Transit-Based Housing and Residential Satisfaction: Review of the Literature and Methodological Approach

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Given increasing problems with automobile dependence, many planners, policymakers, and others are examining the potential for alternative land use patterns in urban areas, specifically developing increased densities around existing or planned transit stations or developing new communities that would be served by rail transit. However, rail transit systems require certain minimum densities at both origins and destinations to be successful. Given a choice of residential locations within a metropolitan area, it is an open question whether residents will choose to live at densities necessary to support various types of transit service. Past research that has dealt directly or indirectly with this question is examined. Residential satisfaction studies have the most to offer; these are reviewed in some detail, and key findings are summarized. Hedonic pricing studies are reviewed and contrasted with studies of residential satisfaction. The strengths and weaknesses of both approaches are discussed, and modifications are suggested where appropriate. Finally, current research on satisfaction with high-density, transit-based housing is described.

Long accepted as given features of the American physical and cultural landscape, the automobile and the extensive network of roadways in American cities are currently under attack from many directions. Environmentalists point to the contribution of the internal combustion engine to dangerous levels of air pollutants in many cities. Economists note the drain on regional economies caused by the inefficiencies inherent in traffic congestion. Planners and policymakers worry about reliance on an energy source (oil) that is imported from other countries in large quantities, which decreases national energy independence. And everyone who experiences regular, extended traffic congestion complains about the associated stress and unpleasantness.

In light of these problematic aspects of continuing automobile dependence, an increasing number of planners, policymakers, architects, and developers are examining the potential for alternative land use patterns in urban areas to decrease the reliance on automobiles. A common starting point has been to support or develop increased densities around existing or planned transit stations or to develop neotraditional communities that would be served by rail transit. Theoretically, the higher residential densities would increase the potential ridership of transit lines and would also provide the consumer base necessary to support local commercial establishments within walking distance of many of the residents. In both of these ways, higher residential densities would contribute to decreased automobile dependence while maintaining or increasing accessibility to jobs, services, and other urban functions.

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NEW DEVELOPMENT ALTERNATIVES

Newly designed communities suitable for rail transit have been given considerable attention in recent years (*1,2*). Few if any such developments are actually in place, but plans have been proposed for several sites in northern California, including a potential city of 80,000 in Placer County east of Sacramento (*3*). The proposal would connect 10 "village neighborhoods" with walkways and mass transit. In the county of Sacramento itself, transit-oriented developments are explicitly identified as an objective in the county's draft general plan land use element (*4*). The objective, supported by a number of specific policies, states: "Locate higher residential densities and non-residential intensities that are designed to accommodate non-automobile modes of travel within walking distance of transit stops and along key transit corridors" (*4*,p. 96).

Transit and land use planners in many cities that currently have light or heavy rail lines have urged development of high-density residential, commercial, and office buildings near transit stations. In the San Francisco Bay Area, such development has occurred in fits and starts around Bay Area Rapid Transit (BART) stations since the late 1960s. Local opposition to zoning variances, periods of economic sluggishness, and the multiplicity of jurisdictions through which BART passes have all restricted opportunities for such development, although recent development proposals and state, regional, and local plans have begun to shift slightly toward transit-based development. A 1991 study released by the Transit/Residential Access Center of the University of California's Institute of Urban and Regional Development identified 16 major projects under construction or recently completed in the Bay Area near BART, CalTrain, or the Guadalupe rail system in Santa Clara County (*5*). Each development exceeded 30 units in size and 15 units/acre in density, and each had been built to capitalize on access to rail transit stations.

Transportation and land use planners have generally supported the idea that increased residential or employment densities around the stations would reduce traffic congestion and increase transit ridership. A sensitivity test of the 1991 Regional Transportation Plan for the San Francisco Bay Area assumed denser residential development around various Bay Area transit stations in the year 2010 (*6,7*). Although im-

provements to traffic conditions were fairly modest, this collaborative effort between the Metropolitan Transportation Commission and the Association of Bay Area Governments indicates the willingness of land use and transportation planners and policymakers to explore land use options for mitigating transportation problems.

Pushkarev and Zupan (*8*) examined existing residential and employment densities in the New York City metropolitan area in terms of the level of transit service each subcenter (such as Newark, Hartford, and midtown Manhattan) was able to support. They arranged transit systems in a rough hierarchy, depending on the densities required for each system to operate successfully (i.e., within the generally accepted levels of operating subsidies provided to transit systems at that time). Taxicabs and dial-a-bus services operated successfully at the lowest densities, followed by local fixed-route bus service, express buses, light rail, heavy rail ("standard rapid transit"), and commuter rail. Although any specific application of these technologies to a particular place and time would produce variations in the theoretical minimum densities required, the examples cited by Pushkarev and Zupan of transit services in the various New York subcenters tend to support their overall conclusions. A particular type of transit would work well in a city that met or exceeded the theoretical minimum density (expressed in residences per acre and million square feet of nonresidential floor space in the downtown area) but would usually struggle in a city that did not meet this minimum.

These findings, based on empirical analyses of existing systems, provide a benchmark against which minimum residential densities can be measured for their suitability for various types of transit service. For instance, in a later work, the authors noted North American cities that might be appropriate sites for rapid and light-rail systems on the basis of residential density patterns and the size of their central business districts (*9*). Such studies, although useful for determining what types of transit systems might not work in a given setting, are flawed in their assumption that residential densities of the type needed to support a particular transit system would in fact be achievable. In other words, they paint an idealized portrait of the best possible transit system an area could support; if actual residential densities are lower than anticipated, the expectations for transit service would need to be scaled down appropriately.

STATEMENT OF PROBLEM

Given a choice of residential locations within a metropolitan area, will enough people choose to live at densities supportive of various types of rail transit service for these services to be viable? The TRAC study mentioned above offers a tentative answer in the affirmative, but the large amount of rental housing in the projects under study (85 percent of total units) raises doubts about the extent of choice actually available to the projects' residents. This question would seem to be key to anticipating the success of various transit systems (particularly capital-intensive systems, such as light and heavy rail lines, which often are sold on their ability to focus development around transit stations). In addition, answering this question would provide an indication of the potential success of the new transit-oriented developments mentioned earlier.

The study on which this paper is based addressed the broad question of the viability of transit-based high-density residences by focusing on two more specific questions:

- What elements or attributes of transit-based, high-density housing are most attractive and least attractive to potential residents?
- Do potential submarkets exist that respond more or less favorably to transit-based, high-density housing?

A better understanding of the desirable and undesirable attributes of transit-based, high-density housing can aid planners in developing specifications and modifying zoning around transit stations to support attractive and discourage unattractive attributes. In addition, such information should prove useful to developers, designers, and architects interested in constructing or modifying such housing. An identification of existing or potential submarkets will also enable the construction of appropriate housing and neighborhood conditions. To the extent that such submarkets can be identified, they can also provide insights for transit planners that can anticipate particular sets of travel behaviors, travel frequencies, and mode choices, depending on the likely residents near the transit stations.

The key research literature for this study is the work on residential satisfaction although neither density nor transit proximity has been a key variable in most residential satisfaction research. The paper also reviews relevant hedonic pricing studies, which, although using a very different method, attempt to answer some of the same questions as residential satisfaction researchers: in particular, what are the key attributes that contribute to value in housing?

RESIDENTIAL SATISFACTION

Residential satisfaction research provides the strongest basis for an investigation into attitudes toward transit-based, high-density residences. No in-depth studies have focused specifically on this set of characteristics, although density has been a common topic of investigation and transit accessibility an occasional one. To some extent, this reflects the relative newness of much of the transit-based residential work.

Research Overview

Foote et al. (*10*) provide an overview of early research in residential satisfaction and identify several themes that have continued to be a focus of research:

- Home ownership is an extremely strong social value.

> It seems safe to say that owning a home, even more than suburban living per se, is a basic part of the American dream of the good life. The fact that economists regard it as a questionable course of action on the part of the marginal buyer is more or less beside the point. Home ownership is not a purely rational utilitarian choice. It is overcrusted with sentiment, symbolic value, and considerations of status and prestige. (*10*,p. 190)

- Residents generally are satisfied with both the location and the quality of their dwellings.

- The social characteristics of the neighborhood are a potentially significant source of dissatisfaction with the residential location [see also work by Keller (*11*) and Moriarty (*12*)].
- Men are generally more satisfied with suburban living than are women, and adults in their 20s through 40s are more satisfied with the suburbs than teenagers and adults over 50.
- Suburban developments are valued highly for amenities for young children, especially safety, room to play, and good schools.

For the questions posed here, however, this summary lacks two key elements: residents' reactions to higher-density dwellings per se, and attitudes toward various transportation modes. These elements are introduced in research by Lansing et al. (*13,14*). In their latter work, the authors studied several planned communities in the United States (including Reston, Virginia; Columbia, Maryland; and Radburn, New Jersey), matching them with studies of "less-planned" communities. The effort to determine the extent to which the planned nature of the community affects the attitudes and behaviors of the residents is intriguing, although the study is hampered by the relative newness of Reston and Columbia (most residents had moved to these communities within the previous 2 years). Residents expressed greatest satisfaction with low neighborhood densities (under 2.5 dwelling units/acre), although only the highest density (above 12.5 dwelling units/acre) substantially decreased residents' satisfaction. Townhouses (predominating in higher-density areas) showed similar levels of satisfaction to single-family houses, except at extremes of density. Apartment dwellers were not studied. The authors note that "the preference for low density seems to arise out of needs for privacy, quiet, and outdoor space, needs which are met in varying degrees by different site arrangements" (*14*,p. 122).

The study also examined transportation behavior. Of the newer suburbs, both planned and less planned, only Reston showed a substantial number of transit commuters because of commuter bus service to Washington, D.C. Radburn and its "matched" community in the New York suburban ring both had substantial commuter use of transit, with bus, rapid transit, and commuter railroads all used. Although Columbia apparently had more bus service than a typical suburban or exurban community, only 5 percent of respondents said that they used the bus at least once a week, although 39 percent stated that it was "very important" to have a bus stop near their home. Because transportation facilities were not an integral part of the development of any of the planned communities studied here (including those in the central city areas of Detroit and Washington, D.C.), this research can only act as a general guide to the question of the attractiveness of transit-based, high-density residential developments.

A nationwide survey of metropolitan area residents (*15*) provided a richly detailed examination of residents' satisfaction with their environments. The research framework focused on attributes of various life domains, including housing, neighborhood, and community. The model included both individual perceptions of objective attributes and standards against which attributes are judged to relate attributes to expressed levels of satisfaction.

> Thus the model . . . makes a critical distinction between objective indicators (the reality) and subjective indicators (perceptions, assessments, and satisfactions) of the quality of the residential environment. This distinction is based on the assumption that characteristics of the individual intervene so as to influence the subjective indicators. Specifically, the manner in which an objective environmental attribute is perceived and assessed by individuals is modified by their present situation, their attitudes, and their past experiences. (*15*,p. 264–265)

Unfortunately, the study provided little information about residential density at either a community or neighborhood level. Type of residence was used as an independent variable, with significant correlations on ratings of satisfaction. However, this relationship largely disappeared when factors such as type of tenure (owner or renter) and unit size were taken into account. No questions were asked of travel behavior or proximity to transit service. Nevertheless, the study provides a cogent framework for understanding any relationship between satisfaction and environmental attributes [see also work by Marans and Rogers (*16*) and Marans (*17*)].

Another national survey conducted in the early 1970s is described by Baldassare (*18*). Following Hawley (*19*), he notes the potential benefits of high-density neighborhoods: a higher opportunity for diversity and stimulation, more conveniences, and a qualitative improvement in transportation and communication (*20*). But high-density neighborhoods can also produce conflicts over scarce resources and increased congestion. Baldassare observes that some individuals choose to live in high-density neighborhoods and speculates that "people with greater economic resources may be able to manipulate high-density settings to drastically reduce their costs and increase their benefits (e.g., using doormen and soundproofing to reduce interference)" (*18*,p. 161).

Baldassare identified moderate negative correlations between neighborhood density and overall neighborhood satisfaction (controlling for age, education, home ownership, years in the neighborhood, and census tract median income). However, these correlations did not translate into an increased desire to move. A possible explanation for this somewhat counterintuitive finding is provided by Michelson (*21*), who reports on one of the few longitudinal studies of residential satisfaction. Apartment dwellers, although expressing less satisfaction than residents of single-family houses, are no more likely to move because of their general expectation that their living conditions are temporary; that is, they plan to eventually move into lower-density housing in a suburban environment.

All the studies described found at least a moderate level of satisfaction with the residential environment. This general satisfaction is found among residents of single-family houses, townhouses, mobile homes (*22,23*), and even high-rise apartment buildings (*21,24*). However, most respondents aspire to a single-family detached house (*25,26*). This undoubtedly reflects the strong North American value placed on home ownership, as mentioned above by Foote et al. (*10*). However, it also is a reflection of objective features of a single-family house. One of the most salient of these may be private outside space (*27–29*), particularly for families with children. The ability of an owned, as opposed to rented, residence to be altered at the owners' wishes is also important (*21,30*).

Several studies have supported the findings of Foote et al. (*10*) that men are generally more satisfied with lower-density living than are women, particularly if women are not employed outside the house (*31,32*). Shlay and DiGregorio rec-

ommend that women would be more satisfied in residential settings with higher densities, levels of public service, and transportation, but "retain(ing) much of their residential ambience" (*32*,p. 66). Spain (*33*), however, noted that marital status appears to be more significant than sex as a predictor of neighborhood satisfaction; households consisting of a single person, whether male or female, express lower levels of neighborhood satisfaction than do those with married couples. Because persons in single-person households may be younger than those in married households, additional research is needed to determine if this finding is an artifact of age. Increasing age is generally associated with increasing satisfaction (*15*).

These findings support Galster's (*34*) critique of residential satisfaction studies, that such studies should be disaggregated by household type. In addition, he identifies nonlinearities between residential settings and their associated levels of satisfaction. These stem from the possibility that an upper bound of satisfaction is reached on various attributes (such as number of rooms within a house) and the diminishing marginal utility of increases in the levels of these attributes. These operate together to produce a curvilinear function that describes the relationship between satisfaction and various features of the residential environment. However, the shape of these functions is likely to vary substantially across different households that have their own sets of aspirations or perceived needs and that respond uniquely to gaps in such aspirations or needs and reality.

This disaggregation by households suggests differences in "life-styles," a topic explored on a parallel path by Kitamura (*35*) in his examination of life-style factors and travel demand. He identifies two major components of life-style: activity and time-use patterns, and values and behavioral orientation. Both components are useful in conceptualizing individual variations of residential satisfaction: values motivate individuals (or households) to achieve certain types of residential settings, and the settings in turn constrain or assist particular activity and time-use patterns.

This overview of residential satisfaction assessments suggests several themes that are of importance in evaluating the potential for transit-based, high-density residential developments:

- Most residents have a strong preference for ownership of a detached, single-family house.
- Certain groups of residents may be less inclined to favor single-family houses, particularly in suburban locations; these include the elderly, teenagers, and housewives working in the home. In addition, single householders of either type may be less likely to favor low-density living.
- Regardless of their current living conditions, most residents report general satisfaction with their home and neighborhood. Statements of dissatisfaction in and of themselves are not indications that an individual or household is planning or expecting to move.
- Income is likely to be a significant intervening variable affecting attitudes toward various residential locations.

Measures of Density and Proximity to Transit

Most residential satisfaction studies have not included valid measures of residential density in their model specifications. Many studies have not attempted to include such a measure, although some include characteristics that are clearly correlated with density. Sanoff and Sawhney (*27*) measured privacy from neighbors, ability to park in front of home, presence of front or back yard, and proximity to friends and services; all of these are likely to be correlated with various levels of density. Campbell et al. (*15*) measured size of community and evaluation of "convenience" of neighborhood, which are also likely to be correlated with residential density.

Other studies have explicitly included density measures but have not adequately specified such measures. The respondent's housing type has been used as a surrogate for residential density (*21,36*), as has size of community (*15,25*) and general location of residence in a metropolitan area (*37*). Density also has been subjectively presented to respondents as neighborhoods that are "densely populated" or "sparsely populated" (*32*). Some of these researchers have noted the inadequacy of their specifications but have been constrained by resources to use only easily available information or have simply not focused on density as an important variable.

Baldassare (*18*) represented neighborhood density as number of persons per residential acre. Similarly, Galster and Hesser (*38*) defined density as number of households per residential acre, identical to Baldassare's specification if a factor for number of persons per household is applied. These definitions of density as a continuous variable not identical to (although certainly correlated with) dwelling type or community size produce a much more flexible independent variable. This conceptualization is also much more closely related to density measurements used by planners and urban designers (*39*).

As noted above, proximity to transit has rarely been considered as a potential determinant of residential satisfaction; Lansing et al. (*14*) have conducted the only study that explicitly included transit service, and their study considered only rarely used bus transit. Other studies that included "accessibility" as a causal variable (*27,38*) may be measuring some amount of transit service, but such service is not explicitly identified. Such neglect of a potentially important feature of the urban landscape may be symptomatic of the declining role of transit in America over the past quarter century, or it may reflect a general neglect by residential satisfaction researchers of the various dimensions of accessibility; where accessibility is included as a variable, it is generally defined simply as travel distance, with no consideration of travel time, mode, or other potential components of a valid accessibility measure.

HEDONIC PRICING

Research Overview

Hedonic pricing refers to economists' efforts to understand the relative importance of various attributes of a particular commodity and to associate those attributes with the market price of the commodity. This technique has been widely applied to the analysis of housing markets. As described by Follain and Malpezzi (*40*), the process partitions the value of a commodity into components that can be individually measured; prices are then estimated for each component using

multiple regression. "These prices can then be used to compute a standardized measure of housing quality. The measure, for any housing unit, is simply a weighted average of the components embodied in the unit, where the weights are the estimated prices of the components" (*40*,p. ix). Williams (*41*) traces the development of hedonic pricing theory from goods-attribute theory (*42*) and residential location theory (*43,44*). Kain and Quigley (*45*) were among the first researchers to focus on individual dwellings and give serious attention to the proper measure of the quality of residential services. Quigley and Rubinfeld (*46*) note that "the use of hedonic methods to evaluate the attributes of housing has become widespread, especially after the publication of Rosen" (*47*), who provided a synthesis of earlier material (p. 2).

McLeod (*48*) and Williams (*41*) observed that the bulk of empirical work (on housing as well as other topics, such as air quality) has focused solely on the individual value estimates of attributes (the hedonic price function). McLeod states that "very few studies have utilised the marginal valuations of characteristics implied by the estimated hedonic price function to develop estimates of willingness to pay for changes in the level of provision" (*48*,p. 389). Thus, much of the focus of this work has been on the identification and weighting (through multiple regression) of key attributes of housing and neighborhoods. This has provided the housing researcher with a rich data base of identified variables, along with some indication of their relative importance with respect to marginal housing prices.

Hedonic pricing (especially this first stage of relative attribute pricing or weighting) has much in common with measures of residential satisfaction. Both attempt to ascertain the value of housing (although value is not generally defined the same way in the two different approaches), usually through determining the impacts of housing components or attributes on the overall housing valuation.

Hedonic pricing equates the "value" of a particular dwelling unit with its cost, and the contribution of any feature of that unit (number of bedrooms, location next to a park, etc.) is expressed in terms of the amount of monetary value that such a feature adds or subtracts from the cost of the dwelling unit. In residential satisfaction studies, "value" is usually represented by expressed levels of satisfaction with housing, neighborhood, community, or some combination of all three. Occasionally, willingness to move is used as an expression of dissatisfaction, and thus (lack of) value, but such willingness is not generally correlated with measures of satisfaction (*21,49*). Of the two techniques, hedonic pricing has greater face validity; dollar amounts are culturally accepted as at least a rough indication of an object's (or attribute's) value, which may not be true of satisfaction ratings; certainly, such a rating represents a less common indicator of value. This also reflects the likely greater reliability of hedonic pricing measures: a $200,000 house with a certain set of attributes is likely to be more clearly understood by most people than the same house with the same set of attributes and a certain satisfaction score. Even hedonic pricing results, however, must be viewed in context; the value of, say, a $200,000 house can be very different depending on the locational and temporal context of the valuation. The validity and reliability of hedonic pricing measures, just as the validity and reliability of residential satisfaction surveys, must be viewed within a particular context.

Measures of Density and Proximity to Transit

As with residential satisfaction studies, dwelling type often stands as a surrogate for residential density in hedonic pricing studies (*45,50,51*). Follain and Malpezzi (*40*) calculate a measure of internal density (persons per room) but do not measure external density. Williams (*41*) included "residential density" as a housing attribute, but simply estimated "above average, average, and below average" house sizes from an exterior vantage point. Lot size was measured in square meters. From this description of the density variables, it is difficult to determine how a general breakdown of houses into large, medium, and small, even if it is somehow linked to lot size—a link that is not explicitly made—says anything about residential density, whether interior (e.g., persons per room) or exterior (e.g., dwelling units per block or per acre).

To the author's knowledge, no hedonic pricing studies have explicitly examined the effects of external residential density on price. Although it may be argued that hedonic pricing studies have determined the impacts of variables that might serve as surrogates for density, such as dwelling type, building size, and lot size, these variables can exhibit such a variety of specifications (*39*) that they effectively say very little about actual site or neighborhood densities.

Two hedonic pricing studies have examined the impacts of accessibility to rail transit stations on housing prices. Diamond (*52*) notes that accessibility to commuter rail stations is an important amenity to many residents.

> However, there is a clear division between those for whom it matters (commuters to the CBD) and those for whom it is irrelevant. It seems that the former group dominates the formation of land prices since there is a relatively strong effect on them. But those who have no use for the rail lines can avoid paying those prices by moving further away from the stations. The two groups may nullify each other in the general pattern, with the result of a negligible correlation with income and, relatedly, relatively large variance on the estimate of the income elasticity

for the rail station accessibility variable (*52*,p. 11). Such interpretation of the results clearly suggests the need for a market segmentation into CBD workers and other residents. In general, the residents did not live near the rail stations; the mean distance to a rail station was 3.0 mi with a standard deviation of 1.3 mi.

Dewees (*53*) describes a more relevant hedonic pricing study, examining the impacts on housing sale prices of construction of a subway line in Toronto. The subway replaced a streetcar line; unfortunately, the report does not indicate if headways changed along with the change in mode, although the subway did operate at speeds about double those of the streetcars (22 mph versus 10 to 12 mph). Housing prices were significantly related ($p < .05$) to accessibility to the transit system both before and after construction of the subway system. Dewees tested several specifications of the transportation variable in the regression model, including walking distance, travel time, and travel cost. In general, travel time proved to be a better measure of access than distance or travel cost, and access to the transit facility was more important than access to the CBD. In addition, using a threshold cut-off distance of ⅓ mi, the author demonstrated that construction of the subway had no impact on housing prices beyond this point. Within ⅓ mi

of the subway station, rent slopes increased almost 50 percent in constant dollars, suggesting a definite impact of increased transit service on area property values.

The primary weakness of hedonic pricing for the purpose of the current study is its inability to ascertain the value of new housing characteristics or new combinations of existing characteristics (*54*). Since relatively few transit-based, high-density developments have yet been constructed [and many of those currently in place are rental units (*5*)], a method that relies on sales of existing dwelling units for its data set will not be able to provide an adequate data base. Hedonic pricing seems most appropriate when minor changes are being made or proposed to existing systems, services, or structures, and preferences can be fairly clearly identified. Where qualitatively new situations are being considered—such as "pedestrian pockets" and residential densification around existing rail lines—residential satisfaction surveys are more appropriate.

To some extent, the dichotomy between hedonic pricing and residential satisfaction studies parallels that of revealed preference–stated preference survey techniques. The former relies on directly observed (or reported) behaviors to draw conclusions about the desirability or undesirability of certain actions under specific conditions. Revealed preference models suffer from some of the same shortcomings as hedonic pricing models: variables of potentially limited range and a lack of some choice alternatives (*55*).

Stated preference surveys can manipulate the dependent variables based on a controlled experimental design procedure (*56*). However, some researchers note the possibility that such surveys can be prone to response bias (*57,58*). These concerns also have been raised regarding attitudinal surveys and statements of intended behavior. Recent techniques to evaluate public goods, such as the contingent valuation method (*59*), may reduce such threats to validity.

COMPARISON OF RESIDENTIAL SATISFACTION AND HEDONIC PRICING METHODOLOGIES

Despite their differences, residential satisfaction and hedonic pricing methods often have been used to answer questions that are basically identical: what are the important attributes of housing, and what do they contribute to the overall value of housing? As indicated above, these procedures use divergent means (generally those of stated preference versus those of revealed preference, respectively) and are based on various conceptions of "value." However, they share several methodological strengths and weaknesses:

1. Both lend themselves to disaggregate data analysis. Because both methods are based on actions or statements by individuals or households, the data have been collected at a disaggregated level and thus provide analysts with a flexible data base to test a wide variety of behavioral hypotheses, and (with a large enough sample) to control for a variety of socioeconomic or demographic variables. However, neither method has been widely used in this manner, and analysis often has neglected potentially useful submarket divisions (*34,60*). Residential satisfaction techniques would seem to be more capable of exploring such divisions, because information about a large number of household or individual characteristics can be collected in the process of interviewing. Hedonic pricing studies, on the other hand, are usually [although not always—see a previous study (*45*)] limited to information available from records of home sales. Additional information may be available from other sources (*53*) but often only at an aggregate level. Efforts to provide proxy measurements of socioeconomic characteristics of individual households, for example by assigning median census tract values for income, age, and family size (*48*), say more about neighborhood characteristics than about individual household characteristics and may produce spurious results.

2. Both produce models that should generally take account of nonlinearities but infrequently do so (*34,48,60*). In general, hedonic pricing analysis more often develops nonlinear specifications for the relationships between the housing valuations and the housing attributes (generally semi-log and log-linear models). Both methods, however, too frequently assume simple linear relationships.

3. As noted above, neither method has developed an adequate standard representation for residential density. Such a representation should relate a unit of population to a unit of area; depending on the needs of the researchers, the numerator might be persons or households, and the denominator might be square footage, acres, or blocks of a standard size. In addition, residential density measurements should specify the extent to which nonresidential land uses found in proximity to residences are being included; such land uses include streets, shops, and various business and commercial services (*39*). Such specifications would link estimates of housing value with more detailed representations of the residential environment, which in turn are linked to estimates of transit patronage through trip generation rates and mode choice estimates. Thus, use of an appropriate measure of density may provide a linkage among residential housing value (whether measured through residential satisfaction studies, hedonic pricing, or some other method), residential density, and projected transit service demand.

NEXT STEPS

Based on the findings described above, as well as the rationale for high-density, transit-based housing discussed previously, research is currently under way to investigate the following questions:

- Given a choice of dwelling units, would residents select those at such densities as to allow the successful operation of various forms of urban transit?
- What attributes of the residence are most closely associated with positive or negative attitudes toward density?
- What variables distinguish groups of people (i.e., markets) with various reactions to high-density, transit-based housing?

Questions of residential satisfaction and attitudes toward various residential attributes are being asked of a sample of the general public and a sample of current residents of high-density, transit-based housing. Both focus groups and face-to-face interviews are being used. By inquiring about partic-

ular attributes of housing and neighborhoods, this study will provide information about desirable and undesirable housing/neighborhood features. In addition, attitudes toward specific attributes will be broken down by various market segments, permitting detailed analysis of residential satisfaction across various groups of respondents. The answers to these questions should help to determine the potential success of current high-density, transit-based residential developments; they also should be useful to planners and developers considering future high-density, transit-based housing projects and transportation planners estimating future transit demand from such projects.

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