groups cases based on their similarity across multiple measured attributes. A K-Mean cluster analysis (Aldenderfer and Blashfield 1984) was performed on TAZs of the two regions, utilizing the thirteen variables listed in the appendix. To render the meaning of the clusters as consistent as possible between the two areas, clustering was done for Atlanta and Boston in the same analysis; that is, the TAZs of the two regions were combined in a single data set, and clusters were created without regard to the region in which they were located. In this fashion, the statistical meaning—if not the perceived land use and transportation implications—of a given cluster is the same between the two regions.

To divide up the two regions into neighborhood types based on the multidimensional data above, a set of five clusters were specified a priori. This number was designed to correspond roughly with five classes of areas: central business district (cluster A), other central city (cluster B), inner suburban (cluster C), middle suburban (cluster D), and outer suburban/exurban (cluster E). For both Boston and Atlanta, the

clusters fall into a distinct concentric pattern, with generally increasing accessibility and transit and pedestrian orientation toward the center of the metropolitan area (see Figures 1 and 2). A visual inspection of the maps reveals the very significant difference in profile between the two metropolitan areas. The territory of Atlanta is much more occupied by neighborhoods in cluster E, the outermost and least pedestrian/transit-friendly cluster, than Boston. Boston, in contrast, presents observably more territory in clusters B and C, which rank much higher in the many dimensions that constitute accessibility and transit and pedestrian friendliness.¹

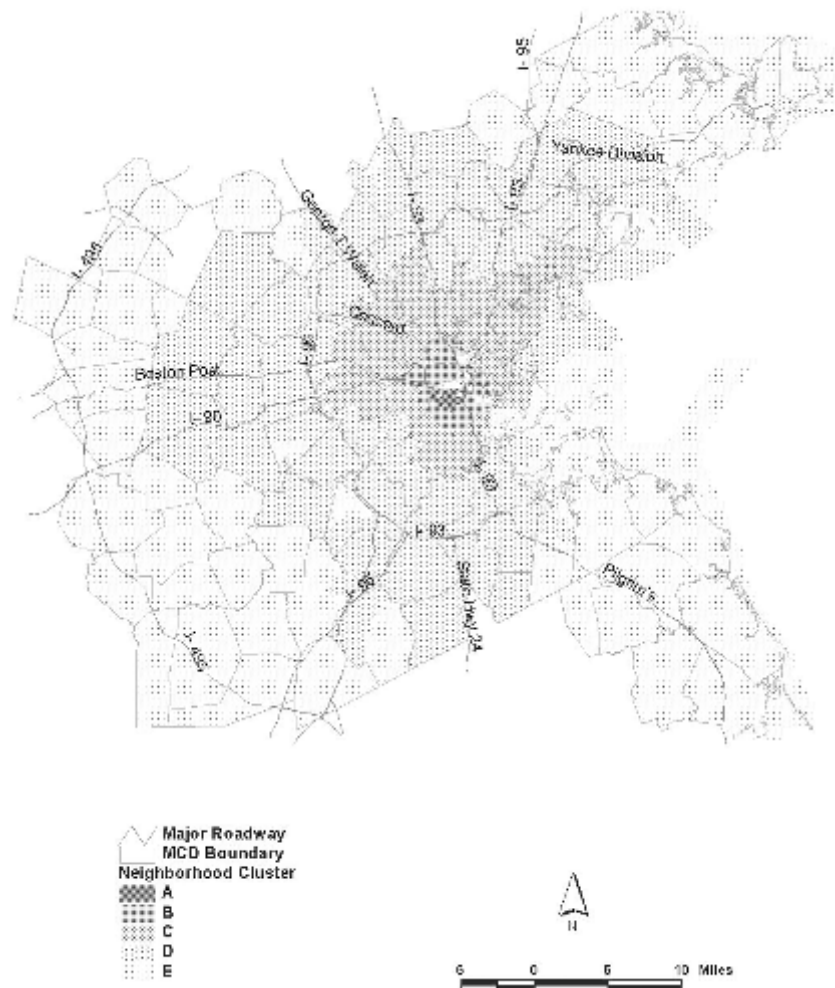
The visual display of the clusters tends to understate the difference between the two regions in terms of availability of housing in different neighborhood types. For example, while less than 3 percent of Atlanta households were located in neighborhood type B, more than 17 percent of Boston households lived in this zone, a difference greater than that of the relative areas of the zones (see Table 1).

Survey Methodology

A survey was developed and pretested for conducting by telephone. The survey focused on respondents' transportation–land use preferences, regardless of the neighborhood in which the respondents actually reside. Many of the key questions were phrased in trade-off format, under the guiding philosophy that many people hold a set of preferences that are internally contradictory; for example, they may want walkability on one hand but only low-density, land use separated development forms on the other. The idea of the trade-off-styled questions was to force them into a choice between potentially contradictory elements of their preferences to ascertain which was a higher priority.

Examples of pairs of statements are given in Table 2; respondents were asked to select between “a” and “b” and then to indicate the intensity they felt for their chosen statement.

The survey sample was developed through a random selection of individuals in a consumer database drawing on multiple sources, including credit reporting data. Overall, 1,607 individuals completed the survey for a response rate of 38.9 percent. Weights were applied to the sample to ensure that the



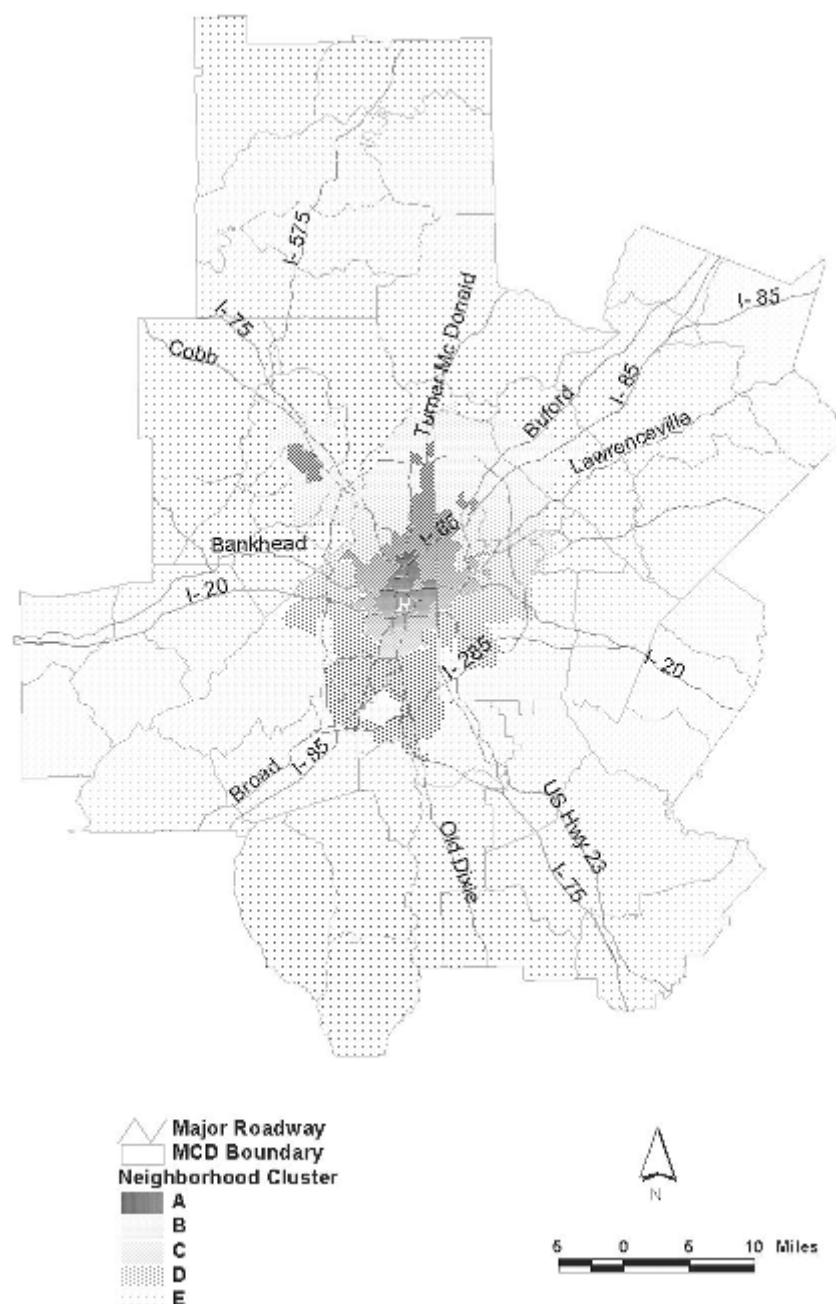


Figure 2. Clustering results for Atlanta.
Note: MCD = minor civil division.

of factors that represent a significantly larger number of variables, this technique can facilitate further modeling without using the full set of variables. In this analysis, a single factor, interpreted as an indicator of neighborhood transportation-land use preferences, was extracted. For each respondent, a factor score was calculated along a continuum from -2.2 , indicating preference for transit- and pedestrian-oriented neighborhoods, to 2.3 , indicating preference for auto-oriented

neighborhoods. The distribution of this factor among the samples is displayed in Table 3; the table displays the significantly different preference structures of the Atlanta and Boston samples, with the latter being considerably more inclined toward transit- and pedestrian-oriented neighborhoods than the former. Nonetheless, it is worth noting that more than 29 percent of the Atlanta respondents (and 40 percent of the Boston respondents) expressed preferences for transit- and pedestrian-oriented neighborhoods (henceforth “pedestrian neighborhoods”).

Given the combination of the divergent preferences of residents of the two areas and the significantly different metropolitan form of each area, it may be that differences in the characteristics of people’s neighborhood environments are explained by differences in their preferences. For example, on the whole, Atlantans live in more car-oriented environments than Bostonians. Is the difference in their preferences sufficient to explain the differences in the neighborhood environments in which they find themselves?

Data presented in Figure 3 suggest that this is not the case. The figure demonstrates the probability of residence in zones A, B, or C, the three most transit- and pedestrian-friendly zones in Atlanta, by people’s transportation-land use preferences. For example, people with the strongest (i.e., top decile) preferences for pedestrian neighborhoods in metropolitan Boston had an 83 percent probability of living in those zones; their Atlanta counterparts with identical preferences had only a 48 percent chance of living in zone A, B, or C. This gap suggests that

there is demand in Atlanta for residence in transit- and pedestrian-friendly zones that is not satisfied given current choices.

Figure 3 appears to validate the transportation-land use preference scale used in these analyses, as the mean transit-pedestrian ratings of people’s environments declines quite regularly as people’s preferences move from transit and pedestrian to more automobile-oriented environments. But more important, it illustrates that the variation in residence in

Table 1.
Households by cluster, Atlanta and Boston,
1995 (in percentages).

<i>Cluster</i>	<i>Atlanta Households</i>	<i>Boston Households</i>
A	0.5	2.6
B	2.9	17.3
C	8.4	34.6
D	27.9	33.2
E	60.3	12.4

Source: 1995 estimates by Atlanta and Boston Metropolitan Planning Organizations (MPOs) and obtained directly from the two MPOs.

Table 2.
Examples of trade-off-styled questions
to elicit neighborhood preference.

1a. I like living in a neighborhood where people can walk to places like stores, libraries, or restaurants, even if this means that the houses and commercial areas are within a block or two of each other.	1b. I like living in a neighborhood where the commercial areas are kept far from the houses, even if this means that people can't walk to places like stores, libraries, or restaurants.
2a. I like living in a neighborhood with single-family houses on larger lots, even if this means that public transit is not available.	2b. I like living in a neighborhood with a good bus and train system, even if this means a neighborhood with a mix of single-family houses and multifamily buildings that are close together.

pedestrian neighborhoods is only partly explained by the difference in households' preferences between the two regions.

► Neighborhood Self-Selection

Differences between Boston and Atlanta residents can also shed some light on the debate pertaining to the role of

neighborhood self-selection in the relationship between urban form and travel behavior. Travel behavior studies regularly document significant density effects on travel behavior measures such as commute length (e.g., Frank and Pivo 1994; Levinson and Kumar 1997). These studies have been criticized on the basis of neighborhood self-selection; that is, if people who prefer to walk or use transit select those neighborhoods, the observed effect may not be attributable fully to design factors but to the tendency of households to gravitate to those neighborhoods that offer them the transportation options they seek (Boarnet and Sarmiento 1998). Eliminating this self-selection "bias" amounts to testing the impact of urban form on the average individual rather than the self-selected household with distinct predilections toward transit or pedestrianism.

Yet given the gap depicted in Figure 3, it seems unlikely that new transit-oriented housing in Atlanta would fill up with average Atlantans; rather, it would tend to be occupied by people with distinct preferences for such housing who previously lacked the ability to satisfy those preferences in the Atlanta environment. Self-selection in this case would be a real effect, but it would hardly negate the impact of urban form on travel behavior. This is because in the absence of such development, those households would be unlikely to reside in a pedestrian neighborhood and would have little choice but to adopt auto-oriented travel patterns. Where pedestrian neighborhoods are undersupplied because of regulation or other constraints, the self-selection effect associated with expansion of these neighborhoods can be a very real impact—perhaps even the most significant impact—of the urban form, rather than a source of statistical bias to be isolated and discarded. For this reason, studies linking travel behavior to urban form are uninterpretable in the absence of an underlying theory of neighborhood production.

► Discrete Choice Modeling of Choice of Neighborhood Clusters

Figure 3 is strictly bivariate and as such is unable to analyze the relationship of preference and choice for particular

Table 3.
Distribution of neighborhood preference factor, Boston and Atlanta.

<i>Neighborhood Preference</i>	<i>Very Strong Pedestrian Neighborhood Preference</i>	<i>Pedestrian Neighborhood Preference</i>	<i>Mean Preference</i>	<i>Auto Neighborhood Preference</i>	<i>Very Strong Auto Neighborhood Preference</i>
Factor score standard deviations					
from mean	−2.2 to −1.5	> −1.5 to −0.5	−0.5 to <0.5	0.5 to <1.5	1.5 to 2.3
Boston	4.5%	35.5%	31.2%	24.3%	4.5%
Atlanta	6.4%	23.0%	29.7%	34.2%	6.7%

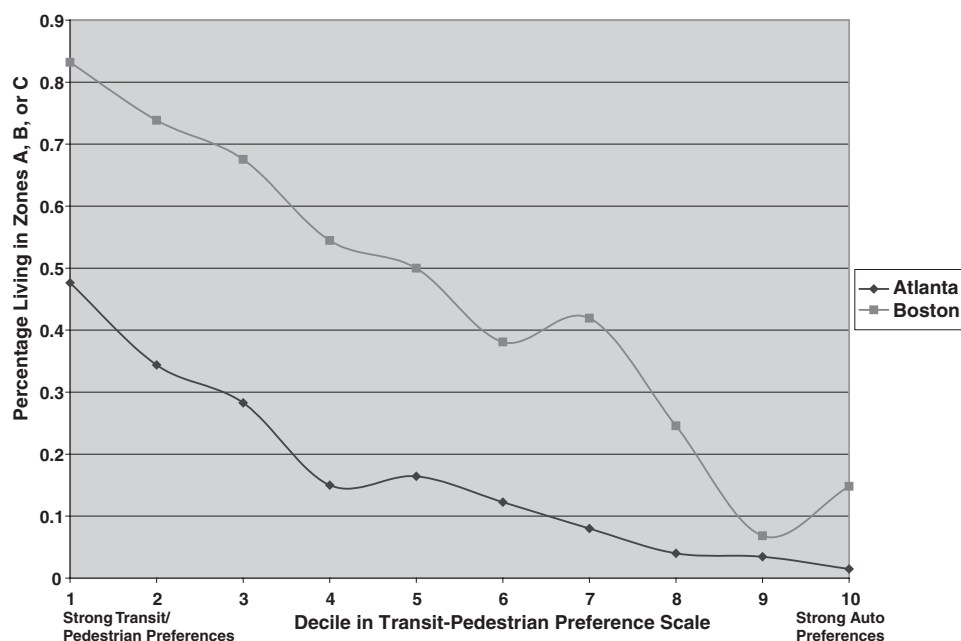


Figure 3. Relationship of transit-pedestrian preference to residence in transit- and pedestrian-friendly zones.

zones or particular groups. Such an analysis would depend on a modeling framework within which individual households choose from among the identified neighborhood types. Since neighborhood types here are conceived of discretely—they are real places whose character shifts with different development periods over space in a discontinuous fashion—the tools of discrete choice are employed. In particular, the choice from among the five neighborhood types identified is modeled as a multinomial logit (Ben-Akiva and Lerman 1985). Six models were estimated for each metropolitan area: a model for the population as a whole and models for whites; nonwhites; and households of low, medium, and high income. Each model has two sets of independent variables: neighborhood-specific constants and the neighborhood preference score described above (interacting with neighborhood choices). In all cases, neighborhood type E is the omitted category, and types A and B have been combined because of low sample sizes in zone A.

The models are constructed to assess the closeness of the “fit” between people’s transportation–land use preferences and their choice of actual neighborhood and the sensitivity of people’s choices to their preferences. That is, how readily can people act upon their transportation–land use preferences when selecting a residential location?

The models are presented in Table 4. All coefficients are significant with at least 95 percent confidence with the exception of the models for nonwhites and the Boston model for low

income. All coefficients of the preference score variable carry the expected negative sign; lower preference scores mean greater preferences for pedestrian neighborhoods. In all cases (save the model for nonwhites in Boston), the coefficients become progressively more negative as the choices approach the central A and B zones, indicating the impact of stronger pedestrian neighborhood preferences on the utility of residence in one of those zones.

All of the Atlanta models have significantly greater explanatory power than their corresponding Boston model. This can be gauged

with the pseudo- R^2 statistic, the multinomial logit analog to regression’s R^2 —a measure of the model’s overall explanatory power. These statistics range around .3 to .4 for Atlanta and around .1 to .2 for Boston. This is an artifact of the lopsided distribution of households in Atlanta, with 60 percent of households residing in zone E; Boston’s more even distribution of households between zones tends to lead to less explanatory power in the models. Two approaches are used to control for this distribution effect. First, models with neighborhood alternative-specific constants—but no transportation–land use preference data—were estimated. These models were then compared to models that also incorporated information about the respondent’s transportation–land use preferences. In five out of six models estimated, the addition to the models’ explanatory power with the incorporation of preference data was greater for Boston than for Atlanta. In other words, knowing what a respondent prefers in transportation and land use gives us greater marginal information about what kind of neighborhood he or she actually gets if that person is a Bostonian than if that person is an Atlantan. The ability to act on one’s preferences is a product of the choices available; in the development market of Atlanta, lack of pedestrian neighborhoods led to a disconnection between preference and choice for people who desired that option.

This effect is seen much more acutely when the marginal effects are examined.² Marginal effects can be interpreted as the change in probability of selection of a neighborhood type

Table 4.
Multinomial logit models of choice of neighborhood type.

	<i>All</i>		<i>Whites</i>		<i>Nonwhites</i>		<i>Less Than \$35,000 Income</i>		<i>\$35,000- \$74,999 Income</i>		<i>\$75,000 Income and Greater</i>	
	<i>Boston</i>	<i>Atlanta</i>	<i>Boston</i>	<i>Atlanta</i>	<i>Boston</i>	<i>Atlanta</i>	<i>Boston</i>	<i>Atlanta</i>	<i>Boston</i>	<i>Atlanta</i>	<i>Boston</i>	<i>Atlanta</i>
Coefficients of alternative specific constants												
Zones A or B	-0.28	-3.26	-0.40	-3.58	1.14	-2.59	-0.07	-3.22	-0.57	-3.15	-0.54	—
(<i>t</i> -statistic)	(-1.5)	(-10.6)	(-2.0)	(-8.5)	(1.4)	(-5.6)	(-0.2)	(-4.8)	(-1.6)	(-5.8)	(-1.5)	—
Zone C	0.85	-1.74	0.75	-1.70	2.39	-1.89	0.92	-1.44	0.81	-1.99	0.55	-1.89
(<i>t</i> -statistic)	(6.5)	(-12.2)	(5.6)	(-10.7)	(3.3)	(-5.6)	(3.8)	(-5.3)	(3.6)	(-6.7)	(2.2)	(-7.2)
Zone D	1.05	-0.48	1.01	-0.58	1.91	-0.13	1.17	-0.31	0.97	-0.79	0.96	-0.76
(<i>t</i> -statistic)	(8.5)	(-5.3)	(8.0)	(-5.5)	(2.6)	(-0.73)	(5.2)	(-1.6)	(4.6)	(-4.3)	(4.2)	(-4.4)
Coefficients of neighborhood preference scores (interacting with neighborhood choices)												
Zones A or B	-1.97	-1.73	-2.05	-2.02	-1.05	-0.91	-1.51	-2.35	-2.16	-1.62	-2.45	—
(<i>t</i> -statistic)	(-10.4)	(-6.0)	(-10.4)	(-5.6)	(1.0)	(-1.7)	(-4.6)	(-4.3)	(-6.1)	(-2.9)	(-6.8)	—
Zone C	-1.22	-1.25	-1.2	-1.31	-1.41	-0.88	-1.04	-1.39	-1.14	-1.25	-1.44	-1.26
(<i>t</i> -statistic)	(-8.4)	(-8.1)	(-8.2)	(-7.8)	(-1.4)	(-2.3)	(-4.0)	(-4.8)	(-4.5)	(-3.9)	(-5.4)	(-4.7)
Zone D	-0.55	-0.48	-0.55	-0.81	-0.30	-0.13	-0.30	-0.90	0.97	-0.65	-0.75	-0.80
(<i>t</i> -statistic)	(-4.0)	(-5.3)	(-4.1)	(-7.3)	(0.3)	(-0.7)	(-1.3)	(-4.5)	(4.6)	(-3.4)	(-3.2)	(-4.5)
Marginal effects of neighborhood preference scores on neighborhood choice ^a												
Zones A or B	-0.25	-0.03	-0.26	-0.03	-0.13	-0.03	-0.19	-0.061	-0.26	-0.04	-0.29	—
Zone C	-0.26	-0.08	-0.25	-0.09	-0.31	-0.06	-0.22	-0.11	-0.025	-0.07	-0.27	-0.07
Zone D	-0.12	-0.14	-0.12	-0.14	-0.06	-0.10	-0.07	-0.17	-0.12	-0.11	-0.17	-0.12
Overall model statistics												
<i>n</i>	798	800	748	653	50	147	241	191	262	215	245	284
Adjusted pseudo- <i>R</i> ²	.13	.38	.13	.41	.23	.27	.12	.33	.12	.40	.15	.36
Adjusted pseudo- <i>R</i> ² , model with alternative-specific constants only	.05	.31	.05	.33	.19	.25	.07	.21	.05	.34	.02	.30
	$\Delta = .08$	$\Delta = .07$	$\Delta = .08$	$\Delta = .08$	$\Delta = .04$	$\Delta = .02$	$\Delta = .05$	$\Delta = .12$	$\Delta = .07$	$\Delta = .06$	$\Delta = .13$	$\Delta = .06$
Average neighborhood preference scores ^b	-.38	.40	-.39	.46	-.24	.16	-.46	-.04	-.42	.39	-.34	.59

a. $(\delta y / \delta x)$, where y = probability of selection of given neighborhood and x = transportation-land use preference score.

b. Boston-Atlanta differences significant with >.99 confidence. Differences within Boston groups not statistically significant. Differences within Atlanta groups (ethnicity, income) significant with >.99 confidence.

that is associated with a 1-point move in the transportation-land use preference score (Table 3). Thus, for example, a 1-point move in a person's preference score toward auto-oriented neighborhoods is associated with a 25-percentage-point reduction in the chance of living in zone A or B in Boston but only a 3-percentage-point reduction in Atlanta. The converse is true as well: a 1-point move toward pedestrian neighborhood preference boosts the probability of living in zones A or B by 25 percentage points in Boston but only 3 percentage points in Atlanta. Thus, the marginal effects are interpreted as an indicator of the sensitivity of a household's neighborhood choice to its transportation-land use preferences.

The difference between Boston and Atlanta is quite dramatic. Relative lack of choice in the Atlanta context rendered one's neighborhood selections much less sensitive to one's preferences than in Boston. In general, marginal effects for zones A, B, and C were much greater in Boston than in Atlanta; in contrast, marginal effects for zone D (the next-to-outer ring) were somewhat greater in Atlanta. Given the greater supply of suburban housing in Atlanta, people with preferences for this type of housing were slightly more able to satisfy those preferences than their Boston counterparts. However, the relative Boston disadvantage in this neighborhood type is considerably less than the relative advantage for the more pedestrian

Table 5.
Estimated probabilities of residence in neighborhood types, by
transportation–land use preference and socioeconomic group (in percentages).

Zone	<i>All</i>		<i>Whites</i>		<i>Nonwhites</i>		<i>Less Than \$35,000 Income</i>		<i>\$35,000- \$74,999 Income</i>		<i>\$75,000 Income and Greater</i>	
	<i>Boston</i>	<i>Atlanta</i>	<i>Boston</i>	<i>Atlanta</i>	<i>Boston</i>	<i>Atlanta</i>	<i>Boston</i>	<i>Atlanta</i>	<i>Boston</i>	<i>Atlanta</i>	<i>Boston</i>	<i>Atlanta</i>
Respondent with pedestrian neighborhood preference greater than 75 percent of sample												
A or B	25	7	26	6	14	7	23	8	31	7	29	N/A
C	41	20	39	20	68	13	42	21	51	17	36	19
D	28	36	29	40	16	40	28	43	10	34	30	39
E	6	38	7	35	2	40	7	27	8	42	6	42
Respondent with median pedestrian neighborhood preferences												
A or B	11	2	10	2	14	4	12	2	9	3	10	N/A
C	33	9	32	10	50	7	33	12	34	8	29	9
D	41	34	42	31	31	42	42	36	42	28	44	29
E	15	55	15	57	5	48	13	50	16	61	17	62
Respondent with pedestrian neighborhood preferences greater than 25 percent of sample												
A or B	4	1	3	0	12	2	5	0	1	1	2	N/A
C	22	4	21	4	30	4	22	5	11	4	17	4
D	48	28	48	21	48	42	52	24	76	20	47	18
E	27	68	28	74	9	53	21	70	13	76	34	78

neighborhoods; this is further supported by the fact that the marginal effect on explanatory power of the addition of transportation–land use preference as an independent variable is consistently greater for Boston than for Atlanta.

Similar analyses are displayed for population subgroups. For example, marginal effects for nonwhites in both Boston and Atlanta were significantly less than for whites, suggesting a more constrained ability on the part of the nonwhites to act on transportation–land use preferences. Analysis of marginal effects at different income levels is revealing. In the case of the Boston sample, the marginal effects increase markedly with income. This is as expected; the higher one's income, the greater the effect one's neighborhood preferences would have on one's neighborhood choices. Results for low-income people in Atlanta are anomalous in this regard in that both the marginal effects and the additional explanatory power of neighborhood preferences appear to be highest in the low-income group.

The multinomial logit model described in Table 3 can be employed to estimate probabilities of residence in the various zones for households of different socioeconomic characteristics and transportation–land use preferences (see Table 5). These results can help illustrate the difficulty of satisfying

preferences for pedestrian neighborhoods in an area like Atlanta with constrained supply. For example, a person with transit and pedestrian preferences stronger than 75 percent of the sample would have a 25 percent probability of living in zones A or B in Boston but only a 7 percent probability in Atlanta. If the household were nonwhite, the relevant probability in Boston would drop to 14 percent but would remain unchanged in Atlanta. A white household with median transportation–land use preferences would have a 15 percent probability of living in outer zone E in Boston but a 57 percent probability in Atlanta. Thus, even when preferences are held constant, these results suggest that the physical form of Atlanta tends to result in choices of residential environments that are less accessible metropolitan Boston.

None of the foregoing analysis is to suggest that preferences for the physical characteristics and accessibility of neighborhoods dominate, or should dominate, other aspects of the residential choice decision. Clearly, issues such as school quality and neighborhood safety tend to be more important to the locational decisions of many if not most households. But this analysis does not rest on any assumption of primacy of transportation and accessibility factors. Rather, it is assumed that where greater choices are available, more households will be

able to satisfy their preferences even for nonprimary characteristics in their neighborhood wish list. For example, imagine a locating household whose first priority is a neighborhood with good schools and whose second priority is a neighborhood that facilitates pedestrianism, transit, and short-distance commuting. If all the neighborhoods affordable to this household that offer good schools are located in auto-oriented suburbs with poor accessibility characteristics, it would likely choose such a locale, and its preferences for accessible living, transit, and pedestrianism would never be revealed. On the other hand, if because of greater diversity of choice, the desired neighborhood environmental characteristics could be found in affordable communities with good schools, a selection closer to the household's preferences—both primary and secondary—could be made.

► Conclusion

This study was concerned with the core rationale for the development of physical forms—including new urbanist neighborhoods, transit villages, job-housing balance, and “smart growth”—that seek to provide an alternative to low-density, automobile-oriented neighborhoods and communities. Much of the research and policy debate currently surrounding these physical and policy directions centers on the potential impact their provision may or may not have on travel behavior; under this formulation, scientific evidence establishing the connection between alternative forms of urbanization and reduced automobile use is the rationale for policies that would be supportive of such alternatives.

Underlying such a framework is an implicit worldview that current auto-dependent development patterns are the product of individual preferences revealing themselves through markets and that development of alternatives rests on planning's regulatory intervention into market processes. But the process of neighborhood development is hardly an unfettered market, as is evidenced by the rich literature on exclusionary zoning in the United States. Individual communities frequently employ their regulatory powers to limit certain types of land uses, notably housing that is likely to be occupied by people of lower socioeconomic status than current community residents. Very often, those land uses can constitute precisely the kinds of alternatives to low-density, automobile-oriented development that are discussed in this article. Where markets can support alternative development forms, the primary benefit of these forms is in allowing their residents to forge a closer link between their preferences for transportation and land use environments on one hand and their actual choices on the other.

This study started from this notion, suggesting that a region that offers rich alternatives in both low-density, auto-oriented neighborhoods and pedestrian neighborhoods would afford residents the opportunity to create a closer preference-choice match than a region whose dominant development form was low-density and automobile-oriented. This would hold if transportation–land use preferences in the latter region were distributed more toward pedestrian neighborhoods than the actual housing stock. By separately characterizing the preferences of households in Boston and Atlanta, and the characteristics of the zones these households occupy, the study quantified the matches that each region offered its residents. Bostonians both prefer and reside in more transit- and pedestrian-friendly environments than Atlantans, but the differences in preferences are insufficient to explain differences in outcomes. Rather, Atlanta residents with high preferences for pedestrian neighborhoods lived in neighborhoods that match this description significantly more poorly than Bostonians. These results suggest that if these groups in Atlanta had a set of choices available that was less constrained into a low-density, automobile-oriented development form, they might well opt for such choices, and such a move would bring their preferences and their choices closer together. The reasonable hope that this reform would ultimately reduce vehicle miles traveled is best observed over the longer run.

These results should call into question presumptions regarding the efficiency of a network of land use regulations that seek to lower development densities. While economists have frequently supported such policies because they can promote the development of relatively homogeneous communities that are efficient at service provision, other factors tend to negate these efficiency gains. These include the loss to the household associated with being excluded from its preferred residential location, including the continuing costs of transportation—or inaccessibility—that the exclusion engendered.

This argument is not intended to criticize land use regulation per se. Such intervention arose from early reformist activism aimed at unhealthy urban conditions, a concern that remains relevant today. Moreover, land use tools can very appropriately be employed to coordinate the development of the accessibility-based development forms in areas where there is sufficient market impetus to bring these forms about. But despite their reformist roots, the tools today are broadly misused to exclude some development forms (and the population groups that would inhabit them) from selected neighborhoods and communities. They are not the only barriers, to be sure. But as tools implemented by directed planning and public policy, these regulations and their potential choice-constraining effects deserve more critical scrutiny than is currently evident in the national debate about the relationship between land use and transportation policy.

► Appendix

Variables Used to Characterize Neighborhoods.

Variable	Definition	Comments
Density Variables		
Population density	Total population divided by total residential land.	Residential land extracted from land use geographic information systems (GIS) coverage. This variable used in natural log form for cluster analysis.
Employment density	Jobs divided by total land area.	Used in natural log form.
Road network characteristics		
Percentage “T” intersections	The number of “T” intersections (versus four-way or more intersections) divided by total intersections.	Indicator of connectedness of a street network.
Intersection density	Intersections per square mile of total land area.	Used in natural log form.
Street length density	Total roadway length divided by total land area.	
Average speed	Average congested speeds of major streets in and surrounding the traffic analysis zone (TAZ).	“Average speed” used created polygons bordered by links of the transportation modeling network; these polygons were overlain onto TAZs and values calculated by weighted average of land area.
Average number of lanes	Average number of lanes in major streets in and surrounding the TAZ.	Calculated in a similar fashion to average speed.
Regional and local accessibility		
Automobile accessibility	<p>Accessibility to employment via automobile network. For zone i, one of j total zones, $\text{access}_i =$</p> $\sum_{j=1}^n f(c_{ij}) \times \text{employment}_j.$ <p>This is the denominator of the production constrained gravity model:</p> $T_{ij} = P_i \times \frac{A_j \times f(c_{ij})}{\sum_{z=1}^n A_z \times f(c_{iz})},$ <p>where T_{ij} = trips between zones i and j, P = trip productions, A = trip attractions, $f(c_{ij})$ = friction factor associated with travel time c between zones i and j, and z = all zones.</p>	For consistency of interpretation, friction factors estimated for Boston by the Central Transportation Planning Staff were used for both areas. The choice of Boston factors has little impact on results, as Pearson correlation (r) between the Boston and Atlanta friction factors = .98. Friction factors: $f(c_{ij}) = e^{-b(c_{ij})}$, where e = the base of natural logarithms and b = a parameter empirically and iteratively estimated to maximize the fit between predictions of the gravity model (left) and observed distribution of trip lengths, times, or costs.
Transit-auto ratio	Ratio of employment accessibility by transit to employment accessibility by auto. Transit accessibility calculated as automobile accessibility above.	Some TAZs offer no transit access; value become zero for these zones.
Land use intensity: quarter mile	A measure of land use mixing: the number of surrounding quarter mile grid cells with a different land use from the center cell, averaged over a TAZ.	
Land use variety: quarter mile	A measure of land use mixing: the number of land uses in surrounding quarter mile grid cells different from the land use of the center cell, averaged over a TAZ.	
Land use intensity: two mile	As above, but a two-mile radius used.	
Land use variety: two mile	As above, but a two-mile radius used.	

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► Notes

1. Urban design aspects of case study neighborhoods in each of the zones are analyzed in detail in Levine et al. (2002). Examples of zone A neighborhoods in Boston included five-story lot line apartment buildings and a public housing complex adjacent to downtown of similar density. The parallel zone in Atlanta included some centrally located, gated residential developments as well as apartments incorporated in large downtown built-up blocks. Zone B in Boston and Atlanta included neighborhoods of mixed single-family homes and small apartments, generally with nearby retail. Examples of zone C in Boston included a mix of apartment buildings along major routes, with single-family neighborhoods adjacent; zone C neighborhoods in Atlanta included 1940s-vintage smaller bungalows with neighborhood commercial zones. Zone D in Atlanta included single-family development of the 1950s to 1960s on mid-sized lots. Examples in Boston included older villages incorporated into the Boston metropolitan area and their surrounding development. Zone E in both Boston and Atlanta included newly constructed single-family homes of more than three thousand square feet and three-plus car garages. In Boston, these were combined with some of the more remote older villages of the region; in Atlanta, some large lot suburban development of the 1960s and 1970s was included in this outer zone.

2. The marginal effect is

$$\sum_{i=1}^n (\delta y_i / \delta x_i) / n,$$

where y = the probability of selection of a given neighborhood type, x = transportation-land use preference score, n = number of observations in sample, and i = an index for an individual observation.

► References

- Aldenderfer, Mark S., and Roger K. Blashfield. 1984. *Cluster analysis*. Beverly Hills, CA: Sage.
- Badoe, Daniel A., and Eric J. Miller. 2000. Transportation-land-use interaction: Empirical findings in North America, and their implications for modeling. *Transportation Research Part A, Policy and Practice* 5D (4): 235-63.
- Ben-Akiva, Moshe, and Steven R. Lerman. 1985. *Discrete choice analysis: Theory and application to travel demand*. Cambridge, MA: MIT Press.
- Boarnet, Marlon, and Randall Crane. 2001. *Travel by design: The influence of urban form on travel*. New York: Oxford University Press.
- Boarnet, Marlon G., and Sharon Sarmiento. 1998. Can land-use policy really affect travel behavior? A study of the link between non-work travel and land-use characteristics. *Urban Studies* 35 (7): 1155-69.
- Bogart, William Thomas. 1998. *The economics of cities and suburbs*. Upper Saddle River, NJ: Prentice Hall.
- Brueckner, Jan K. 2000. Urban sprawl: Diagnosis and remedies. *International Regional Science Review* 23 (2): 160-71.
- Cervero, Robert. 1996. Mixed land-uses and commuting: Evidence from the American Housing Survey. *Transportation Research A* 30 (5): 361-77.
- . 1998. Jobs-housing balance revisited: Trends and impacts in the San Francisco Bay Area. *Journal of the American Planning Association* 62 (4): 492-511.
- Crane, Randall. 1996. Cars and drivers in the new suburbs: Linking access to travel in neotraditional planning. *Journal of the American Planning Association* 62 (1): 51-65.
- Fischel, William. 1985. *The economics of zoning laws: A property rights approach to American land use controls*. Baltimore: Johns Hopkins University Press.
- Frank, Lawrence D., and Gary Pivo. 1994. Impacts of mixed use and density on utilization of three modes of travel: Single-occupant vehicle, transit, and walking. *Transportation Research Record* 1466:44-52.
- Giuliano, Genevieve, and Kenneth A. Small. 1993. Is the journey to work explained by urban structure? *Urban Studies* 30:1485-500.
- Gordon, Peter, Harry Richardson, and Myung-Jin Jun. 1991. The commuting paradox: Evidence from the top twenty. *Journal of the American Planning Association* 57 (4): 416-20.
- Hamilton, Bruce W. 1975. Zoning and property taxation in a system of local governments. *Urban Studies* 12:205-11.
- Inam, Aseem, Jonathan Levine, and Richard Werbel. 2002. Developer-planner interaction in transportation and land use sustainability. Mineta Transportation Institute Report 01-21. San Jose, CA: Mineta Transportation Institute. Retrieved from <http://www.transweb.sjsu.edu/publications/LandUse.pdf>.
- Levine, Jonathan, Aseem Inam, Richard Werbel, and Gwo-Wei Torng. 2002. Land use and transportation alternatives: Constraint or expansion of household choice. Mineta Transportation Institute Report 01-10. San Jose, CA: Mineta Transportation Institute. Retrieved from <http://www.transweb.sjsu.edu/publications/LandUse.pdf>.
- Levinson, David M., and Ajay Kumar. 1997. Density and the journey to work. *Growth and Change* 28:147-72.
- Pasha, Hafiz A. 1996. Suburban minimum lot zoning and spatial equilibrium. *Journal of Urban Economics* 40:1-12.
- Tiebout, Charles. 1956. A pure theory of local public expenditures. *Journal of Political Economy* 64 (5): 416-24.
- Wheaton, William C. 1993. Land capitalization, Tiebout mobility and the role of zoning regulations. *Journal of Urban Economics* 34:102-17.