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4 THE HOME-WORK RELATIONSHIP AND URBAN ECOLOGICAL STRUCTURE

Donald G. Jamelle & Michael F. Goodchild

4.1 Introduction

The home-work relationship is a fundamental determinant in the evolving ecological structure of cities. For any single household, this relationship sets the financial, temporal and spatial limits on life styles and behavioural patterns. In turn, these limits impose constraints on a city's ecological development. The linkage between individual behaviour and urban ecological structure is the principal focus of this chapter. The home-work relationship, seen as a constraint on the individual's activities, provides the context for adopting a time-geography perspective (Hagerstrand 1970, Parkes & Thrift 1980), and the analysis of space-time diaries (Anderson 1971) for urban residents provides for some preliminary empirical evaluation.

Several conceptual frameworks for considering the integration of individual behaviour within broader environmental systems have been reviewed by Parkes & Thrift (1980, pp. 205-224). These include the routine and culturally transmitted structure theory (Bullcock et al. 1974, Tomlinson et al. 1973, Shapcott & Steadman 1978), routine and deliberated choice theory (Cullen & Godson 1975), and Chaplin's (1974) transductive approach, focusing on the preconditioning of subpopulations to adopt certain activity patterns. Of these, Chaplin's concept places greater emphasis on individual decision making, whereas the other two see daily, routine behaviour more as a product of one's situation. Pred (1981) relates this latter view to the dialectic of individuals under the constraint of socio-economic systems. Associated with this are the abilities of dominant institutions and social norms to entrain the activities of individuals in set patterns, an idea explored by Parkes & Thrift (1979). In addition, Barker's (1968) concept of the "behaviour setting" as an environment that invokes individual conformance to its temporal and spatial patterns, represents a statement of clear linkage between individual activity and ecological structures.

Clearly, obligations to the job and to the needs of the household impose such entrainment effects. Aside from sleep, probably more than any other activity, work, and its implied authority constraints, sets the dominant rhythm of the weekday routine. Hospitals, schools, businesses, industries and other establishments all exert strong regulatory control over the timing of an individual's movements and the time that he or she has available for other activities. In addition, the functional linkages between these establishments and individual households determine the generally-acceptable distance limits between activity sites (e.g. home and work).

The distance between the home and the work place is crucial to interpreting links between behaviour at the individual level with ecological patterns. Since the home is the base for satisfying most of one's daily and lifetime biological needs and for meeting most of one's critical

social obligations, any increase in its distance from the workplace would be at the expense of time that could go for household and other activities. Yet, although the documentation is sparse, evidence points to a long-term trend of increasing distances. In 1969 the mean home-work trip for the United States was 14.8 km (U.S. Dept. of Transportation 1973), increasing to 17.9 km in 1975 and to 19.2 km in 1979 (U.S. Bureau of the Census 1982). Transportation innovations have permitted this trend. In addition, higher space standards (e.g. large house lots, extra space for potential factory and store expansion, space for parking more and more cars, etc.) and new technologies (e.g. single-floor industrial plants) have increased the average distances that separate activities in urban regions. These increases have not been systematically documented but, if one accepts the claim by Doxiadis (1968), the average densities in several major cities dropped by two-thirds between the 1920s and the late 1960s.

Transportation has played a crucial role in facilitating greater separation between home and work; however, Jean Gottmann (1977) has identified "terms of employment" as an equally significant social determinant of urban spatial patterns. Contractual agreements between employers and employees have led to shorter work weeks, longer paid vacations and flexible work hours, and even to job sharing and early retirement. These trends have released employees from severe temporal constraints and have permitted many individuals to channel the freed time into creative and pleasurable activities, and into commutes from residences located at greater distances from the workplace.

Changes in the terms of employment are seen by Gottmann as contributing to a broader range of living environments and to the potential for massive suburbanization. Dutch transport analyst Geurt Hupkes (1982) indicates that there may be a fixed budget to the time that people will spend in travel. He documents tendencies in many different countries to suggest that there has been no significant change in the number of trips per capita, per annum, and no change in the amount of time devoted to travel in the period since 1960. Instead, the advantages of extra speed have been used exclusively to broaden the geographical range of activities. Based on time-budget surveys for the Netherlands, Hupkes (1982) observes that the average number of minutes devoted to travel per day had not changed appreciably over 10 years; 71.3 minutes for all trips per day in 1962, and 70.5 minutes in 1972. In contrast, the average total distance traveled per day per capita increased from 4.4 to 7.0 km.

These general observations on the distance relationship between the home and the workplace are limited by their national scale of aggregation and by failure to differentiate by appropriate subpopulations. They also fail to capture the significant changes in the social and functional character of urban spaces that occur over the course of a day. To try and resolve these problems, a time-geography perspective on the city is integrated with the analysis of data from space-time diaries.

4.2 A time-geography perspective on the city

A time-geography perspective treats time and space as co-equal physical constructs, and integrates them into a single framework for describing

patterns of geographical distributions and movements. The timing, sequence and synchronization of activities are treated simultaneously with the more traditional geographical concepts of location and spatial association. In this study, the units of observations are at two levels, the individual human being and urban sub-regions (ecological zones). It is only through the ability to track large numbers of individuals continuously throughout the day that the changing human composition of urban sub-regions can be determined. The remainder of this chapter illustrates some of the empirical approaches, evidence, and research plans adopted by the Time-Geography of a Canadian City Project (Goodchild & Janelle 1984). In using space-time diary data from Halifax, Canada (Elliott et al. 1976), it (1) describes some of the work-household relationships included in the daily space-time paths (Hagerstrand 1970) of individuals, (2) uses the factorial-ecological approach adopted by Taylor & Parkes (1975) to describe diurnal changes in the social ecology of urban sub-regions, and (3) presents an interpretation of individual movement behaviour with the unfolding daily patterns of urban ecological structure.

4.2.1 The data

The data used for this investigation are derived from a space-time diary survey of a representative random sample of 2,141 residents of Halifax, Canada in 1971. Information on the survey design and its reliability are documented by Elliott et al. (1976). Additional technical details on their use in this investigation are contained in Janelle & Goodchild (1983a, 1983b) and Goodchild & Janelle (1984).

A space-time diary (Anderson 1971) represents an extension of time-budget surveys (e.g. Szalai 1972; Michelson & Reed 1975) by including information on where activities are carried out, in addition to when they take place. This concept has been used for investigations of behaviour in particular kinds of settings (e.g. activities in a university environment, Cullen & Godson 1975), for specific subpopulations (e.g. residential movers, Michelson et al. 1973), and for specific types of activities (e.g. travel diaries, Marble 1970). However, there are only a few cities in the world for which space-time diaries have been collected in sufficient detail to justify their use for reconstructing the general space-time patterns of socio-demographic change at the daily level. Among the most notable of these surveys are those for Uppsala, Sweden (Hanson and Hanson 1981), Hamburg, Germany (Dangschat et al. 1982), and Halifax, Canada (Elliott et al. 1976).

The Halifax data allow for tracing of respondents to the nearest .10 km and provide detailed socio-economic characteristics for each respondent. Of particular value is the opportunity to aggregate respondents according to socio-demographic variables, locations, times of the day, and combinations thereof. Taking advantage of these attributes, analyses of individual behaviour and ecological patterns may be pursued.

4.2.2 Individual space-time paths and the home-workplace relationship

There are many algorithms for clustering respondents into homogeneous groupings (Aldenderfer & Blashfield 1984). However, in this study a deliberate a priori selection of six attributes is used to allocate

individuals into mutually exclusive role groups. Attributes were selected to reflect the basic coupling and capability constraints described by Hagerstrand (1970). They include sex, marital status, employment status, childcare responsibility, home-ownership status, and the availability of an automobile.

A simple concatenation of the dichotomous categories of these attributes results in 64 possible role-group designations, six of which are described in Table 4.1. These multi-variable groupings circumvent problems associated with drawing inferences about the behaviours of individuals that are aggregated into only single-variable subpopulations (for example, all males or all home owners). In contrast, measures based on the six-variable role groups show much less statistical variance from group means and come closer to describing real human beings.

In principle, each role group is representative of a particular combination of coupling and capability constraints. Jobs, spouses, children, and home ownership require people to occupy particular locations and to discharge certain obligations at appropriate times. Automobile ownership relates to the ability to overcome distance and provides one with flexibility in the timing of travels and other activities.

For each individual in the sample, it is possible to calculate a wide range of descriptive measures on their activities and travels. A few of these measures, selected to represent relationships between the home and the workplace, and between these locations and the urban environment, are presented in Table 4.1. These are aggregated by role group at the daily level and relate to those 1,207 respondents who completed weekday diaries and who resided within the municipal boundaries of Halifax and its twin city, Dartmouth. Whereas Janelle & Goodchild (1983a) provide detailed analyses of role-group variations for such measures, the discussion that follows is based on subjective interpretations of the data in Table 4.1.

The first three role groups described in Table 4.1 all rent their accommodations, have jobs, do not have child-care responsibilities, and are single. In general, they live much closer to work, spend more time at work, and have fewer home-centred obligations than their married counterparts (groups 4, 5 and 6). The two groups of single females differ only in the availability of an automobile. Not surprisingly, the group without cars travels at a much slower average speed, and does not range far from the home and work locations; individuals within this group appear to compensate by living much closer to work and to shopping facilities. They also show much lower standard deviations on these five measures, possibly reflecting the greater entrainment effect of being non-car owners in a society where nearly ninety percent of households have automobiles.

Despite a nineteen percent greater proximity between their homes and workplaces, single males with automobiles (group 3) differ from their female counterparts by spending nearly 47 percent more time in travel and ranging further from the home and work locations on an average weekday. Much of this may relate to differences in work roles; more men are involved with travel as part of their employment.

Groups 4 and 5 (Table 4.1) describe married female and male respondents who have jobs, along with obligations to the maintenance of an owned home and to the care of children. While the men spend considerably more

Table 4.1 Attributes of daily space-time paths for selected role groups: Halifax Canada, 1971

Attributes of space-time paths	Role Groups*: Sample size:	1 F-S-NC-E-R-NA 48	2 F-S-NC-E-R-A 31	3 M-S-NC-E-R-A 22	4 F-W-C-E-O-A 55	5 M-W-C-E-O-A 134	6 F-W-C-U-O-A (133)	Total Sample (1,270)
Max. km.** from home on diary day	mean	2.9 +	4.0	4.6	3.9	5.3	3.8	4.4
	S.D.	(2.7)	(3.2)	(6.0)	(3.6)	(5.4)	(6.0)	(4.4)
Max. km.** from primary work place on diary day		3.0 +	3.8	4.7	4.3	5.8 +	---	4.5
		(2.9)	(2.9)	(6.1)	(3.5)	(5.4)	---	(4.3)
Speed: km/hr** on work trips by auto		13.8	18.4	15.8	17.5	19.2	---	18.1
		(6.8)	(12.9)	(8.8)	(11.8)	(11.2)	---	(11.2)
Total minutes of travel per day		78.8	81.3	119.4 +	63.5	85.0 +	51.0 +	68.1
		(63.6)	(46.0)	(136.0)	(42.0)	(49.0)	(45.5)	(53.4)
Km.** between home and work locations		2.1 +	3.1	2.6	3.1	3.9 +	---	3.3
		(2.0)	(3.1)	(2.6)	(3.3)	(2.3)	---	(2.9)
Km.** to usual shopping location		2.3 ++	3.4	2.8	3.6	3.2	3.8 +	3.0
		(1.6)	(3.6)	(2.4)	(3.4)	(2.6)	(2.9)	(2.6)
No. of hours in market work per week		37.0	36.7	43.8 ++	32.8 +	42.6 +	---	38.6
		(7.0)	(7.5)	(7.8)	(11.0)	(9.9)	---	(11.2)
No. of hours in home-centered obligatory activities***		5.1 +	4.8 +	4.5 +	7.0 +	4.4 +	8.8 +	5.9
		(1.5)	(1.5)	(1.5)	(2.2)	(1.4)	(1.8)	(2.3)

* F = female, M = male, S = single, W = married, NC = no children, C = children to care for, E = employed, U = unemployed, R = renter, O = home owner, A = auto available, NA = no auto

** Based on straight-line distances

*** For example, domestic work and care of children

+ Significant at .01 level

++ Significant at .05 level

Source: Calculated with data from the Halifax Time Budget Study (Elliott et al. 1976)

time at work and in travel, the women have a 37 percent greater commitment to home-centred obligations. Group 6 fits the image of the prototype housewife, "lost in the suburbs", incurring the greatest distance to shopping facilities, the least time in travel activity, and the most time in household chores.

Despite the strong homogenizing effect of the classification scheme used to define the role groups, the standard deviations for several of the measures remain quite high. This may point to a considerable latitude in behaviour for individual members of a role group.

4.3 Space-time patterns of urban ecological structure

The environmental context of an individual's behaviour may be represented, in part, by the space-time ecology of his or her local region. The technical ability to use space-time diaries in generating census-like data for urban subareas at various times of the day was demonstrated by Goodchild & Janelle (1984). This was achieved by monitoring the flows of people in and out of subareas and by calculating measures of the socio-demographic composition of the regions for selected times of the day. This approach avoids the night-time bias of the traditional census and allows for extending the standard urban ecological analyses (see Berry 1971) according to the experimental design suggested by Taylor & Parkes (1975).

Using principal-axis factor analysis, Taylor and Parkes suggested a solution for comparing factors across times. This was achieved by treating the different times for each region as separate observational units. Thus, in the example that follows, observations for each of the six times selected to represent the range and general timing of dominant activities (e.g. sleep at 0200 hours, work at 0910 and 1500, and lunch at 1215) were recorded for each of 32 sub-regions within Halifax-Dartmouth, for a total of 192 observational units. Respondents were sorted according to the geocoding of events listed in their diaries for the six study times and, for each region, average or percentage values were calculated for the variables listed in Table 4.2. Although the data are derived from a survey of all diary respondents, they were selected to match as closely as possible the kinds of census variables that have been included in studies of urban factorial ecology, stressing demographic and socio-economic characteristics.

Principal-axis factor analysis was used for identifying and mapping the underlying dimensions of the data base. Four factors, accounting for 95 percent of the explained variance, were labelled as follows: (1) household incomes, (2) education and job status, (3) age and transience, and (4) sex and employment. The factor loadings (Table 4.2) and the map-

Table 4.2 Factorial ecology of social and demographic characteristics for Halifax-Dartmouth

Variable	Mean	S.D.	Communality	Factors and loadings *
				I II III IV
Average age	38.1	4.1	.77	.86
% female	58.5	10.5	.73	-.83
% not married	17.3	12.5	.53	.41
% widowed, divorced or separated	8.4	5.9	.51	.61
% employed	61.6	14.3	.68	.31
% employed as skilled, semi- or unskilled	42.3	17.9	.77	-.85
Average median household income	5.1	1.2	.79	-.73
% home owners	52.2	23.9	.72	-.63
% Paying more than \$200 rent per month	37.9	17.5	.68	-.76
% Living in same residence for more than 2 years	55.8	17.6	.77	.85
% no autos in household	18.1	14.0	.81	.86
Average years of school with one or more years of university	10.5	6	.82	.83
% Protestant	30.6	14.8	.73	.64
	55.5	14.4	.32	-.30
				-.34
				.34
				1.2
				30.1
				16.8
				82.5
				95.0

* Only loadings with absolute values of 0.30 or greater are shown. Based on Principal-axis Factor Analysis (SPSS version 6.2, Mey, 1982) with varimax rotation after Kaiser Normalization. Data (14 variables) were derived from the 1971-72 Halifax Time-Budget Study (see Elliott et al. 1976)

plings of factor scores (Figure 4.1) provide the basis for these labels. In mapping the factor scores, each region is represented by a graph of six bars, one for each of the study times. The length of a bar is related to the number of standard deviation units that a given region is above or below the mean value for all 192 observational units.

The household income factor (I) is derived from high positive and negative loadings on several variables. Since the income variable is defined at the household level, unmarried respondents, who tend to live by themselves, are associated with low household incomes. The ownership of cars and homes is also related to household income, but, in addition, this combination of variables is suggestive of family orientation in life style. In Figure 4.1, higher household incomes and family orientation are represented by bars extending below the horizontal line (negative scores). Thus, the central peninsula of Halifax is associated with below-average household incomes and family orientation. In contrast, the peripheral regions to the East (in Dartmouth) and to the West represent the suburban pull of the family-oriented, higher-income households. This factor does not show great diurnal variation within and among

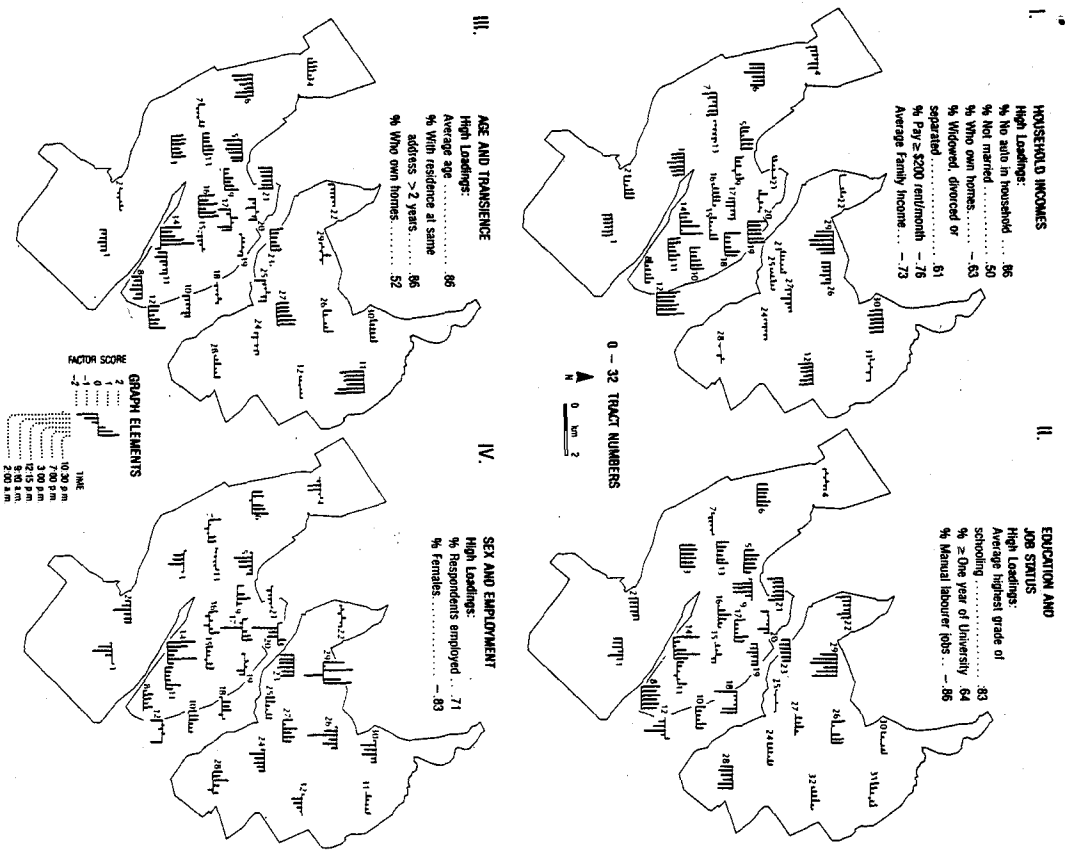


Figure 4.1. Diurnal variations in the space-time patterns of ecological structure for Halifax-Dartmouth, Canada (a principal-axis factor analysis of 14 socio-demographic variables).

tracts. However, tract 18, part of the central business district (CBD) does show a sharp decline in the income/family orientation of its occupants in the very early morning and in the evening hours, and the tracts surrounding it show a similar but less pronounced tendency. Factor II is a status factor based on education level and occupation category. The cyclical nature of the employment level and occupation category leads to a considerable oscillation in scores within tracts, particularly on the central peninsula. Tract 12, for instance, attracts many blue-collar workers to the port's container terminal and to the railway marshalling yards; but, by late evening, it shows above-average occupational and educational status. Tract 18 (the CBD) shows the opposite trend; business and government executives invade the area during the day and vacate it by early evening, raising and then lowering the average status of its occupants. In general, tracts with consistent patterns of bars below the base line represent either work sites for blue-collar employment, the container terminal in 12, oil refineries and a military base in 28, and military facilities in 19 and 22, or dominantly blue-collar residential zones, 21 and 29.

Factor III shows a strong link between residential stability and age of respondents, but does not show any pronounced diurnal variation within tracts. An interesting exception is tract 17, where, by mid-day, most of the short-term and younger residents have travelled to other tracts, leaving behind a more stable and older population.

Although it only accounts for 12.5 percent of the explained variance, Factor IV illustrates some interesting diurnal shifts based on the distribution of women (negative loadings) and employment (positive loadings). The dominant tendency for several peripheral tracts is to have low scores (high on female occupation) during the mid period of the day, in some cases extending two or more standard deviation units from the mean. The exceedingly great diurnal shifts on this dimension reflect the controls of job timing on the daily rhythm of city life.

4.4 Conclusions: the home-work relationship as individual adaptation to daily changes in urban ecology

The interpretation of factors through time and space has shown, in part, how the city's patterns of social geography are bounded by the functional linkages between the home and the workplace. Two factors, I and III, were related to the home, with strong loadings on variables such as ownership status, monthly rents, and length of residence. In contrast, factors II and IV were work-oriented, with high loadings on variables that relate to occupation and employment status. These are not unexpected findings. However, the detection and mapping of shifts in the locational patterns of these factors throughout the day represent significant extensions of traditional urban ecological analysis. These responses to the aggregate of population movements over the course of the day may be inferred to follow the basic temporal cycles set by society, by human biological needs, and by individual preference. There is a danger, however, that these broad temporal patterns of ecological structure may mask those features of urban environments that are most germane to interpreting the space-time paths of specific subpopulations (for instance, those role groups identified in Table 4.1).

The problem of relating individual behaviour to the changing patterns of urban space requires research advances at two levels. First, the approach to describing urban ecological structure must be expanded so that it is possible to determine the levels of explained variance for a given factor at a particular time of day and for a particular part of the city. This would provide a strong theoretical basis for integrating the ecological perspective with the behaviour of individuals. Based on the authors' current investigations, a three-mode factor analytic model, such as that suggested by Harshman, Ladefoged & Goldstein (1977), appears to offer significant promise. A second need is to monitor the flows of specific well-defined subpopulations with respect to the ecological character of their zones of origin and destination for journeys made during the day. As Kutter (1973) observes, the general space-time activity patterns of urban environments result from the concurrence of activity patterns by individuals. Thus, it is important that researchers attempt to mesh the properties of the individual's daily space-time path with changes in the city's ecological structure. It is suggested that the merger of these two levels of analysis would allow for more fundamental empirical assessment of the home-work relationship.

The home-work relationship has associated with it a set of activity opportunities in the vicinities of the home and work locations, and along the travel paths that join them. To the extent that this relationship is defined by a distance, a mode of travel, and a set of accessible activities, it may be regarded as a deliberated choice by urban residents. Lack of satisfaction with this relationship may prompt decisions to change residences and jobs, and to alter one's mode of travel. However, this research has demonstrated that this relationship is not constant over the course of the day. The very adaptation of urban spaces to take on different functions and to serve different clientele at different times of the day suggests that individuals may select work and home locations, and modes and paths of transportation, that allow them to adapt most comfortably to the daily ecological rhythms of the city. Thus, it is suggested that analysis of the home-work relationship might be usefully recast in this more dynamic framework. It is important to determine how diurnal changes in the character of locations relate to the behaviours of subpopulations who are beset with different kinds of coupling, capability and authority constraints. This paper has demonstrated how the extended uses of space-time diary data allow for monitoring the ecological character of urban spatial units throughout the day and for tracing the daily movements of individuals. However, more research, along the lines suggested above, is required in order to arrive at a theoretically sound understanding of the underlying processes.

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5
HIERARCHICAL INTEGRATED MARKETS VERSUS DUAL HOUSING SYSTEMS:
RESIDENTIAL MOBILITY, "SELF-HELP" HOUSING AND INSTITUTIONAL
CONSTRAINTS IN ATHENS

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5.1 Introduction: Reformulating the Problem

The interconnection between residential mobility, "self-help" housing and institutional constraints in the context of "Third World" cities is a familiar matter. Mobility in this case refers to the process of migration to the city, the effort of poor migrants to get a foothold and the move (or lack of such) towards more secure employment and housing and improved living standards. "Self-help" housing offers a common and often essential avenue for successful mobility within such cities. Institutional constraints on building and the acquisition - by legal or other means - of land in the periphery of the city are a major influence in this process by hindering or facilitating such a mobility path. Residential mobility in this context is an integral aspect of a process of improvement in the socio-economic as well as the housing situation of the household. I will deal here solely with this meaning of mobility, that is, mobility-as-improvement rather than the more secondary aspects of mobility such as choice of location or movements in response to the formation of households and the change in their composition. From this viewpoint, the issues raised by "self-help" housing and the related institutional constraints in the context of "Third World" urbanisation have an obvious relevance for the evaluation of housing policies for low-income groups and the pros and cons are well rehearsed in the literature. What about, however, cities and countries that, although they are still in the stage of a developing and urbanising society, do not conform to the model of a "Third World" urban system with its extreme socio-economic polarisation and massive poverty? The same question arises in the case of developing countries in intermediate levels of income where the bulk of the urban working class does not conform to the image of the poor migrant who tries to improve his condition but is unable to gain access to housing within the "normal" system. How is the issue of mobility and constraints posed in this different context which is more relevant for cases similar to Greece? It would seem at first glance that in such cases mobility-as-improvement does not depend on solutions such as "squatter" housing, with which "self-help" housing is commonly associated. In fact, the very terms by which "self-help" housing is usually understood imply that matters should be expected to differ when income growth and a healthy urban economy make more "normal" and less "marginal" housing choices possible for the large majority of lower income groups. The hypothesis that suggests itself in this context is that mobility-as-improvement will for increasing numbers become a process of incorporation into the "normal" housing system. In most cases, of course, this means incorporation into a more or less typical market system. Is such a hypothesis valid? Does low-income mobility in cities that pass to a more developed stage shift towards integration into the normal