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# POPULATION MOVEMENT AND CITY-SUBURB REDISTRIBUTION: AN ANALYTIC FRAMEWORK

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*Abstract*—This paper introduces an analytic framework that can be used to assess the relationships between individual movement differentials and place characteristics, on the one hand, and aggregate mobility levels and city-suburb population change (in size or composition), on the other. Application of this framework using census data for individual metropolitan areas allows the analyst to decompose population changes due to net migration into contributing mobility streams and their component rates which are subject to unique community and individual influences. The paper provides both theoretical and empirical rationale for the framework, illustrates its use with 1970 census data, and discusses its implications for empirical research on city-suburb population redistribution.

## INTRODUCTION

It is often difficult for demographers to explain or project population redistribution patterns in a specific context on the basis of existing literature. The large body of empirical work on geographic mobility that exists ranges in scope from a description of mobility differentials by individual characteristics, e.g., age, to a documentation of net migration rates for geographic areas (U.S. Commission on Population Growth and the American Future, 1972; Shaw, 1975; Ritchey, 1976). For the analyst wading through this literature, it would be useful to have an analytic framework to aid in piecing together the various differentials, streams, and aggregate rates in a manner that provides an explanation of the redistribution process under investigation.

A greater economy of effort might accrue from an orientation to movement research that stresses the integration of analysis levels along the lines proposed by Lee (1966). Such an orientation would be furthered by the development of analytic frameworks that specify relationships among those differentials, streams, and explanatory factors that pertain to redistribution analyses in particular contexts. Each framework could then serve to orient future data collection and empirical research related to specific redistribution problems.

We introduce in this paper an analytic framework which can be used to explain city-suburb redistribution in a metropolitan area, through place determinants and individual differentials that are associated with contributing movement streams. Much of what is presently known about movement which leads to population redistribution in cities and suburbs has been reported in a few empirical studies which are based on the parallel subject reports of the 1960 and 1970 censuses on *Mobility for Metropolitan Areas* (U.S. Bureau of the Census, 1963, 1973) (see Taeuber and Taeuber, 1964; Tarver, 1969; Farley, 1970, 1976; Olsen and Guest, 1977). While this research has contributed significantly to existing knowledge on the topic, it is primarily descriptive in nature. Like most empirical work on migration, it fails to establish linkages between determinants of mobility at different levels of analysis necessary to make inferences about the aggregate redistribution process. The framework presented here, while using the same data sources, will permit analyses of movement and redistribution patterns which go beyond the descriptive approach.

In the remainder of this paper, then, we present the parameters of the analytic framework along with its underlying rationale and illustrate how these parameters can be related to the aggregate redistribution process in analyses of city-suburb population size and compositional change.

## FRAMEWORK PARAMETERS

The analytic framework consists of a number of parameters which are associated with the following migration or mobility streams:

I. intrametropolitan—city-to-suburb or suburb-to-city—mobility streams,

II. in-migration streams to city or suburbs from outside the SMSA, and

III. out-migration streams from cities or suburbs to places outside the SMSA.

These streams represent all avenues whereby the city or suburb population is affected by mobility. Each represents an analytically distinct type with respect to its geographic scope and the class of place attributes which affect its size. A clear differentiation can be made between intrametropolitan mobility streams (I), on the one hand, and in- and out-migration streams (II and III), on the other. The former streams can be characterized as local, residential mobility which take place within the single labor market area of the SMSA. The latter are termed migration streams because moves into and out of the SMSA are generally associated with a change in labor market areas.

Although a distinction is made between three types of mobility/migration streams, the analytic framework presented here is based on more than three parameters. These parameters, with one exception (discussed below), represent rates which are applied to various populations at risk and are presented in Chart 1. Previous research on individual mobility decision making and on aggregate movement patterns suggests that the three streams cannot necessarily be viewed as single-stage events. Rather, each can be analyzed in terms of one or more stages with different causal factors operating at each stage. These considerations underlie the specification of multiple parameters associated with streams I and II.

Chart 1.—City-Suburb Movement Streams and Associated Parameters

I. Intrametropolitan City-to-suburb (or Suburb-to-city) Mobility
   a. Mobility incidence rate of residents: $i_c$ (or $i_s$)
      The rate at which city (or suburb) residents move anywhere within the SMSA during an interval
   b. Destination propensity rate of movers: $p_{c\to s}$ (or $p_{s\to c}$)
      The rate at which city-origin (or suburb-origin) movers relocate in a suburb (or city) destination during an interval

II. In-migration to City (or Suburbs) From Outside the SMSA
   a. Migration into the SMSA: $M_o$
      Number of migrants into the SMSA during an interval
   b. Destination propensity rate of in-migrants: $p_{o\to c}$ (or $p_{o\to s}$)
      The rate at which SMSA In-migrants relocate to a city (or suburb) destination during an interval

III. Out-migration From the City (or Suburbs)
   a. Out-migration incidence rate of residents: $m_{c\to o}$ (or $m_{s\to o}$)
      The rate at which city (or suburb) residents migrate out of the SMSA during an interval

### *Stream I Parameters*

Both theoretical and empirical work on the individual residential mobility process indicates that mobility *from* an origin *to* a destination involves at least two major decisions: the resident's decision to move; and the mover's choice of a destination (Rossi, 1955; Butler, 1969; Brown and Moore, 1970; Speare et al., 1975). This view of the individual mobility process implies an analog for aggregate movement necessary to make inferences about the aggregate redistribution process. The framework presented here, while using the same data sources, will permit analyses of movement and redistribution patterns which go beyond the descriptive approach.

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      The rate at which city-origin (or suburb-origin) movers relocate in a suburb (or city) destination during an interval

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   a. Migration into the SMSA: $M_o$
      Number of migrants into the SMSA during an interval
   b. Destination propensity rate of in-migrants: $p_{o\to c}$ (or $p_{o\to s}$)
      The rate at which SMSA In-migrants relocate to a city (or suburb) destination during an interval

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Accordingly, it is possible to designate stream rates of city-to-suburb mobility or suburb-to-city mobility, that can be defined as the product of two component rates, as follows:

$$\text{city-to-suburb mobility rate} = i_c p_{c\to s}, \quad (1)$$

$$\text{suburb-to-city mobility rate} = i_s p_{s\to c}, \quad (2)$$

where $i_c$, $i_s$, $p_{c\to s}$, and $p_{s\to c}$ are defined in Chart 1. The first component rate of each mobility rate represents the proportion of an area's total population which moves residentially during a given interval. In the present framework, "mobility incidence rates" will be applied to the resident city population and the resident suburb population (parameters $i_c$ and $i_s$, respectively) at the beginning of an interval.

The second component of each mobility rate indicates the proportion of an area's *movers* that relocate in the opposite part of an SMSA during an interval. This rate has been termed a "destination propensity rate" and can be used more generally to refer to the proportion of an at-risk population of movers which relocate in a specified destination. The present framework identifies the suburb propensity rate of city movers as $p_{c\to s}$ and the city propensity rates of suburb movers as $p_{s\to c}$.

The utility of representing each stream mobility rate as the product of a mobility incidence rate and a destination propensity rate rests on the assumption that different sets of origin and/or destination causal factors operate on each component. A supporting illustration is presented in Figure 1 based on 1965–1970 movement in 59 of the nation's 65 largest SMSAs. (Six SMSAs were omitted from the analysis due to large military populations or substantial changes in central city boundaries.)

Panel A shows the component rates of city-to-suburb stream mobility: the mobility incidence of city residents and the suburban propensity of city-origin movers plotted for 59 SMSAs in ascending order according to the stream rate. It is clear from this graph that variation across SMSAs is dissimilar for each component rate, suggesting that each rate responds to different sets of metropolitan-specific influences or differentially to the same influences. (An analogous plot for suburb-to-city stream mobility rates and associated component rates appears in panel B.) Moreover, analyses (not shown) establish that the suburb destination propensity rate for city-origin movers uniquely accounts for 72 percent of intermetropolitan variation in the city-to-suburb mobility rate, and that the city destination propensity rate for suburb-origin movers accounts for 64 percent of intermetropolitan variation in the suburb-to-city mobility rate.

*Stream II Parameters*

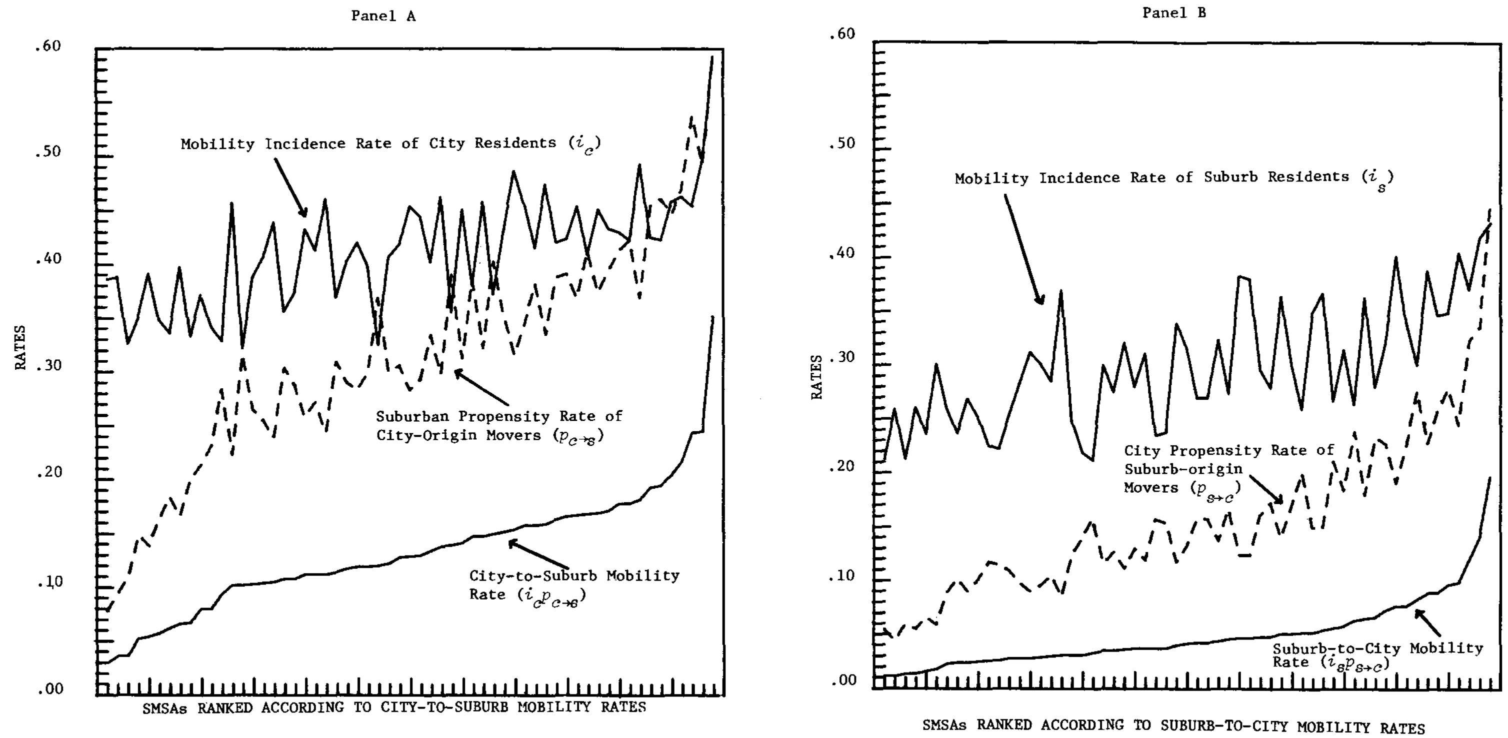
If one turns now to the in-migration streams, two framework parameters are identified for each stream: (a) the number of SMSA in-migrants, and (b) the city (or suburb) destination propensity rate of in-migrants:

$$\text{number of SMSA in-migrants to the city} = M_o p_{o\to c}, \quad (3)$$

and

$$\text{number of SMSA in-migrants to the suburbs} = M_o p_{o\to s}, \quad (4)$$

where $M_o$, $p_{o\to c}$, and $p_{o\to s}$ are defined in Chart 1, and $p_{o\to s} = (1.0 - p_{o\to c})$. This separation of parameters is suggested by findings which indicate that migrants are initially attracted to labor market attributes of the area in which the destination is




Source: U.S. Bureau of the Census, 1973 (see Appendix).

Figure 1.—SMSA-specific Values for Mobility Incidence Rates of Residents and Destination Propensity Rates of Movers, Leading to City-to-suburb Mobility Rates and Suburb-to-city Mobility Rates Based on 1965–1970 Movement, 59 SMSAs

located (Saben, 1964; Lansing and Mueller, 1967). The community of destination within the labor market area (SMSA) then becomes a secondary consideration for in-migrants and will be chosen on the basis of a different set of factors.

For the in-migration streams only, the framework will identify numbers of in-migrants associated with each stream rather than rates of stream participation which can be applied to a resident population. Unlike the other streams which contribute to city-suburb redistribution in an SMSA, the appropriate at-risk resident population for an SMSA in-migration rate would necessitate including the total population that resides outside the boundaries of the metropolitan area.

*Stream III Parameters*

Only one framework parameter is used to specify the out-migration rates from metropolitan cities or suburbs, since, for the purpose of measuring intrametropolitan population change, it is not necessary to identify the destinations of these streams. Therefore,

$$\text{out-migration incidence rate from the city} = m_{c \to o} \quad (5)$$

and

$$\text{out-migration incidence rate from the suburbs} = m_{s \to o} \quad (6)$$

where $m_{c \to o}$ and $m_{s \to o}$ are defined in Chart 1.

To put all the framework parameters into perspective, the redistribution of movers and in-migrants across a metropolitan area's city and suburbs can be seen as an allocation of three "pools" of movers—movers among city residents, those among suburb residents, and in-migrants to the SMSA. The magnitudes of the first two pools are determined by the mobility incidence rates $i_c$ and $i_s$, while the size of the third pool is represented by the $M_o$ parameter. The movers in each pool are then allocated to city and suburb destinations in accordance with destination propensity rates: $p_{c \to s}$ for city-origin movers, $p_{s \to c}$ for suburb-origin movers, and $p_{o \to c}$, $p_{o \to s}$ for SMSA in-migrants. Out-movement from cities and suburbs occurs, first, through out-migration from the SMSA as determined by parameters $m_{c \to o}$ and $m_{s \to o}$ and, second, through the intrametropolitan allocation process described above.

*Framework Parameter Differentials by Individual Characteristics*

It is possible to document individual differentials for other framework parameters in addition to the more conventionally reported mobility incidence differentials. Differentials in destination propensity rates, for example, reflect selectivity among mover subgroups in both preferences and means to relocate in a city versus a suburb destination. To illustrate, framework parameter differentials by categories of race and years of school completed are presented in Table 1. The parameter values shown represent means for the 59 SMSAs.

Differentials associated with the racial categories demonstrate the point that different patterns of selectivity can occur across parameters. Although blacks tend to display higher mobility incidence rates than nonblacks, the suburban propensity of black city movers to relocate in the suburbs is less than a quarter of that for nonblack city movers (.081 to .375). City propensity rates for both black suburban movers and black SMSA in-migrants are strikingly higher than the corresponding rates for nonblacks. These destination propensity differentials indicate a high degree of racial selectivity in the suburbanward relocation of movers.

Different selectivity patterns are also evident by categories of education. There exists a generally positive relationship between years of schooling, on the one hand, and levels of mobility incidence and SMSA in-migration, on the other. However, as with race, destination propensity rates associated with years of schooling

Table 1.—Mean Values for Framework Parameters by Categories of Race and Years of School Completed Based on 1965–1970 Movement, 59 SMSAs

| Race and Years of School Completed | City-to-Suburb Mobility $i_c$ | City-to-Suburb Mobility $p_{c \to s}$ | Suburb-to-City Mobility $i_s$ | Suburb-to-City Mobility $p_{s \to c}$ | In-Migration to SMSA $M_o$ [a] | In-Migration to SMSA $p_{o \to c}$ [b] | Out-Migration $m_{c \to o}$ $m_{s \to o}$ [c] |
|---|---|---|---|---|---|---|---|
| 1970 population aged 5+ | .413 | .315 | .301 | .156 | 1709 | .370 | .140 |
| Black | .445 | .081 | .422 | .471 | 125 | .747 | .092 |
| Nonblack | .410 | .375 | .298 | .146 | 1584 | .340 | .148 |
| 1970 population aged 25+ | .376 | .322 | .274 | .156 | 891 | .355 | .120 |
| Elementary | | | | | | | |
| Less than 8 years | .318 | .210 | .240 | .175 | 59 | .455 | .064 |
| 8 years | .315 | .266 | .228 | .158 | 55 | .385 | .076 |
| High school | | | | | | | |
| 1-3 years | .376 | .286 | .270 | .163 | 122 | .388 | .089 |
| 4 years | .402 | .365 | .286 | .147 | 274 | .328 | .118 |
| College | | | | | | | |
| 1-3 years | .424 | .392 | .304 | .169 | 150 | .338 | .172 |
| 4+ years | .432 | .420 | .310 | .171 | 231 | .352 | .246 |

a - Expressed in hundreds.

b - Refers to proportion of SMSA in-migrants relocating in a city destination; mean value for proportion relocating in a suburb destination equals 1.0 minus the value shown.

c - Because the desired rates of out-migration from city and suburb ($m_{c \to o}$ and $m_{s \to o}$) cannot be obtained from the published census volumes, data refer to the rate of out-migration from the SMSA as a whole.

Source: U.S. Bureau of the Census, 1973 (see Appendix).

exhibit contrasting patterns in selectivity—positive for city movers, negative for in-migrants, and mixed for suburb movers. It is apparent from these data that the stream selectivity in race and socioeconomic status, which has been reported in previous research, may have resulted from selectivity in destination propensity, selectivity in mobility incidence, or both.

## THE RELATIONSHIP BETWEEN FRAMEWORK PARAMETERS AND CITY-SUBURB REDISTRIBUTION

The framework parameters can be seen as basic elements in an analysis of mobility-induced change in city-suburb distribution of population. As has been discussed, each parameter is associated with an analytically distinct mobility/migration stream and is subject to unique community and individual influences. By employing readily obtainable migration tabulations, it is possible to examine the relationships between framework parameter values and the aggregate redistribution of population in cities and suburbs that results from the mobility/migration streams with which they are associated. These relationships, as they pertain to changes in population size and composition for cities and suburbs, are elaborated below along with supporting illustrations.

### *Relating Parameter Values to Changes in the Population Sizes of Cities and Suburbs*

Given the sizes of an SMSA's city and suburb populations at the beginning of a migration interval, one can reconstruct stream movement levels and "net" population changes that are associated with a particular set of framework parameters. The following equations specify these relationships for the migration interval ($t$, $t + n$):

$$\begin{aligned} P_{c}{}^{t+n} = {} & sP_c{}^t - sP_c{}^t m_{c\to o} \\ & - s(P_c{}^t - P_c{}^t m_{c\to o}) i_c p_{c\to s} \\ & + s(P_s{}^t - P_s{}^t m_{s\to o}) i_s p_{s\to c} \\ & + sM_o p_{o\to c}, \end{aligned} \tag{7}$$

$$\begin{aligned} P_{s*}{}^{t+n} = {} & sP_s{}^t - sP_s{}^t m_{s\to o} \\ & - s(P_s{}^t - P_s{}^t m_{s\to o}) i_s p_{s\to c} \\ & + s(P_c{}^t - P_c{}^t m_{c\to o}) i_c p_{c\to s} \\ & + sM_o p_{o\to s}, \end{aligned} \tag{8}$$

where

$P_{c*}{}^{t+n}$ = city population aged $n$ and over at time $t + n$,
$P_{s*}{}^{t+n}$ = suburb population aged $n$ and over at time $t + n$,
$P_c{}^t$ = city population at time $t$,
$P_s{}^t$ = suburb population at time $t$,
$s$ = survival rate specific to each mover, migrant, or nonmover population,
$m_{c\to o}$ = out-migration incidence rate of city residents between $t$ and $t + n$,
$m_{s\to o}$ = out-migration incidence rate of suburb residents between $t$ and $t + n$,
$i_c$ = mobility incidence rate of city residents between $t$ and $t + n$,
$i_s$ = mobility incidence rate of suburb residents between $t$ and $t + n$,
$p_{c\to s}$ = suburb destination propensity rate of city-origin movers between $t$ and $t + n$,
$p_{s\to c}$ = city destination propensity rate of suburb-origin movers between $t$ and $t + n$,
$M_o$ = number of in-migrants to the SMSA between $t$ and $t + n$ who were alive at time $t$,
$p_{o\to c}$ = city destination propensity rate of SMSA in-migrants between $t$ and $t + n$,

and

$p_{o\to s}$ = suburb destination propensity rate of SMSA in-migrants between $t$ and $t + n$.

As they appear above, these equations leave out the fertility component, since the predicted populations at the end of the migration interval, $P_{c*}{}^{t+n}$ and $P_{s*}{}^{t+n}$, do not include individuals who were born during the interval. It is possible to specify the total populations at the end of the interval assuming that one is able to estimate the number of births occurring to various nonmover, mover stream, and migrant stream populations for the interval $(t, t + n)$ along with appropriate survival rates. Hence,

$$P_c^{t+n} = P_{c*}^{t+n} + sB_c, \quad (9)$$

and

$$P_s^{t+n} = P_{s*}^{t+n} + sB_s, \quad (10)$$

where

$P_c^{t+n}$ = city population at time $t + n$,
$P_s^{t+n}$ = suburb population at time $t + n$,
$B_c$ = number of births occurring to city nonmovers, suburb-to-city movers, and SMSA in-migrants to the city between $t$ and $t + n$, and
$B_s$ = number of births occurring to suburb nonmovers, city-to-suburb movers, and SMSA in-migrants to the suburbs between $t$ and $t + n$.

One should also note that equations (7) and (8) assume that the movement streams occur in a specific sequence. Residential movement within the SMSA during an interval is conditional on not migrating out of the SMSA during the interval. This is predicated on the assumption that only one move can be registered for each resident during an interval and that, from the resident's perspective, a residential move is not considered a substitute for a migratory move. Hence, the total city and suburb populations at time $t$ ($P_c^t$ and $P_s^t$) constitute the respective at-risk populations for out-migration parameters $m_{c\to o}$ and $m_{s\to o}$, while the at-risk populations for $i_c$ and $i_s$ are specified as $(P_c^t - P_c^t m_{c\to o})$ and $(P_s^t - P_s^t m_{s\to o})$, respectively. [Some analysts may not wish to make the assumption that residential movement during the interval is conditional on not migrating out of the SMSA. If this is not assumed, equations (7) and (8) can be rewritten, respectively, as

$$P_{c*}^{t+n} = sP_c^t - sP_c^t m_{c\to o} - sP_c^t i_c p_{c\to s} + sP_s^t i_s p_{s\to c} + sM_o p_{o\to c},$$

and

$$P_{s*}^{t+n} = sP_s^t - sP_s^t m_{s\to o} - sP_s^t i_s p_{s\to c} + sP_s^t i_c p_{c\to s} + sM_o p_{o\to s}.]$$

Each term on the right-hand side of equations (7) and (8) represents the $(t, t + n)$ survivors of a resident, mover stream, or migrant stream population. The first term in each equation identifies the resident city (or suburb) population at the beginning of the migration interval. Subtracted from this is the out-migrant stream (in the second term) and the stream of movers to the opposite SMSA part (in the third term). The last two terms in each equation represent the in-mover stream from the opposite part of the SMSA and in-migrant stream from outside the SMSA, respectively. Simple relationships between the framework parameters and aggregate population redistribution can be observed. When actual values are retained for all framework parameters, the city and suburb population totals for the end of the interval $(P_{c*}^{t+n}, P_{s*}^{t+n})$ will be computed, whereas the substitution of zero values for all incidence and in-migration parameters will yield only the first terms ($sP_c^t$ and $sP_s^t$) as the end-of-interval totals.

*Illustration.* In order to demonstrate how movement streams can be related through their framework parameters to changes in the population size of cities and suburbs, the above relationships will be employed using appropriate data for the Cleveland, Ohio, Atlanta, Georgia, and San Jose, California SMSAs. The data are taken from the 1970 census subject report, *Mobility for Metropolitan Areas* (U.S. Bureau of the Census, 1973) and pertain to the 1965–1970 migration interval. (Details regarding use of this data source in the estimation of framework parameters and population values appear in the Appendix.)

This illustration focuses on the contributions to a redistribution of the population of the four intrametropolitan and in-migration streams: city-to-suburb movement, suburb-to-city movement, SMSA in-migration to the city, and SMSA in-migration to the suburbs. The two SMSA out-migration streams were excluded from consideration for two reasons. The first is a practical one in that data from the published census report do not allow calculation of the $m_{c\to o}$ and $m_{s\to o}$, parameters which are necessary to examine these two streams. Second, the latter portion of this illustration evaluates the impact of destination propensity rates on the reallocation into cities and suburbs of movers in the three "mover pools." Only the four above-mentioned streams are involved in this reallocation process. Because of this restricted focus, it is convenient to rewrite demographic accounting equations (7) and (8) as equations (11) and (12), respectively:

$$P_{c*}^{t+n} = s(P_c^t - P_c^t m_{c\to o}) - s(P_c^t - P_c^t m_{c\to o})i_c p_{c\to s} + s(P_s^t - P_s^t m_{s\to o})i_s p_{s\to c} + sM_o p_{o\to c}, \qquad (11)$$

and

$$P_{s*}^{t+n} = s(P_s^t - P_s^t m_{s\to o}) - s(P_s^t - P_s^t m_{s\to o})i_s p_{s\to c} + s(P_c^t - P_c^t m_{c\to o})i_c p_{c\to s} + sM_o p_{o\to s}, \qquad (12)$$

where, in the present application, $t = 1965$ and $n = 5$.

Appropriate framework parameter and population values for Cleveland, Atlanta, and San Jose appear in Table 2. An examination of the parameters reveals two significant differences across SMSAs. First, a contrast can be made between the destination propensity rates for San Jose, on the one hand, and Cleveland and Atlanta, on the other. Destination propensity rates associated with the former SMSA provide for a more balanced city-suburb allocation of "mover pools" than those associated with the latter areas. Specifically, San Jose's $p_{c\to s}$ rate represents the lowest for the three metropolitan areas, while its $p_{s\to c}$ and $p_{o\to c}$ rates are substantially higher than those in either Cleveland or Atlanta. A second disparity among SMSAs occurs with the in-migration parameter ($M_o$) and distinguishes Atlanta and San Jose from Cleveland, since the former metropolitan areas experience substantially higher levels of in-migration relative to their resident populations. These contrasts should be taken into account when reviewing the aggregate redistribution patterns.

The redistribution consequences of the four movement streams can be ascertained from the measures of change presented in the upper portion of Table 3 (Rows A1 through B4). These measures represent the percent of change in the city or suburb population that can be attributed to each movement stream. They are based on $P_{c*}^{1970}$ and $P_{s*}^{1970}$ values computed from equations (11) and (12) which assume the presence or absence of designated movement streams (discussed in footnote a to Table 3). The denominator for each change measure indicates the 1970 city (or suburb) population that would have resulted if none of the four movement streams had occurred. Hence, the change measures for all cities and suburbs in Row A1 are equal to 0.

The measures of change in row B1 indicate that, in all three SMSAs, the city-to-suburb stream contributes substantially to the growth of population in the suburbs and loss of population in the cities. Its effect is smallest in San Jose, reflecting the lower $p_{c\to s}$ in that metropolitan area. In contrast, the redistribution attributed to the suburb-to-city stream (row B2) is less significant, particularly in the Cleveland and Atlanta SMSAs. This is a function of the generally lower $i_s$ and $p_{s\to c}$ rates in each metropolitan area. However, since the latter rate is highest in

Table 2.—Framework Parameter and Population Values Utilized in the Analysis of the Redistribution of SMSA City and Suburb Populations During 1965–1970: Cleveland, Ohio, Atlanta, Georgia, and San Jose, California

| SMSAs | Framework Parameter and Population Values[a] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | $i^*_c$ | $p_{c\to s}$ | $i^*_s$ | $p_{s\to c}$ | $sM_o$ | $p_{o\to c}$ | $p_{o\to s}$ | $s(P_c^{1965} - P_c^{1965} m_{c\to o})$ | $s(P_s^{1965} - P_s^{1965} m_{s\to o})$ |
| Cleveland, Ohio | .451 | .374 | .285 | .105 | 160,408 | .278 | .722 | 664,363 | 950,094 |
| Atlanta, Georgia | .493 | .369 | .383 | .124 | 238,050 | .264 | .736 | 397,166 | 525,057 |
| San Jose, California | .458 | .322 | .347 | .258 | 234,639 | .418 | .582 | 282,722 | 375,873 |

a - The notation here is consistent with that required as input for text equations (11) and (12). The mobility incidence rates are denoted as $i^*_c$ and $i^*_s$, since they include slight adjustments for the survival differential between intrametropolitan movers and nonmovers (see Appendix).

Source: U.S. Bureau of the Census, 1973 (see Appendix).

Table 3.—Percent Change in 1970 City and Suburb Populations Aged 5 and Over in the Cleveland, Ohio, Atlanta, Georgia, and San Jose, California SMSAs That Can Be Attributed to Actual 1965–1970 Mobility and In-migration Streams and to Hypothetical Streams Associated with Value Changes for Parameters $p_{c\to s}$, $p_{s\to c}$, $p_{o\to c}$, and $p_{o\to s}$

| Actual and Hypothetical Movement Streams, 1965–1970 | Cleveland, Ohio Percent Change in Population[a] | | Atlanta, Georgia Percent Change in Population | | San Jose, California Percent Change in Population | |
|---|---|---|---|---|---|---|
| | City | Suburbs | City | Suburbs | City | Suburbs |
| A1. No intrametropolitan mobility or in-migration | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Impact of actual movement streams[b] | | | | | | |
| B1. City-to-suburb mobility only | -16.9 | +11.8 | -18.2 | +13.8 | -14.7 | +11.1 |
| B2. Suburb-to-city mobility only | + 4.3 | - 3.0 | + 6.3 | - 4.7 | +11.7 | - 8.9 |
| B3. In-migration to SMSA only | + 6.7 | +12.2 | +15.8 | +33.4 | +34.7 | +36.4 |
| B4. All mobility and migration | - 5.9 | +21.0 | + 3.9 | +42.5 | +31.9 | +38.6 |
| Impact of hypothetical movement streams assuming changes in destination propensity values[c] | | | | | | |
| C1. City-to-suburb mobility only | -20.3 | +14.2 | -21.8 | +16.5 | -17.7 | +13.3 |
| C2. Suburb-to-city mobility only | + 3.4 | - 2.4 | + 5.0 | - 3.8 | + 9.5 | - 7.2 |
| C3. In-migration to SMSA only | + 5.4 | +13.1 | +12.7 | +35.8 | +27.7 | +41.6 |
| C4. All mobility and migration | -11.5 | +24.9 | - 4.1 | +48.5 | +19.5 | +47.7 |

a - Percent change in city population is computed as

$$\frac{\left[P^{1970}_{c*}\begin{pmatrix}\text{Based on assumption}\\ \text{indicated in row}\end{pmatrix} - P^{1970}_{c*}\begin{pmatrix}\text{Based on assumption of no}\\ \text{mobility or in-migration}\end{pmatrix}\right] \times 100}{P^{1970}_{c*}\begin{pmatrix}\text{Based on assumption of no}\\ \text{mobility or in-migration}\end{pmatrix}};$$

Percent change in suburb population is computed as

$$\frac{\left[P^{1970}_{s*}\begin{pmatrix}\text{Based on assumption}\\ \text{indicated in row}\end{pmatrix} - P^{1970}_{s*}\begin{pmatrix}\text{Based on assumption of no}\\ \text{mobility of in-migration}\end{pmatrix}\right] \times 100,}{P^{1970}_{s*}\begin{pmatrix}\text{Based on assumption of no}\\ \text{mobility or in-migration}\end{pmatrix}}$$

where $P^{1970}_{c*}$ and $P^{1970}_{s*}$ are 1970 city and suburb populations aged 5 and over as computed from equations (11) and (12) and based on actual or assumed values for parameters $i_c$, $P_{c\to s}$, $i_s$, $P_{s\to c}$, $M_o$, $P_{o\to c}$, and $P_{o\to s}$. When no intrametropolitan mobility or migration takes place, each parameter value above is assumed to equal 0.

b - B1 assumes that $i_c$ and $p_{c\to s}$ = actual values and that $i_s$, $p_{s\to c}$, $M_o$, $P_{o\to c}$ and $p_{o\to s}$ = 0. B2 assumes that $i_s$ and $p_{s\to c}$ = actual values and that $i_c$, $p_{c\to s}$, $M_o$, $p_{o\to c}$, and $p_{o\to s}$ = 0. B3 assumes that $M_o$, $p_{o\to c}$, and $p_{o\to s}$ = actual values and that $i_c$, $p_{c\to s}$, $i_s$ and $p_{s\to c}$ = 0. B4 assumes actual values for all mobility and migration parameters.

c - C1 through C4 assume the same mobility incidence and in-migration values as B1 through B4 but differ in destination propensity values associated with the various streams, in each case reflecting an increased propensity out of the city, or decreased propensity into the city. Hence: C1 assumes the same parameter values as B1, except that $p_{c\to s}$ = 1.20 x actual value. C2 assumes the same parameter values as B2, except that $p_{s\to c}$ = .80 x actual value. C3 assumes the same parameter values as B3, except that $p_{o\to c}$ = .80 x actual value. C4 assumes actual parameter values for $i_c$, $i_s$, $M_o$, $m_{c\to o}$, and $m_{s\to o}$ and hypothetical propensity values in C1, C2, and C3.

Source: Table 2.

San Jose, the suburb-to-city stream has a greater impact on redistribution there—almost countering the effect of the city-to-suburb stream.

The redistribution effects of in-migration streams (row B3) are functions of the $M_o$ as well as $p_{o\to c}$, $p_{o\to s}$ parameters. Because Atlanta and San Jose experience high levels of in-migration ($M_o$), the impact of in-migration streams on both city and suburb change is greater for these SMSAs than for Cleveland. Yet the allocation of in-migrants to cities and suburbs ($p_{o\to c}$, $p_{o\to s}$) differs across SMSAs as well. Unlike Atlanta or Cleveland, a substantial portion of San Jose in-migrants locate in a city destination, thus resulting in almost equal percentage increases for the city and the suburb populations in that SMSA.

The measures in row B4 represent the cumulative impact of all four movement streams on city and suburb population change. The net negative change observed for Cleveland's city population can be attributed to the large city-to-suburb movement stream which is countered by relatively little in-movement from the suburbs and in-migration from outside the SMSA. The net suburban gain can be accounted for by both city-to-suburb and in-migration streams. The pattern for Atlanta is similar except that larger in-migration streams contribute to a small population gain for the city and add substantially to increases in the suburban population which would result from the intrametropolitan exchange alone.

The pattern changes somewhat for San Jose. Here, neither intrametropolitan stream dominates the other, and large net gains for the city and suburb populations result, for the most part, from in-migration. In terms of framework parameters, the unique San Jose pattern can be attributed to more balanced destination propensity rates among mover groups, coupled with a high level of SMSA in-migration.

The above exercise illustrates how population redistribution between cities and suburbs can be evaluated as a product of parameter values associated with the analytic framework. Equations (11) and (12) can also be employed to assess city and suburb population changes that would result from hypothetical or expected changes in one or more of the parameter values. These values could be selected arbitrarily, drawn from the experience of another SMSA, or derived from cross-sectional multivariate (regression) analyses which estimate framework parameters as functions of metropolitan-specific determinants. In order to illustrate this use of the framework, a reanalysis of redistribution of city and suburb populations in three metropolitan areas will be performed.

In this reanalysis, all framework parameters with the exception of the destination propensity rates will retain their actual values as shown in Table 2. The latter, it is assumed, will be arbitrarily changed to reflect the increased propensity for movers from all origins (city, suburbs, and outside the SMSA) to select a suburban destination. In each metropolitan area, the suburb propensity rate of city-origin movers ($p_{c\to s}$) will be increased by 20 percent, while the city propensity rates of suburban-origin movers ($p_{s\to c}$) and in-migrants ($p_{o\to c}$) will be decreased by 20 percent. Although the magnitudes of these assumed changes are purposefully exaggerated, their directions are consistent with what might be expected if, for example, substantial increases in the construction of suburban dwelling units had taken place.

Under these hypothetical conditions, rows C1 through C4 represent parallel comparisons to rows B1 through B4. A comparison of the simulated net effects (row C4) with those associated with the actual streams (row B4) reveals a substantially greater redistribution of movers and migrants into the suburbs. The most striking change occurs for San Jose, where the city population undergoes a hypothetical increase of only 19.5 percent as opposed to 31.9 percent under actual conditions.

The preceding exercises indicate how

the framework can be employed to measure the redistribution consequences associated (a) with actual parameter values of an SMSA, and (b) changes in those values that may be determined by the analyst. They also point up the significance of the destination propensity rate as a distinct parameter in the redistribution process. In the analysis of actual parameter values (rows B1 through B4), the unique destination propensity rates in San Jose effected a substantially different redistribution of city and suburb populations in that SMSA than occurred in Atlanta, which maintained similar values on other framework parameters. In the second exercise, hypothetical changes in destination propensity rates resulted in extremely different city-suburb population redistribution patterns than those which had occurred in the first exercise.

*Relating Parameter Values to Changes in the Population Compositions of Cities and Suburbs*

Just as migration and mobility streams contribute to changes in the population size of cities and suburbs, they contribute as well to change in the population composition of each area. This compositional change can be attributed to the distinct movement patterns of various racial, ethnic, and socioeconomic subgroups in the metropolitan area which, in the aggregate, reflect the total redistribution process. Given appropriate data, the analytic framework can be applied separately to population subgroups disaggregated with respect to such characteristics. In this manner, one can determine stream contributions to changes in city-suburb population compositions which accompany aggregate changes in city-suburb population sizes.

*Illustration.* The procedure for this disaggregated redistribution analysis is identical to that used in the analysis of the total population (Tables 2 and 3), except that, in this case, the procedure is applied separately to each population subgroup. To illustrate, a disaggregated analysis is undertaken with data from the Cleveland, Ohio SMSA decomposed into six "years of school completed" subgroups. The subgroup-specific parameter and population values for this analysis are displayed in the upper portion of Table 4. As a basis of comparison, analogous values for the aggregated population (age 25 and over) are also presented in the table.

An examination of these values reveals two fairly consistent patterns among the mobility incidence and in-migration components ($i_c$, $i_s$, $M_o$), on the one hand, and the destination propensity components ($p_{c\to s}$, $p_{s\to c}$, $p_{o\to c}$, $p_{o\to s}$), on the other. The former parameters—those which determine the sizes of SMSA "mover pools"—display a generally positive relationship with years of school completed, indicating a greater level of mobility and migration among individuals in the more highly educated subgroups. Among the destination propensity rates, an even more consistent positive association is indicated between years of schooling completed and a suburban destination, among movers from all three origins.

These parameter differentials imply that a substantial degree of subgroup selectivity should take place among streams. Subgroup selectivity in city-to-suburb movement results from subgroup differentials in the mobility incidence parameter ($i_c$), which are further compounded by subgroup differentials in the suburb propensity parameter ($p_{c\to s}$). Because the stream mobility rate is a product of the mobility incidence and destination propensity rates, the proportion of city college graduates moving to the suburbs equals .545 multiplied by .696, or .379. In contrast, the proportion for city residents with less than eight years of schooling moving to the suburbs equals .330 multiplied by .268, or .088. Similar reinforcing differentials lead to positive educational selectivity for SMSA in-migration to the suburbs.

Changes in the educational backgrounds of the populations of cities and suburbs resulting from all four streams can be ascertained from subgroup-specific

Table 4.—Percent Change in 1970 City and Suburb Populations Aged 25 and Over That Can Be Attributed to Actual 1965–1970 Mobility and In-migration Streams and to Hypothetical Mobility and In-migration Streams, by Categories of Years of School Completed: SMSA of Cleveland, Ohio

| Years of School Completed | Framework Parameters and Population Values | | | | | | | | | Percent Change in Population[a] | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $i_{c*}$ | $p_{c\to s}$ | $i_{s*}$ | $p_{s\to c}$ | $sM_o$ | $p_{o\to c}$ | $p_{o\to s}$ | $s(P_c^{1965} - P_c^{1965} m_{c\to o})$ | $s(P_s^{1965} - P_s^{1965} m_{s\to o})$ | City | Suburbs |
| *Assuming Actual Framework Parameter Values* | | | | | | | | | | | |
| Total population aged 25 and over | .414 | .412 | .272 | .104 | 83,873 | .251 | .749 | 410,607 | 579,710 | - 7.9 | +20.1 |
| Elementary | | | | | | | | | | | |
| Less than 8 years | .330 | .268 | .228 | .202 | 5,437 | .576 | .424 | 78,454 | 46,014 | - 2.2 | +15.5 |
| 8 years | .343 | .330 | .208 | .135 | 4,651 | .407 | .593 | 55,997 | 53,510 | - 5.2 | +14.2 |
| High school | | | | | | | | | | | |
| 1-3 years | .419 | .337 | .245 | .148 | 11,359 | .424 | .576 | 112,543 | 114,813 | - 6.1 | +15.9 |
| 4 years | .460 | .487 | .274 | .090 | 26,097 | .243 | .757 | 120,320 | 224,206 | -12.5 | +18.4 |
| College | | | | | | | | | | | |
| 1-3 years | .490 | .566 | .313 | .080 | 11,663 | .152 | .848 | 24,725 | 66,846 | -13.8 | +22.6 |
| 4+ years | .545 | .696 | .345 | .055 | 24,666 | .127 | .873 | 18,568 | 74,321 | -13.4 | +36.5 |
| *Assuming Equal Destination Propensity Values Across Categories*[b] | | | | | | | | | | | |
| Total population aged 25 and over | .414 | .412 | .272 | .104 | 83,873 | .251 | .749 | 410,607 | 579,710 | - 7.9 | +20.1 |
| Elementary | | | | | | | | | | | |
| Less than 8 years | .330 | .412 | .228 | .104 | 5,437 | .251 | .749 | 78,454 | 46,014 | -10.5 | +29.7 |
| 8 years | .343 | .412 | .208 | .104 | 4,651 | .251 | .749 | 55,997 | 53,510 | -10.0 | +19.1 |
| High school | | | | | | | | | | | |
| 1-3 years | .419 | .412 | .245 | .104 | 11,359 | .251 | .749 | 112,543 | 114,813 | -12.1 | +21.8 |
| 4 years | .460 | .412 | .274 | .104 | 26,097 | .251 | .749 | 120,320 | 224,206 | - 8.2 | +16.0 |
| College | | | | | | | | | | | |
| 1-3 years | .490 | .412 | .313 | .104 | 11,663 | .251 | .749 | 24,725 | 66,846 | + 0.5 | +17.3 |
| 4+ years | .545 | .412 | .345 | .104 | 24,666 | .251 | .749 | 18,568 | 74,321 | +25.3 | +26.9 |

a - The percent of change in city and suburb populations for specific categories are computed as described in Table 3.

b - Assumes that category-specific values for $p_{c\to s}$, $p_{s\to c}$, $p_{o\to c}$, and $p_{o\to s}$ are equal to the values of the total population aged 25+ for these parameters.

Source: U.S. Bureau of the Census, 1973 (see Appendix).

measures of change entered in the final two columns of Table 4. These subgroup measures are computed in the same manner as are those for the total population (Table 3) and are based on equations (11) and (12) utilizing subgroup-specific population parameters and values. The overall pattern of compositional change—increasing loss for the more highly educated subgroups in the city and increasing gains for their counterparts in the suburbs—is hardly surprising in light of the high degree of stream selectivity outlined above.

The parameter values in the upper portion of Table 4 suggest that differentials in destination propensity rates contribute in large measure to stream selectivity and change in the population composition of cities and suburbs. These differentials are associated with movers in each of the three "pools" and may be linked with education-specific preferences and/or the ability to pay for a suburban location. If one uses equations (11) and (12) and appropriate parameter values, it is possible to determine the aggregate impact of these differentials on the educational compositions of city and suburb populations. This is accomplished by creating a hypothetical redistribution in which *uniform* levels of destination propensity are assumed across subgroups. The difference between the change in the educational composition resulting from this hypothetical redistribution and the actual change in the educational composition of a city or suburb population can then be attributed to subgroup differentials in destination propensity.

The framework parameter and population values used to generate the hypothetical redistribution are presented in the lower portion of Table 4. These values are identical to those in the upper portion of the table for all parameters except the destination propensity parameters $p_{c\rightarrow s}$, $p_{s\rightarrow c}$, $p_{o\rightarrow c}$, and $p_{o\rightarrow s}$. Among the latter, each subgroup takes on the value of the total (aggregated) population. As in the analysis of actual change in population composition of cities and suburbs, subgroup-specific measures of population change have been computed and appear in the lower portion of Table 4.

The hypothetical measures of change reveal a more moderate pattern of educational selectivity. The most striking difference between the two redistribution processes occurs among city college graduates. In the absence of destination propensity differentials, this subgroup experiences a population increase of 25.3 percent as opposed to the 13.4 percent loss observed under actual conditions. Among suburban subgroups, there no longer exists a positive association between population increase and the educational status of the subgroup. In sum, these data indicate that the actual pattern of selective city loss and suburb gain among educational subgroups in Cleveland can, in large part, be accounted for by differentials in destination propensity rates.

Disaggregated redistribution analyses such as those just illustrated can be performed on the basis of age, race, or any other individual-level characteristic. As the latter exercise demonstrates, these analyses can be particularly useful for examining compositional changes that might be associated with a widening or narrowing of subgroup movement differentials.

## IMPLICATIONS

Although the changing sizes and compositions of central city populations within metropolitan areas has increasingly become a focus among urban specialists, existing demographic studies have fallen short of providing a basis from which the sources for these changes can be identified. The present framework can be used to confront the most problematic demographic component of these changes—net migration—by examining separately the determinants of each contributing stream. Because the framework parameters associated with each stream are subject to unique sets of influences, they can be employed to establish relationships between individual mobility differentials and place characteristics, on the one hand, and aggregate movement levels and city-suburb population change, on the other. [Application of this framework to substantive issues appears in Frey (1977, 1978).]

One purpose in advancing this framework is to provide an orientation to further empirical research on city-suburb population redistribution. The considerations which have been discussed suggest that the following areas be given priority in this work.

1. *Community Determinants of Intrametropolitan Streams.* Although a host of demographic studies have been devoted to metropolitan determinants of in-migration and out-migration to the SMSA per se, there has been little systematic research of community attributes which affect intrametropolitan streams leading to city-suburb redistribution. The framework parameters related to these streams represent analytically distinct stages of the mobility process which can be used as "dependent variables" in future evaluations of community-level mobility determinants.

2. *Relationships Between Subgroup Differentials and Stream Selectivity.* It has been clearly demonstrated that stream selectivity and city-suburb compositional change can result from subgroup differentials in *all* framework parameters and not only those in conventionally reported mobility incidence rates. There is a need for more empirical research directed to identifying subgroup differentials for each framework parameter relevant to city-suburb compositional change and to evaluating the consistency of these differentials across metropolitan areas.

3. *Research on Destination Propensity Rates.* The illustrations presented here have underscored the importance of the destination propensity rates of intrametropolitan movers and in-migrants as distinct parameters in the analysis of city-suburb redistribution. An empirical examination of these rates indicates that they respond to community and individual influences independently of other framework parameters. Unfortunately, far less work has been amassed on the local destination locations of movers than on the incidence of movement or the levels of in-migration to an area. Greater effort should be devoted to documenting determinants, differentials, and geographic variations in mover destination propensity rates as a separate area of inquiry in migration research.

## APPENDIX: USE OF 1970 CENSUS DATA IN TEXT ILLUSTRATIONS

### *Source of Data*

The data employed to illustrate various aspects of the analytic framework in the text are taken from the 1970 census subject report, *Mobility for Metropolitan Areas* (U.S. Bureau of the Census, 1973). This source cross-tabulates the 1965 city, suburb, and nonmetropolitan residence status of 1970 SMSA residents aged five and over in each of the 65 SMSAs. Further detail is provided according to age, race, and measures of socioeconomic status. With this source, it is possible to partition residents of individual SMSAs into appropriate categories for estimating values for seven of the nine framework parameters. These categories are given below.

1965–1970 nonmobile city population
1965–1970 within-city movers
1965–1970 suburb-to-city movers
1965–1970 SMSA in-migrants to city
1965–1970 nonmobile suburb population
1965–1970 within-suburb movers
1965–1970 city-to-suburb movers
1965–1970 SMSA in-migrants to suburbs

The two out-migration parameters, $m_{c\to o}$ and $m_{s\to o}$, cannot be estimated from this source, since 1965 city or suburb residence location for 1965–1970 SMSA out-migrants has not been published.

It should be emphasized that only one move can be registered for each individual over the course of the interval. Hence, the "move" registered for a multiple mover

over the interval is defined according to the origin of the first move (reported 1965 residence) and the destination of the last move. No "move" is registered for a resident who may have moved during the interval but reported living in the same dwelling unit in 1965 and 1970.

Also, each individual's 1965 place of residence is based on recall, and a significant number of residents misreport or do not report their previous residence. In the *Mobility for Metropolitan Areas* subject report, the latter individuals are included in a category denoted as "residence abroad or not reported." These individuals did not enter into the calculation of parameters for the present analysis.

*Computation of Framework Parameter and Population Values*

The framework parameters were computed for the 1965–1970 period from the above-mentioned census categories as follows:

$$i_c = \frac{\text{within-city movers} + \text{city-to-suburb movers}}{\text{nonmobile city population} + \text{within-city movers} + \text{city-to-suburb movers}},$$

$$p_{c\to s} = \frac{\text{city-to-suburb movers}}{\text{within-city movers} + \text{city-to-suburb movers}},$$

$$i_s = \frac{\text{within-suburb movers} + \text{suburb-to-city movers}}{\text{nonmobile suburb population} + \text{within-suburb movers} + \text{suburb-to-city movers}},$$

$$p_{s\to c} = \frac{\text{suburb-to-city movers}}{\text{within-suburb movers} + \text{suburb-to-city movers}},$$

$$M_o = \text{SMSA in-migrants to city} + \text{SMSA in-migrants to suburbs},$$

$$p_{o\to c} = \frac{\text{SMSA in-migrants to city}}{\text{SMSA in-migrants to city} + \text{SMSA in-migrants to suburbs}}$$

and

$$p_{o\to s} = \frac{\text{SMSA in-migrants to suburbs}}{\text{SMSA in-migrants to city} + \text{SMSA in-migrants to suburbs}}$$

It should be recognized that, by computing these parameters among survivors at the end of the migration interval, their values (in comparison to those computed at the beginning of the interval or at the time of the move) incorporate the differential mortality experiences of nonmovers, movers, and migrants over the interval. Due to the relative youthfulness of movers and migrants, the end of interval $i_c$ and $i_s$ parameters slightly overstates, and the end of interval $M_o$ slightly understates, those values which would be measured earlier in the interval. The analyses using equations (11) and (12), in Tables 2, 3, and 4, require that parameters be measured at the time of the move. Hence, the incidence parameters in Tables 2 and 4 are denoted as $i_c^*$ and $i_s^*$ [where $i_c^* = fi_c$ and $i_s^* = gi_s$, such that $f$ and $g$ represent survival rate adjustment factors, and $i_c$ and $i_s$ represent the incidence parameters in equations (11) and (12)]. In like manner, SMSA in-migration is denoted as $sM_o$ in Tables 2 and 4 to be consistent with equations (11) and (12). Since there is no a priori reason to believe that those locating in a city experience significantly different mortality levels than those locating in a suburb, the destination propensity parameters ($p_{c\to s}$, $p_{s\to c}$, $p_{o\to c}$, and $p_{o\to s}$) are assumed to be constant across the interval.

Finally, the following two terms are necessary to perform calculations with equations (11) and (12): $s(P_c{}^t - P_c{}^t m_{c\to o})$ = 1965–1970 nonmobile city population +1965–1970 within-city movers + 1965–1970 city-to-suburb movers, and $s(P_s{}^t - P_s{}^t m_{s\to o})$ = 1965–1970 nonmobile suburb population + 1965–1970 within-suburb movers + 1965–1970 suburb-to-city movers.

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