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ABSTRACT

The determinants of several measures of journey to work for residents of metropolitan and nonmetropolitan areas are analyzed and compared based on findings from a national study. Some of the more important issues raised by other researchers are also explored in this paper. The basic concern of this report is whether the journey to work patterns of residents of nonmetropolitan areas are responsive to the same kinds of forces as those that influence the journey to work patterns of residents of metropolitan areas. An argument is developed that shows that journey to work patterns are influenced heavily by the spatial structure of housing markets in relation to the spatial distribution of activities in urban areas, and that differences in the journey to work patterns of nonmetropolitan and metropolitan residents are largely a function of differences in the scale of the respective urban spatial systems. Essential to the discussion is the assertion that as urban spatial systems increase in scale, their morphological structure undergoes successive transformations that result in a redistribution of land activities (including residential activities). The same factors that significantly affect the journey to work pattern of metropolitan residents also affect those of nonmetropolitan residents, although effects vary with respect to size and direction. (Author/AM)

JOURNEY TO WORK: METROPOLITAN-NONMETROPOLITAN COMPARISONS

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ABSTRACT

The determinants of several measures of journey to work for residents of metropolitan and nonmetropolitan areas are analyzed and compared. The findings reported here suggest that residents of the largest size SMSAs and the smallest size nonmetropolitan communities travel greater distances and spend more time per mile of travel getting to work than residents of other size communities. The same factors that significantly affect the journey to work pattern of metropolitan residents also affect those of nonmetropolitan residents, although it is clear that such affects vary with respect to size and direction. Age, job tenure, SES, mobility, changes in tenure status, mode of travel, and distance to the center of the largest city in the region were found to have significant effects on journey to work.

JOURNEY TO WORK:
METROPOLITAN-NONMETROPOLITAN COMPARISONS

Introduction

In a recent report on "The Journey to Work for Rural Industrial Employees," Clementes and Summers (1975) suggested that models used to explain the journey to work patterns of metropolitan residents may not be applicable to residents of nonmetropolitan regions. This conclusion was based on the fact that three of the variables frequently used to explain the distance metropolitan residents traveled to workplace had no statistically significant effects. More specifically, their results showed that age, SES, and job income had no effect on the distance white male employees of a large manufacturing facility located in rural Illinois, traveled to their worksite. Although their findings were unequivocal for the sample of men studied, it is likely that their results may not reflect general trends in patterns of commuting in nonmetropolitan areas. This is because their analysis was restricted to a single locality, and to the journey to work patterns of a sample of males who lived in several communities but who worked at the same facility. This paper reports findings from a national study in which the journey to work patterns of residents of metropolitan and nonmetropolitan areas are compared. Some of the more important issues raised by Clementes and Summers (1975) and other researchers are explored further in this paper. The basic concern of this inquiry can be stated thusly: Are the journey to work patterns of residents of nonmetropolitan areas responsive to the same kinds of forces as those that influence the journey to work

patterns of residents of metropolitan areas? As Clementes and Summers (1975:217) noted, the literature in this area is virtually nonexistent, and more analyses need to be performed before any definitive statements can be made.

In the next section, I develop an argument showing that journey to work patterns are very heavily influenced by the spatial structure of housing markets in relations to the spatial distribution of other activities in urban areas, and, that differences in the journey to work patterns of nonmetropolitan and metropolitan residents are largely a function of differences in the scale of the respective urban spatial systems. Essential to the discussion is the assertion that as urban spatial systems increase in scale, their morphological structure undergoes successive transformations that result in a redistribution of land use activities (including residential activities).

Theory and Research

Models of the Determinants of Journey to Work

The results of recent surveys suggested that journey to work was the single most important form of dwelling-originated travel behavior, because of both the transportation costs involved and the amount of time such traveling consumed (Meyer, et.al., 1965; Lansing and Hendricks, 1967; Kain, 1968; Roistacher, 1974; Ray, 1973; Goodman, 1974). It has also been suggested that journey to work was largely determined by the demographic and socioeconomic characteristics of households. This literature

is only summarized here, since extensive reviews are available elsewhere (Duncan and Duncan, 1970; Meyer et. al., 1965; Lansing et. al., 1970; Schnore, 1965a; Wheeler, 1967, 1969; Hoover, 1968; Kain, 1968; Hawley, 1971; Poston, 1972; Whitbread and Bird, 1973; Ray, 1973; Apps, 1973a, 1973b, 1974; Roistacher, 1974; Goodman, 1974; Clementes and Summers, 1975). Income, occupational status, family size, job tenure, and age of household head have been found significant predictors of distance, when households travel from residence to workplace. Employed household heads with high incomes, white-collar jobs, and medium-size families are likely to travel greater distances to work than heads of other types of households.

Several models have been developed to explain the observed relationship between accessibility to workplace and the characteristics of households. One of the first such models was based on the principle of least effort, that hypothesized that industrial workers seek to minimize the distance from home to work by locating as close to workplace as possible. (Carroll, 1949, 1952; Schnore, 1965a; Wheeler, 1967; Clementes and Summers, 1975). This hypothesis was very much consistent with what was known about the relationship between residence and workplace characteristic of earlier western cities before the advent of efficient low-cost intraurban forms of transportation and the rise of the factory system as the major form of productive organization (Sjoberg, 1960; Pirenne, 1962; Hawley, 1971). In the case of the modern metropolis, the hypothesis has little predictive value. As Schnore (1965a:333) suggests, "the hypothesis offers a plausible explanation of the concentration of

residence near work sites, but fails to account for the equally obvious scatter away from those sites."

Beverly Duncan (1956) reformulated the least effort hypothesis to note that urban workers will reside in areas nearest their workplace that are compatible with their socioeconomic levels. I know of no study that has tested this reformulation directly, although Wheeler (1967) observed that individuals in different occupation status groupings, on the average, do appear to minimize residence-workplace separation.

The two most frequently cited models developed to explain differentials in residence-workplace separation are labeled by Alonso (1974) as the historical and structural theories of urban form. Alonso's labeling of the former model as historical is inappropriate, and probably results from his use of Burgess' classic discussion of the concentric zone theory as representing the clearest statement of the ecological approach.

The structural approach uses the consumption of residential space (land) to explain residence-workplace separation. This approach has a rather impressive list of economic practitioners, including Wingo (1961), Alonso (1964), Mills (1967), Muth (1969, 1970), and Kain (1970). The objective of the structural approach is to show how households' preference for living space, for convenient access to employment, and for consumption goods are converted into a market demand for urban real estate.

If it can be assumed that households have a strong taste for land, and that the quantity of land possessed by any single household varies with income, then higher-income households are affected relatively less

by the costs of commuting to work because they are able to save on total cost (location rent) by consuming larger quantities of land. Therefore, the ideal location for a household with a given income is that point in urban space beyond which further savings in land costs are insufficient to cover the added costs of transportation to work. Thus the model argues that the rich are price-oriented whereas the poor are location-oriented, and as households acquire more income accessibility the household behaves as if accessibility is an inferior good.

Although a number of theoretical works have appeared to either clarify or modify earlier formulations of this approach, little empirical work has been done thus far to either support or refute the model (Muth, 1969; Nelson, 1973; Goldberg, 1970; Hoover, 1968; Harris, 1968; Kain, 1968). Kain (1970) made an attempt to evaluate the plausibility of this trade-off model with transportation data on the travel behavior of residents of Detroit. Moreover, a careful review of the variables Kain used in his analysis indicates that his results could be used to partially confirm both the ecological and the structural models, and therefore are of little value in determining which of the models has the most predictive utility in terms of explaining the relationship between residence and workplace (Harris, 1968).

There are three basic problems in applying this model. First, the model assumes households are homogeneous with respect to compositional structure (young, mature, and old families versus primary individual, male- and female-headed families, etc.), and therefore implies that the compositional structure does not affect the spatial distribution of households. Second, it assumes residential sites and dwellings are homogeneous goods, that implies households are indifferent to the

attributes that make up their residential consumption packages, except for quantity of land. Finally, the model assumes employment is concentrated in or around the point of maximum accessibility, for example, the central business district. There is sufficient evidence available to suggest this assumption is at best oversimplified, and at worst incorrect (Leven, 1972; Bahl, 1972; Kain, 1970; Berry and Cohen, 1973; Wilson, 1975). Previous research on this issue indicates that journey to work is very much affected by the extent to which employment is concentrated at a central point (Duncan, 1956; Duncan and Duncan, 1970; Winsborough, 1972; Darrock and Winsborough, 1972; Bahl, 1972).

The ecological approach to explaining residence-workplace differentials by characteristics of households argues that accessibility to workplace is heavily influenced by the spatial structure of local housing markets. Hawley's (1950:280-284) classic discussion of how families with different characteristics come to be spatially distributed in urban areas presents the clearest statement to date of the ecological approach to explaining the relationship between residence and workplace. In the discussion below, I have modified Hawley's model in order to take into account the results of more recent studies.

Physical structures that are used for residential purposes stand in fixed relation to each other and to other forms of land-use activities found in urban areas. Inasmuch as urban concentrations function primarily as a means of facilitating contacts between various decision units, it should come as no surprise that households place a premium on being accessible to other decision units with whom they frequently

interact. Accessibility is here defined as the physical proximity of households to other residential and nonresidential activities (Hoover, 1968:237-248). The importance of accessibility is derived from the economics of intraurban travel behavior. First, households who have to commute to other land-use activities incur monetary costs resulting from the distance traveled, the mode of travel, and the frequency such trips are made per unit of time. Secondly, there are opportunity costs involved in intraurban travel. These costs are defined in terms of the amount of time individuals consume in trip-making, some portion of which could have been used for other purposes had the individual's residence been situated closer to the unit with whom he wished to interact (Beesley, 1965).

That portion of residential costs attributed to accessibility is based upon the aggregate market valuations associated with the attributes of a residential area that households consider desirable and for which they have a demand. In order to clarify this point, consider a hypothetical urban areas in which all households are pure consumers of residential services (i.e., renter households), and pay identical unit prices for housing services (e.g., services peculiar to the attributes of dwelling units). Under this type of regime, one may ask what factors determine the prices households will pay for residential services? Clearly, variations in the prices of residential services will be determined by variations in the amenity attributes of residential areas, variations in the quantity of housing services consumed by the average household, and variations in the accessibility of the average household to other land-use activities in the urban

area. More formally, the demand for residential services can be expressed in terms of the following equation:

$$RS_i = f\ (\ A_i + B_i + C_i + D_i + E_i)\ ,$$

where RS refers to the i^{th} bundle of residential services; A refers to the accessibility of the i^{th} residential area to land-use activities that have a centrifugal effect on the demand for residential space; B refers to the accessibility of the i^{th} residential area to land-use activities that have a centripetal effect on the demand for residential space; C refers to the amenity attributes inherent in residential areas such as topography, intensity of land-use (density), and the socioeconomic and ethnic status characteristics of the area; D refers to the average quantity of housing services (includes space, type and quality) consumed per dwelling unit; and, E refers to the stability of the i^{th} residential area with respect to current and future land-use activities.

In this type of urban area, it is reasonable to assume the prices of residential services will be lowest in those areas that are adjacent to activities that have a centrifugal effect on the demand for residential space (e.g., commercial and industrial activities which generate pollution and traffic congestions that are antithetical to family activities). Prices will also be lowest in areas where dwelling units yield lower quantitites of housing services, have low amenity attributes, and are unstable in land-use activities. Residential areas that will be able to command the highest prices will be those adjacent to activities that have a centripetal effect on the demand for residential space (e.g., close

to planned regional shopping centers, parks, lakes and other family oriented recreational facilities), those with high amenity attributes, in which dwelling units yield large quantities of housing services, and those with stable land-use patterns. Indeed, in neighborhoods in which the prices of residential services are high, these four sets of attributes are usually coincidental in location.

The point that should be emphasized is that most households who choose to reside in neighborhoods with high amenity attributes can do so only at the expense of being inaccessible to major employment centers. If we assume that the demand for residential services is elastic with respect to income, then low-income households will be forced to consume low-quality residential service bundles, since they cannot outbid higher-income households for choice residential sites. Although this observation may lead one to believe that low-income households are generally more accessible to employment centers, it should not be concluded that their journey to work distances are shorter, because the labor force demands of such centers may not be consistent with the occupational skills of low-income households (Bahl, 1972).

More generally, high-quality housing is strongly associated with high-quality neighborhoods, while these two factors are negatively related to accessibility to centers of economic activity. Thus, households who desire to consume high-quality housing and/or high-quality neighborhoods can only do so by experiencing longer journey to work distances. Of course, there are exceptions, i.e., the presence of high rise middle- and upper-class islands in or near the center of large

metropolitan areas. Moreover, the kinds of households which are usually attracted to these dwelling accommodations are those that consist of single individuals and childless and middle-aged couples who consider accessibility more important than either the desire for residential space or high-quality neighborhoods.

Results obtained from studies of intraurban residential mobility are consistent with Hawley's discussion of how income (or socioeconomic status in general) and family composition influence the residential distribution of households in urban areas. Systematic analyses of the spatial distribution of metropolitan populations by Guest (1970, 1971) suggest that one of the major reasons families with children are found at the periphery of the city or in suburbia is because in these areas home ownership, detached and roomy housing, and low density are in abundance. In an analysis of the location of different types of families in the city of Cleveland, Guest (1972) shows how the location of residential neighborhoods (with respect to the central business district) is affected by age or period of development of the area, internal and external housing space, and site features such as industrial and recreational activities. He suggests that these structural variables in turn determine the location of families in relation to the center of Cleveland. Space was found to be the most important, and site, the least important factor in determining the location of types of families.

Metropolitan-Nonmetropolitan Distinction

It was suggested earlier that if the journey to work patterns of nonmetropolitan residents differed from those of metropolitan residents,

the most reasonable explanation would be that they reflect differences in the scale of the two respective urban systems. The concept of scale is used here to index the fact that as urban communities increase in size, density, and organizational structure, the potential for differentiation becomes more pronounced, which manifests itself in the manner in which urban populations distribute themselves residentially both with respect to each other and with respect to other forms of land-use activities. R.D. McKenzie (1933) observed that as the territorial scope of the activities of the community expands, its morphological structure becomes more differentiated with respect to the location of land usages and the specialization of activities. Some activities tend to spread out in centrifugal fashion from the central point of the community, while others concentrate more and more around that point. Thus, community growth or expansion involves not merely a multiplication of services, structures, and transportation networks, but a process of differentiation and segregation takes place as well (Hawley, 1950, 1968).

Thus, small size communities cannot support the level of differentiation present in large communities, with respect to residence-workplace separations (Ogburn and Duncan, 1964). The segregation of resident populations and the separation of residence and workplace require a level of organizational complexity that cannot be obtained in small size communities (Schnore, 1965b:317-386).

These general observations suggest several hypotheses in regard to differences in the commuting patterns of metropolitan versus nonmetropolitan residents. First, residents of large-size communities should

travel greater distances to their workplace than residents of smaller-size communities. Second, given that the transportation arteries of metropolitan areas are far more congested during the morning and evening rush hours, it can be expected that metropolitan residents would spend more time traveling to workplace. Third, socioeconomic status, low income, family size, age, marital status, and housing consumption should exert strong positive influences on distances traveled to work for residents of metropolitan areas, and negative effects on the distance nonmetropolitan residents travel to their workplace. As was indicated previously, metropolitan areas are likely to have a spatial structure in which land-use activities are more differentiated and segregated from each other. In addition, it can be suggested that being close to one's place of work is not an important factor residents of large cities take into consideration when initiating a local move. Indeed, research in the area of intrametropolitan mobility suggests that local movers are likely to travel greater distances to workplace after the move, than before (Ray, 1973; Goodman, 1974).

Methodology

The availability of data from the Panel Study of Income Dynamics (Morgan, 1974) provides a unique opportunity to analyze the determinants of journey to work patterns for residents of metropolitan and nonmetropolitan areas. This particular data set has several unique features. First, it is based on a national sample of households who have been

interviewed successively since 1968. Second, this data set permits the specification of several measures of journey to work, for example, distance (in miles) to place of work, an estimate of the average amount of time consumed traveling to work, and an estimate of the opportunity costs involved in traveling to work. Finally, the data set contains an extensive array of independent variables, including change measures, some of which have not been related to the dependent variables previously. The data used in this analysis were taken from the 1972-1974 interviewing years, and the universe includes all heads of households who worked in 1973.

Variables

The dependent variables include in this analysis are distance traveled to work in miles (one way), an estimate of the average amount of time consumed in traveling to work, and an estimate of the opportunity costs associated with traveling to work. The latter variables have been standardized by dividing by miles traveled to work in order remove the effects of the latter. The independent variables are organized into sets, most of which have been found to be related at least to distance traveled to work.

The measures of socioeconomic status include occupational status scores for major occupational groups (Duncan's SES); education, categorized into years of schooling completed; hourly wage rate; and job tenure, categorized into the number of years worked at the same job. Family characteristics include age, sex (1 if male), race (1 if white),

number of children under eighteen years of age present in the household, and marital status (dummy variables if household head is single, divorced, or widowed). Means of transportation to work is a dummy variable in which individuals who use automobile transportation are assigned values of one. Geographic location includes a measure of the distance of each household's residence to the center of the largest city contained in the primary sampling unit, and three dummy variables indicating whether the household lives in the North Central, South, or West region of the United States. Measures of housing consumption include the number of rooms in the dwelling unit, housing quality,[1] and changes in tenure status (dummy variables for homeowners for the period 1972-1973, and change in tenure status from renters to owners and from owners to renters during the same period). Finally, the measures of geographic mobility, include dummy variables for whether the household moved from another state or county, moved within a county, and whether the household moved for employment-related reasons.

Procedure

The analyses of the determinants of journey to work are reported by size of place and metropolitan-nonmetropolitan residence. The dependent variables, age, hourly wage rate, and distance from the center of the largest city are expressed in natural logrithm in the regressions reported. Previously performed analyses determined that a semi-log equation provided the best specification of the relationship under consideration.[2] Finally, since the original household sample drawn

oversampled the low-income population of the U.S., all of the results reported here are for the weighted sample.[3]

Results

Distance Traveled to Work

Table 1 reports the means and standard deviations of two of the dependent variables by metropolitan status and size of place of residence. The relationship between miles traveled to work and size of place of work is curvinlinear for this sample of households. Residents of nonmetropolitan communities of less than 10,000 population clearly travel the longest distance to work, followed by residents of metropolitan communities of greater than 100,000 population. With respect to hours traveled per week (one way), the pattern exhibits a fairly uniform decline from the largest size communities to those of greater than 10,000 population and increases substantially for residents of the smallest size communities. This is certainly not the pattern expected. The fact that residents of smaller size communities travel greater distances and spend almost as much time as metropolitan residents commuting appears to be consistent with Clementes' and Summers' (1975:217) argument that towns and villages located in predominately rural settings act as housing nodes for rural industries.

When hours traveled to work is standardized on distance, a somewhat different picture emerges. While residents of the smallest size communities spend more time per mile commuting to work, residents of

TABLE 1

Means and Standard Deviations of Measures of Journey to Work (Weighted Sample of Heads of Households)

Dependent Variables	Metropolitan				Nonmetropolitan			
	100,000>		50,000-99,999		10,000-49,999		>10,000	
	Means	Standard Deviation	Means	Standard Deviation	Means	Standard Deviation	Means	Standard Deviation
Miles traveled to work (one way)	9.462	10.337	7.859	10.963	7.083	10.975	10.4806	13.844
Hours traveled per day (one way)	.3867	.301	.3241	.2881	.2670	.2675	.3486	.3392
Hours traveled per day per mile (one way)	.0594	.0897	.0623	.0794	.0606	.0669	.0659	.1227
N (unweighted)	2066		387		523		457	

the largest size SMSAs spent the least time. This pattern undoubtedly reflects the fact that the largest size metropolitan areas have more efficient transportation networks than those found in smaller size places. Most metropolitan areas, for example, have transportation networks that are integrated with the interstate highways that often cut through and around their boundaries.

Table 2 reports standardized regression coefficients for the determinants of distance traveled to work by metropolitan status and size of place. Two sets of coefficients are reported. The columns labeled "gross" were computed with only the family and socioeconomic characteristics of heads of households included in the equations, while the columns labeled "net" were obtained from equations with all of the variables included. The gross set are included to provide the reader with an indication of the extent to which the effects of socio-economic and family status characteristics are affected by the inclusion of the other independent variables. The discussion will focus primarily on the net coefficients. An inspection of the coefficients in Table 2 reveals some interesting patterns of variations by size of place.

Although the effects of socioeconomic status are not constant for residents of different size places, it is clearly the case that these effects are statistically significant and in some cases substantial. These findings contradict those reported by Clementes and Summers (1975) and provide rather impressive evidence that the effects of measures of socioeconomic status on journey to work not only are of varying sizes but also are not in the same direction. The fact that the

TABLE 2

Determinants of Distance Traveled to Work by Size of Place
(Standardized Regression Coefficients for Weighted Sample)

Independent Variables	Metropolitan				Nonmetropolitan			
	100,000>		50,000-99,999		10,000-49,999		>10,000	
	Gross	Net	Gross	Net	Gross	Net	Gross	Net
I. Socioeconomic status								
Occupational status	.1581	.1088	.0847	.0005*	.0688	.0189	.0395	-.0466
Hourly wage rate	.1879	.1362	.2342	.1888	.3568	.2269	.3912	.2520
Education	-.0530	-.0278	-.2001	-.1329	-.2777	-.2202	-.2216	-.1657
Job tenure	.1097	.0598	.1529	.0134	.0950	-.0032*	.0841	-.0261
II. Family characteristics								
Age	-.0815	-.0322	-.2462	-.1151	-.1965	-.1069	-.1072	-.0966
Sex	-.0247	-.0077*	-.1444	-.0668	-.0407	-.0431	.0141*	.0027*
Race	-.0068*	-.0615	-.0123*	-.0184	-.0395	-.0262	-.0171*	-.0237
Number of children	.0027*	-.0164	.0344	.0036*	-.0256	-.0263	.0861	.0504
Marital status								
Single	-.1342	-.0332	-.0742	.0537	.0598	.0377	.0194	.0256
Widowed	-.0303	-.0182	.0267	.0351	.0324	.0431	-.0328	.0141*
Divorced	-.0692	-.0166	.0428	.0544	.0123*	.0224	-.0138*	-.0174*
III. Geographic location								
Region								
North Central		.0000*		-.2744		-.1381		-.0401
South		-.0161		-.1195		-.0063		.0559
West		.0155		-.2154		-.1105		-.0616
Distance to center of largest city		.1233		.1239		.0268		-.0802

TABLE 2 (cont.)

Independent Variables	Metropolitan				Nonmetropolitan			
	100,000>		50,000-99,999		10,000-49,999		>10,000	
	Gross	Net	Gross	Net	Gross	Net	Gross	Net
IV. Residential consumption								
Number of rooms		.0093		-.0131*		.0045*		.0129*
Housing quality		.0480		.0150		.0040*		-.0645
Change in tenure								
Remain owners		.0477		.0258		-.0008*		.0862
Renters to owners		.0357		.0661		.0097*		-.0046*
Owners to renters		-.0103		.0095*		-.0384		.0192
V. Geographic Mobility								
Move for employment related reasons		-.0670		-.0160		.0123*		-.0709
Move across state		.0624		-.0179		-.0328		.0067*
Move across county		.0494		-.0392		.0537		-.0236
Move intra-county		.0105		-.0342		-.0203		-.0454
VI. Automobile transportation		.4003		.5420		.4575		.4752
Mean	1.9068		1.6423		1.510		1.756	
R^2	.1434	.3155	.2050	.5040	.1583	.3539	.1980	.4158
N	2066		387		523		457	

sizes of some of the coefficients were reduced substantially, even to the point of reversals in signs, when the full set of specifications are employed, should be a warning to future researches to avoid relating socioeconomic and family status characteristics to measures of journey to work without instituting the proper kinds of controls.

The socioeconomic status measures that show the largest effect on distance traveled to work are hourly wage rate and education. It can be noted that the responsiveness of distance traveled to work to hourly wage rate increases linearly with decreases in size of place, which is not consistent with previously stated expectations. This pattern undoubtedly reflects the fact that nonmetropolitan residents appear more willing to travel greater distances to work if they are compensated with higher wages than are metropolitan residents. On the other hand, the effects of education are distinctly negative, because the magnitude of the coefficients increases as size of place decreases. It should be emphasized that for metropolitan residents, the fact that the coefficients for education are negative should not be interpretated as indicating that highly-educated persons live near the center of the city. Moreover, what they do indicate is that some highly educated individuals live fairly close to their place of work. Industries that employ highly-skilled personnel, but do not generate large volumes of traffic or pollution are ofttimes located in attractive and high-status suburban areas. Communications, professional, electronics, and public administration industries are the most obvious examples. The large negative coefficients for nonmetropolitan areas are probably indicative

of the fact that higher educational and occupational groups are more likely to work within the corporate limits of the community in which they live (Wheeler, 1967).

Finally, before commenting on the coefficients for the other variables included in Table 2, the reader should note that the effects of job tenure and distance traveled to work for metropolitan residents are positive. Although these findings would appear to contradict the often stated opinion that workers (over time) will change their residence in order to minimize the distance they traveled to work, it should be noted that geographic moves associated with employment are explicitly controlled for in the analysis. What these findings suggest is that the use of job tenure as a variable to test the minimization hypothesis may be inappropriate and could lead to the drawing of erroneous conclusions.

The effects of family characteristics on distance traveled to work are small and in most cases exhibit no consistent pattern of variation, with a few exceptions. Consistent with the findings of previous studies, young households appear more willing to bear the cost of commuting greater distances than their elders, regardless of size of place of residence. Families living in the smallest size SMSAs and in nonmetropolitan communities of greater than 10,000 population, travel greater distances to work than male heads of households. Although blacks appear to travel greater distances to work than whites, the differences are trivial except for residents of large size SMSAs. This is to be expected, since blacks are more heavily segregated in such places,

and are more likely to live in central locations. With respect to marital status, married household heads are slightly more likely to travel greater distances to work in the largest size places, and least likely in medium and smaller size places.

Distance traveled to work varies substantially by region of residence. Residents of the largest size SMSAs travel the same distance to work regardless of region of residence. This pattern probably reflects the fact that the spatial structure of large size SMSAs are similar. This contrasts sharply with the pattern observed for the other size of place categories. Residents of smaller size places located in the eastern section of the country are substantially more likely to travel greater distances to work. This should come as no surprise given that settlement patterns located in the East are older and are more densely settled. Finally, with respect to geographic location, distance to the center of the largest size city is substantially related to distance traveled to work. Residents of SMSAs who live farther from the center of the central city are likely to travel greater distances to work, while the reverse is true for residents of nonmetropolitan communities. Needless to say, this pattern is consistent with an earlier prediction that differences in the spatial structure of metropolitan versus nonmetropolitan communities have a substantial effect on commuting patterns. Employment centers in smaller size places are more likely to be located near their center, because their growth has not been of a scale which requires the redistribution of land-use activities so often observed for large size places.

The housing consumption and geographic mobility variables were originally intended to be used only as control variables, but it is clear that their pattern of effects on distance traveled to work are of merit in their own right. Consistent with earlier predictions, consumption of quality housing and homeownership (primarily in single family units) is positively related to the distance metropolitan residents travel to work, that results from the fact that dwelling units with these characteristics are more likely to be located away from major employment centers. With respect to residents of the smallest size places, distance traveled to work is negatively related to the consumption of quality housing, but positively related to homeownership. Higher quality housing is more likely to be located within the corporate limits of smaller size places. On the other hand, the large positive effect of homeownership status for smaller size places probably reflects the fact that some individuals who live on farms are likely to work in nonfarm occupations.

Persons who move for employment-related reasons are more likely to travel shorter distances to work, independent of the distance moved and size of place of destination. This finding, to a certain extent, substantiates the minimization hypothesis. Moreover, the significant coefficients for destination of move tend to indicate that employment-related moves are not the only reasons why households move. Note that persons who moved to or within the largest size SMSAs experienced longer journeys to work, while residents of the smallest size SMSAs were likely to experience shorter journey to work distances. One

reasonable interpretation of this pattern is that residents who move to or within smaller size places are more likely to find suitable housing closer to their place of work soon after arriving at their destination.

Finally, the use of the automobile, without question, is the largest single predictor of the distance persons travel to work regardless of size of place of residence. Automobile transportation is often the only form of transportation available for persons whose workplace is farther than three miles from their residence. This is especially true for residents of small size places, where often the automobile is the only available means of long distance travel. On the other hand, even where public transportation is available, the automobile may frequently provide greater convenience and flexibility with respect to getting to work, because neither the route nor the rate of travel are fixed in advanced.

Opportunity Costs

In an earlier section of this paper, it was suggested that the importance of accessibility to work place is derived from the economics of intraurban travel behavior, which is partly reflected in what economists call opportunity costs. These costs are defined in terms of the amount of time individuals consume in trip-making, some portion of which could have been used for other purposes had the person's residence been situated closer to his workplace. One useful way of conceptualizing opportunity costs is to think of it as a portion of the total amount of time an individual works during a given interval of

time (a day), but for which he is not paid. Viewed from this angle, persons who consume more time journeying to work actually have less time in which to do other things.

Beesley (1965) presents evidence suggesting that part of the disutility incurred from using one mode of travel versus another is a result of the fact that mode of travel has direct consequences in terms of the amount of time it takes workers to travel to their workplace. In addition, he finds that the value (in monetary terms) individuals associate with the time spent in traveling to work varies depending on their wage rate. London residents whose wage rate was about average, valuate time travel at about one-third of their wage level, while highly paid individuals place a value of from 42 to 50 percent on travel time (Beesley, 1965:182).

The point I wish to make here is that individuals are perhaps sensitive to both distance traveled to work as well as the amount of time such traveling consumes. There have been few, if any, sociological studies that have focused on the latter. In contrast to distance traveled to workplace, time spent traveling to work per mile is more likely to be affected by both the scale of urban spatial systems and the efficiency of existing transportation networks--that is, the extent to which existing transportation networks facilitate the movement of people to various destinations during the times when the volume of traffic is likely to be heavy. In the regressions reported in Tables 3 and 4, the determinants of the amount of time spent traveling to work and the opportunity associated with traveling to workplace are analyzed. In

TABLE 3

Determinants of Travel Time to Workplace per Mile of Travel by Size of Place
(Standardized Regression Coefficients for Weighted Sample)

Independent Variables	Metropolitan		Nonmetropolitan	
	100,000 +	50,000-99,999	10,000-49,999	>10,000
I. Geographic residence				
Region				
North Central	-.0139	.2863	.1195	-.0028*
South	.0013*	.1456	.0238	.0077*
West	-.0885	.1481	-.0622	.0364
Distance to center of largest city	-.1284	-.0379	.0234	-.0247
II. Geographic mobility				
Move for employment related reasons	.0140	.0762	.0935	.0345
Move across state	-.0805	-.1237	-.0266	-.0144*
Move across county	-.0384	.0546	-.0822	-.0153*
Move intra-county	-.0051*	-.1088	-.0925	.0111*
III. Change in tenure				
Remain owners	-.1229	-.1164	-.0896	-.1725*
Renters to owners	-.0252	-.0136*	.0044*	-.0108*
Owners to renters	-.0672	.1637	.0217	.0603
IV. Race	-.0851	.0141*	-.0282	-.0499
V. Automobile transportation	.0144	.2311	.2496	.1878
Mean (Log)	.3967	.4076	.4080	.3915
R^2	.0579	.1511	.0971	.0827
N	2066	387	523	457

TABLE 4

Determinants of Opportunity Costs Associated with Journeying to Work by Size of Place (Standardized Regression Coefficients for Weighted Sample)

Independent Variables	Metropolitan		Nonmetropolitan	
	100,000>	50,000-99,999	10,000-49,999	>10,000
	Opportunity Cost	Opportunity Cost	Opportunity Cost	Opportunity Cost
I. Socioeconomic status				
Occupational status	.0793	.1126	.1090	.0714
Hourly wage rate	.4180	.2865	.3459	.4155
Education	-.0193	-.0478	.0588	.0739
Job tenure	.1666	.0588	.0440	.0183*
II. Family characteristics				
Age	.0658	.0313	.0544	.1382
Sex	-.0049*	.0885	.0722	.0347
Race	-.0655	.0481	-.0385	-.0505
Number of children	.0105	-.0152*	-.0608	-.0332
Marital status				
Single	.0424	.0438	-.0147*	.0210
Widowed	-.0365	-.0193*	-.0560	.0086*
Divorced	.0105	-.0070*	-.0274	-.0099*
III. Geographic location				
Region				
North Central	-.0338	.2584	.1508	.0082*
South	.0054*	.0474	.0122*	-.0337*
West	-.0565	.1333	-.0321	.0262*
Distance to center of largest city	-.1202	-.0916	.0083*	.0090*

TABLE 4 (cont.)

Independent Variables	Metropolitan		Nonmetropolitan	
	100,000>	50,000-99,999	10,000-49,999	>10,000
	Opportunity Cost	Opportunity Cost	Opportunity Cost	Opportunity Cost
IV. Residential consumption				
Number of rooms	-.0413	-.0649	-.0205	.0739
Housing quality	.0009*	.0331	-.0137*	-.0672
Change in tenure				
Remain owners	-.0588	-.0017*	-.0344	-.1515
Renters to owners	-.0193	-.0065*	.0153*	-.0586
Owners to renters	-.0543	.1156	.0125*	.0042*
V. Geographic mobility				
Move for employment related reasons	.0246	.0389	.0553	.0674
Move across state	-.0302	-.0829	.0255	-.0045*
Move across county	-.0348	-.0044*	-.0407	-.0118*
Move intra-county	.0484	-.0849	-.0494	.0422
VI. Automobile transportation	-.1193	.0542	-.0015*	-.0728
Mean (Log)	.7228	.6339	.4912	.3603
R^2	.2752	.2737	.2379	.2171
N				

contrast to the results reported for distance traveled to work, these results will only be summarized.

Table 3 reports the determinants of travel time to workplace (one way) by size of place. I have restricted the type of independent variables included in the regression because of my belief that travel to work time is affected more by forces external to the activities of individual households. For this reason, only the georaphic residence variables, race, mode of transportation, and geographic mobility are related to travel time to work.

Travel to work time varies significantly by region of residence, although this is less the case for the smallest size places. Persons who live in the smaller size SMSAs located in the North Central, the South, and the West spend more time traveling to work than persons living in the East. Similarly, it can be noted that travel to work time varies significantly with distance from the center of the city, and by size of place. With the exception of medium size nonmetropolitan cities, travel to work time is inversely related to the distance that persons live from the center of the largest city. These findings, as well as those for region, undoubtedly reflect the influence of variations in population density and the efficiency of transportation networks in cities by size or place. Large size places, for example, are more likely to be densely populated but they are also more likely to provide residents greater flexibility in mode and routes of travel.

Although a previous finding indicated that persons who move for job-related reasons are more likely to travel shorter distances to work,

the positive coefficients for this variable in Table 3 indicate that these persons are also more likely to spend more time traveling to work per mile of travel. It could be that persons who live closer to workplace live at higher densities, and therefore are more likely to encounter heavier traffic and have fewer alternative modes of travel available to them. On the other hand, the generally negative coefficients for destination of move and changes in tenure status suggest that persons in these categories spent less time traveling to work. It is difficult to determine exactly what these coefficients mean. Moreover, for large size places, given the fact that these variables have positive effects on distance traveled, the most appropriate interpretation could be the reverse of that applied to job related moves.

The final issue explored in this paper is a discussion of what class of individuals incur higher opportunity costs in traveling to work. Opportunity costs is defined as follows,

$$OC_{Log} = \text{Log } (TS(HWR)/DT)$$

where OC is opportunity costs; TS is time spent traveling to work (one way); HWR is hourly wage rate; and DT is distance traveled to work (one way in miles). I wish to emphasize that I make no assumptions about how opportunity costs enter into the residence decisions of households. Moreover, it does, at the minimum, seem reasonable to assume that individuals are sensitive to time, and distance, and that these factors limit the number and kind of activities that can be conducted within a circumscribed area (Hawley, 1971). Thus, a more reasonable

way to phase the question is to ask: given the spatial distribution of households in urban areas, what affect does location have on the amount of opportunity costs incurred by any given households in journeying to work? The standardized regression coefficients reported in Table 4 are used to provide a preliminary answer to this question.

Occupational status and wage rate are positively related to opportunity, with only minor variations by size of place. The effect of job tenure, on the other hand, is positive and varies linearly with size of place. Hourly wage rate is the most significant variable related to opportunity costs. Although, hourly wage rate is a component of opportunity costs, the zero order correlations among these variables are fairly close to the standardized regression coefficients reported in Table 4.[4] Persons with higher educational backgrounds incur lower opportunity costs in metropolitan areas, and the higher cost in nonmetropolitan areas.

Few of the family characteristics have significant and consistent relationships with opportunity costs, by size of place, except for age, sex, and to a certain extent, race. With respect to region of residence, persons who live in small size SMSAs in the North Central, the South, and the West, and who live in the medium size nonmetropolitan cities in the North Central are more likely to incur higher opportunity costs than persons who live in the East. For metropolitan residents, living greater distances from the center of the largest city in the area implies substantially lower opportunity costs. Persons who move for employment related reasons, incur higher opportunity costs. Finally, the use of

automobile transportation implies lower opportunity costs in the largest metropolitan areas and the smallest size nonmetropolitan cities.

Summary of Findings

I will not attempt to summarize the findings reported in the previous section, since such an effort would be rather lengthy. The major issue that led to the initiation of this analysis was whether the journey to work patterns of nonmetropolitan residents were influenced by the same kinds of factors that were identified as affecting the journey to work patterns of metropolitan residents. The findings reported here suggest a "qualified" yes to answer to this question. In other words, the same variables that significantly affect the journey to work patterns of metropolitan residents also affect those of nonmetropolitan residents, although it could clearly be observed that such affects vary with respect size and direction. These variations in affects by size of place support Clementes' and Summers' (1975) contention that models used to explain the journey to work patterns of metropolitan residents do not explain those of nonmetropolitan residents. Moreover, it should be emphasized that Clementes and Summers based their conclusion on the fact that they could find no significant effects of age, job tenure, and SES on the distance nonmetropolitan residents travel to work. My conclusion, on the other hand, is based not on the fact that these variables had no effect, but rather that such effects varied in sizes and direction by size of place of residence. In addition, I present

evidence showing that journey to work patterns are significantly effected by geographic mobility, changes in tenure status, mode of travel, and distance of residence to the center of the largest city in the region of residence.

The findings reported here suggest that residents of the largest size SMSAs and the smallest size nonmetropolitan communities travel greater distances and spend more time per mile of travel getting to work than residents of other size communities. The journey to work patterns of residents of metropolitan areas probably are a consequence of two major factors (1) specialization of land-use activities and their resulting differentiation in space; and (2) the congestion that occurs with the time pattern of traffic flows, resulting from living under conditions of higher population densities. The journey to work patterns of residents of the smaller size nonmetropolitan communities probably are a consequence of the fact that their spatial structure is not of the same scale as that observed in metropolitan areas, and partly because small size urban places act as housing modes for the industries concentrated around them.

NOTES

[1]This measure of housing quality was constructed by the Survey Research Center of the Institute for Social Research at University of Michigan (1973:151). It is derived as follows: (1) owner-occupants, defined as market value of dwelling divided by number of rooms; (2) renters as dwelling value (assumed to be 10 times annual rent) divided by number of rooms; and (3) neither owners nor renters as dwelling volume (some of rent paid) plus volume of rent received free or in return for services, multiplied by ten and divided by number of rooms.

[2]When a set of simple linear equations in variables were estimated, it was found that the R^2 values for predicting the two dependent variables were on the average less than one-third the size of the values reported in the analysis included here. For example, the ordinary least squares standardized estimates for the effects of the socioeconomic variable on miles traveled to work (net of other variables included in the equation) for residents of SMSAs of greater than 100,000 population were as follows: miles = .09441(occ.) + .1064(wage) - .0199(ed.) R^2 = .1567. These values should be compared with those reported in Table 2.

[3]The 1972 weights are applied (see Morgan, et.al., 1974).

[4]The zero order correlations between hourly wage rate and opportunity costs by size of place are (.4331), (.3611), (.4281), and (.3859), respectively.

REFERENCES

Alonso, William. Location and Land Use: Toward a General Theory of Land Rent. Cambridge: Harvard University Press, 1964.

Alonso, William. "The Historical and the Structural Theories of Urban Form: Their Implications for Urban Renewal." In An Urban World, edited by Charles Tilly, pp. 441-446. Boston: Little, Brown and Company, 1974.

Apps, Patricia F. "An Approach to Urban Modelling and Evaluation, A Residential Model: 1. Theory." Environment and Planning A 5 (September-October 1973):619-632.

Apps, Patricia F. "An Approach to Urban Modelling and Evaluation, A Residential Model: 2. Implicit Prices for Housing Services." Environment and Planning B 5 (November-December 1973):705-717.

Apps, Patricia. "An Approach to Urban Modelling and Evaluation, A Residential Model: 3. Demand Equations for Housing Services." Environment and Planning A, 6 (1974):11-31.

Bahl, Roy W. "Metropolitan Fiscal Structures and the Distribution of Population Within Metropolitan Areas," in U.S., Commission on Population Growth and the American Future, Population, Distribution, and Policy, Volume V of Commission research reports, ed. Sara Mills Mazie (Washington, D.C.: U.S. Government Printing Office, 1972), Part III, Chapter 3, pp. 423-440, (Y3.P81:9/5).

Beesley, M.E. "The Value of Time Spent in Travelling: Some New Evidence." Economica 32 (May 1965):174-185.

Berry, Brian J.L., and Cohen, Yehoshua S. "Decentralization of Commerce and Industry: The Restructuring of Metropolitan America." In The Urbanization of the Suburbs, edited by L.H. Masotti and J.K. Hadden, pp. 431-456. Beverly Hills: Sage Publications, Inc., 1973.

Carroll, Douglas J., Jr. "Some Aspects of the Home-Work Relationships of Industrial Workers." Land Economics 25 (November 1949):414-422.

Carroll, Douglas J., Jr. "The Relation of Homes to Work Places and the Spatial Patterns of Cities." Social Forces 30 (March 1952):271-282.

Clementes, Frank, and Summers, Gene F. "The Journey to Work of Rural Industrial Employees." Social Forces 54 (September 1975):212-219.

Darrock, Gordon A., and Winsborough, Halliman H. "Urban Accessibility and Residential Densities: The Impact of Relative Centrality and the Journey to Work." Working Paper no. 72-2, the Center for Demography and Ecology. The University of Wisconsin, Madison, Wisconsin, 1972.

Duncan, Beverly. "Factors in Work-Residence Separation: Wage and Salary Workers, Chicago, 1951." American Sociological Review 31 (June 1956):48-63.

Duncan, Beverly, and Duncan, Otis D. "The Measurement of Intra-City Locational and Residential Patterns." In Urban Analysis, edited by Alfred N. Page and Warren R. Slyfried, pp. 243-256. Glenview, Ill.: Scott, Foresman and Company, 1970.

Goldberg, Michael A. "Transportation, Urban Land Values, and Rents: A Synthesis." Land Economics 46 (May 1970):153-162.

Goodman, John. "Local Residential Mobility and Family Housing Adjustments." In Five Thousand Families, edited by James A. Morgan, vol. 2, pp. 79-106. Ann Arbor: Survey Research Center, Institute for Social Research, University of Michigan, 1974.

Guest, Avery M. "Families and Housing in Cities." Ph.D. dissertation, University of Wisconsin, 1970.

Guest, Avery M. "Retesting the Burgess Zonal Hypothesis: The Location of White Collar Workers." American Journal of Sociology 76 (May 1971):1084-1093.

Guest, Avery M. "Patterns of Family Location." Demography 9 (February 1972):159-172.

Harris, Britton. "Quantitative Models of Urban Development: Their Role in Metropolitan Policy-Making." In Issues in Urban Economics, edited by Harvey S. Perloff and Lowdan Wingo, Jr., pp. 363-434. Baltimore: John Hopkins Press, 1968.

Hawley, Amos. Human Ecology: A Theory of Community Structure. New York: The Ronald Press, 1950.

Hawley, Amos H. "Human Ecology." In International Encyclopedia of the Social Sciences, ed. David L. Sills. Volume 4, pp. 328-337. New York: Crowell Collier and MacMillan, Inc., 1968.

Hawley, Amos. Urban Society: An Ecological Approach. New York: the Ronald Press, 1971.

Hoover, Edgar M. "The Evolving Form and Organization of the Metropolis." In Issues in Urban Economics, edited by Harvey S. Perloff and Lowdan Wingo, Jr., pp. 237-284. Baltimore: The Johns Hopkins Press, 1968.

Kain, John F. "Urban Travel Behavior," In Social Science and the City, edited by Leo T. Schnore, pp. 161-192. New York: Frederick A. Praeger, Publishers, 1968.

Kain, John F. "The Journey to Work as a Determinant of Residential Location." In Urban Analysis, edited by Alfred N. Page and Warren R. Seyfried, pp. 207-226. Glenview, Ill.: Scott, Foresman and Company, 1970.

Lansing, John B. and Hendricks, Gary. Automobile Ownership and Residential Density. Ann Arbor: Survey Research Center, Institute for Social Research, University of Michigan, 1967.

Lansing, John B., Morans, Robert W., and Zehner, Robert B. Planned Residential Environments. Ann Arbor: Survey Research Center, Institute for Social Research, University of Michigan, 1970.

Leven, Charles L. "Changing Sizes, Forms, and Functions of Urban Areas." In U.S., Commission on Population Growth and the American Future, Population, Distribution, and Policy, Volume V of Commission Research Reports, ed. Sara Mills Mazie (Washington, D.C.: U.S. Government Printing Office, 1972), Part III, Chapter 2, pp. 395-421, (Y3.P81:9/5).

McKenzie, Roderick D. The Metropolitan Community. New York: McGraw-Hill, Inc., 1933.

Meyer, John, Kain, John, and Wohl, Melvin. The Urban Transportation Problem. Cambridge: Harvard University Press, 1965.

Mills, Edwin S. "An Aggregative Model of Resource Allocation in a Metropolitan Area." American Economic Review, Papers and Proceedings 57 (May 1967):197-210.

Morgan, James A., ed. Five Thousand Families; Patterns of Economic Progress. Ann Arbor: Survey Research Center, Institute for Social Research, University of Michigan, 1974.

Muth, Richard F. Cities and Housing. Chicago: The University of Chicago Press, 1969.

Muth, Richard F. "The Demand for Non-farm Housing." In Urban Analysis, edited by Alfred N. Page and Warren R. Seyfreid, pp. 146-165. Glenview, Ill.: Scott, Foresman and Company, 1970.

Nelson, Robert H. "Accessibility and Rent: Applying Becker's 'Time Price' Concept to the Theory of Residential Location." Urban Studies 10 (February 1973):83-86.

Ogburn, William F. and Duncan, Otis D. "City Size as a Sociological Variable." In Urban Sociology, edited by Ernest W. Burgess and Donald J. Bogue, pp. 58-76. Chicago: The University of Chicago Press, 1964.

Pirenne, Henri. Medieval Cities. Garden City, New York: Anchor Books, 1962.

Poston, Dudley L., Jr. "Socioeconomic Status and Work-Residence Separation in Metropolitan America." Pacific Sociological Review 5 (July 1972):367-380.

Ray, Paul H. "Residential Location, Consumer Demand and Urban Structure." Ph.D. dissertation, University of Michigan, 1973.

Roistacher, Elizabeth. "Residential Mobility." In Five Thousand Families, edited by James A. Morgan, vol. 2, pp. 41-78. Ann Arbor: Survey Research Center, Institute for Social Research, University of Michigan, 1974.

Schnore, Leo F. The Urban Scene. New York: The Free Press, 1965a.

Schnore, Leo F. "On the Spatial Structure of Cities in the Two Americas." In The Study of Urbanization, edited by Philip M. Hauser and Leo F. Schnore, pp. 347-398. New York: John Wiley & Sons, Inc., 1965b.

Sjoberg, Gideon. The Preindustrial City. Glencas, Ill.: The Free Press, 1960.

Wheeler, James O. "Occupational Status and Work Trips." Social Forces 45 (June 1967):508-515.

Wheeler, James O. "Some Effects of Occupational Status on Work Trips." Journal of Regional Science 9 (April 1969):69-77.

Whitbread, M., and Bird, Heather. "Rent, Surplus and the Evaluation of Residential Environments." Regional Status 7 (June 1973):193-223.

Wingo, Lowden. Transportation and Urban Land. Washington, D.C.: Resources for the Future, 1961.

Winsborough, Halliman H. "Changes in Mode of Travel to Work, 1934-1960." Working Paper no. 72-12. Center for Demography and Ecology, The University of Wisconsin-Madison, 1972.

Wilson, Franklin D. "The Organizational Components of Expanding Metropolitan Systems." Working Paper no. 75-20. Center for Demography and Ecology, The University of Wisconsin-Madison, 1975.