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DURATION OF RESIDENCE AND PROSPECTIVE MIGRATION: FURTHER EVIDENCE

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Abstract—A basic assumption of the Cornell Mobility Model insofar as it is relevant to inter-community migration is that an individual's propensity to move is a function of, among other things, his length of residence in the community. Parameters of the functional relationship of migration probabilities to duration status are estimated from migration histories for a sample of residents in Monterrey, Mexico, and compared with estimates reported by P. A. Morrison using data from Amsterdam, The Netherlands. In both data sets a negative nonlinear relation of the probability of migrating to duration status, as well as an interaction between age and duration status, is found. Values of parameters describing the relation within age groups differ sufficiently between the two data sets, however, to suggest that further specification of conditions under which a particular form of functional relation will obtain is necessary if the model is to be useful in migration research.

The relationship between duration of residence and migration risk has recently received considerable attention in migration theory and research. On the one hand, studies by Goldstein (1958, 1964) and Taeuber, Haenszel, and Sirken (1961), among others, have indicated that migration tends to characterize a limited segment of a population who make frequent and repeated moves rather than the entire population. On the other hand, this relationship has been formalized and entered as an axiom into a probability model described in several papers by McGinnis and his associates at Cornell (McGinnis, 1968; Myers, McGinnis, and Masnick, 1967; McGinnis and Pilger, 1963). The Cornell model considers migration as a stochastic process governed by probabilities that are non-stationary. Individuals are assumed to be subjected to specified risks of migrating (transition probabilities) during given intervals of time. However, the unique feature of the Cornell model is that it provides a rule for the change of transition probabilities across time. Specifically, *the axiom of cumulative inertia* states that the probability of an individual continuing in a state (residential area) increases with increasing length of previous residence. In short, a basic assumption of the model is that an individual's propensity to move is a function of, among other things, his length of residence in the community.

This axiom has immediate implications for migration research. At a minimum, it demands that we begin to estimate the parameters of the functional relationship of duration status to migration probabilities for a broad variety of populations. Furthermore, if the Cornell model is to successfully mirror the migration experience of specific populations, then the axiom of cumulative inertia must have considerable predictive validity. This paper reports research conducted to extend previous findings on the functional form and predictive validity of the axiom.

Two efforts have been made to empirically specify such an axiom. The first is a preliminary assessment of the Cornell model conducted by Myers, McGinnis, and Masnick (1967). The data employed by the authors were the attendance records for about 1,700 high school students in Seattle, Washington. Mobility histories were inferred from the data by defining a move as a change in high school attendance area. It was found that, as duration of residence increased from one year to over nine years, the proportion of movers declined from .179 to .019 on the average for the years 1955, 1956, and 1957 (computed from Table 1).

A second and more comprehensive test of the basic assumption of the Cornell model is reported by Morrison (1967) using data from Amsterdam, The Netherlands. He began by specifying two primary variables of interest: (1) "duration status" or the cumulated length of time at any particular moment that a person has lived somewhere; and (2) the individual's prospective risk of leaving his community of residence or, in probabilistic terms, the proportion in a population who out-migrate during a specified interval of time. Furthermore, because of age differentials in probability of migration and the possibility of age interacting with duration of residence, Morrison (1967, p. 555) reduced the axiom of cumulative inertia to the following research hypothesis:

For a given interval of time and within specific age groups, the probability of an individual migrating diminishes as his duration status increases.

Demographic and Ecological Comparisons, Data, and Research Design

A major goal of the present paper is to replicate Morrison's research design as closely as possible and to compare the two sets of findings regarding the relationship of duration of residence to prospective migration. However, Morrison's sample was from Amsterdam, a metropolitan center of The Netherlands, while that of the present study is from Monterrey, a metropolitan center of Mexico. (The Monterrey Mobility Study, from which the data analyzed here are drawn, has been described in detail by Balan, Balan, and Browning, n.d. All subsequent references to the characteristics of this sample will be taken from information reported by them.) Any attempt to make meaningful cross-national comparisons of migratory phenomena such as that proposed here must consider the implications of varying demographic and ecological characteristics of the national contexts in which they take place. Comparisons can be meaningfully made on two levels: (1) in terms of the national contexts of the two studies, and (2) in terms of the specific metropolitan communities from which the samples were drawn.

Although it is not possible to delineate here all of the dimensions along which the populations of The Netherlands and Mexico differ, it is relevant to note the striking differences in population density of the two countries. First, in terms of the number of persons per square kilometer, the population of The Netherlands is approximately 19 times as dense as the population of Mexico (United Nations, 1963, Table 1). Second, the mean distance from each of the sample cities to the three other largest cities in their respective countries is approximately 16 times larger for Monterrey than Amsterdam. (Distances were approximated from maps of each country.) The obvious implication of these facts is that migratory moves in Mexico, at least among the major points of population concentration, are likely to involve much larger distances than moves in The Netherlands. Finally, although The

TABLE 1.—Population and Age Composition of Amsterdam (Central City), The Netherlands, and Monterrey (Metropolitan Area), Mexico, *circa* 1950 and 1965

Item	Amsterdam 1947	Amsterdam c. 1965	Monterrey 1950	Monterrey c. 1965
Total population, number	803,847	864,940	367,663	950,000
Percentage distribution by age:				
All ages	100.0	100.0	100.0	100.0
Under age 15	23.6	24.0	37.4	41.0
Ages 15 to 64	69.4	64.8	59.3	55.8
Ages 65 and over	7.0	11.2	3.2	3.2

Sources: Amsterdam, 1947, from 1947 Census of Population, The Netherlands, and c. 1965, estimated population from Demographic Yearbook: 1966 and age distribution from 1960 Census of Population. Monterrey, 1950, from 1950 Census of Population, Mexico, and c. 1965, mid-year population as estimated by Professor Madrigal of the Centro de Investigaciones Economicas de la Universidad de Nuevo Leon and age distribution from 1960 Census.

Netherlands was considerably more urbanized at both points in time, the population of Mexico was urbanizing at an appreciably more rapid pace in the decade from 1950 to 1960. (Specifically, the percent of the population of The Netherlands living in cities of 2,000 or more people was 72.6 and 75.7, *circa* 1947 and 1960, respectively, while the corresponding percentages for Mexico are 45.5 and 50.7. See Gibbs, 1961, Table 1.) Hence, the population of Mexico has recently experienced relatively more rural-urban movement than the population of The Netherlands.

Morrison's Dutch sample was drawn in mid-1965 from two purposively-selected urban municipalities: (1) the central city of Amsterdam, a large city of about 865,000 inhabitants (see Table 1) and (2) Zeist, a small residential suburb of Amsterdam, with a population of about 50,000 (Morrison, 1967, p. 556). The sample consisted of 5,000 members drawn from a population defined as native males who are heads of households. Since the dominant portion of this sample is from Amsterdam, it will hereafter be referred to as the Amsterdam sample and cross-national comparisons will be made on the basis of the city of Amsterdam.

In comparison, the additional data for the present study consist of a stratified random sample of 1,640 cases from the Metropolitan Area of Monterrey, Mexico, which contains the municipalities of Monterrey, Santa Catarina, Garza, San Nichols, and Guadalupe with a total population at the time the sample was drawn of approximately 950,000 (see Table 1). It will hereafter be referred to as the Monterrey sample. The universe of the Monterrey sample consisted of the resident male population July-September, 1965, ages 21–60.

Unfortunately, a number of desired comparisons of the populations of Amsterdam and Monterrey were not available for this paper. (For example, we would have liked to have made a detailed comparison of the occupational structures of Amsterdam and Monterrey.) However, the age distributions depicted in Table 1 show that the population of Monterrey is markedly younger than the population of Amsterdam for both years of comparison. Furthermore, the pattern of change for Amsterdam between 1947 and 1960 was to an older age distribution, whereas the population of Monterrey moved to a younger distribution. Finally, the most dramatic differential change over the decade is the increase in total population. It is unfair to contrast the growth of the central city of Amsterdam between 1947 and 1965 with the metropolitan growth of Monterrey between 1950 and 1965, but there is no question that the latter's rate of growth far exceeds that of the former.

The computation of non-stationary transition probabilities requires longitudinal data, preferably in the form of residential histories. Briefly, the data must provide the probability of moving for any particular duration status. For this purpose, Morrison (1967, p. 556) utilized data in the form of residential histories drawn from the population registration system of The Netherlands. The Dutch registration system consists of 1,009 local municipalities, each of which maintains a register of its current residents in the form of individual cards recording a number of facts about a resident, from which his entire residential history may be reconstructed.

On the other hand, the residential histories of the members of the Monterrey sample were recorded as a part of a complex interview schedule concerning the life history of each respondent. All communities in which the respondent had lived for six months or longer were recorded, beginning with his birth and continuing until the time of the interview. Also, information concerning the the states in which those communities were located as well as the length of time lived in each community was recorded.

A move in Morrison's study was defined as crossing the boundary of an economic-geographic region (Morrison, 1967, p. 556). There are 129 of these units in The Netherlands, each containing from one to twenty municipalities grouped on the basis of economic function and geographic contiguity.

In comparison, two definitions of a move are used in the present study in order to examine the effect of the size of this basic unit on the resulting migration probabilities. First, a move is defined as a change in *municipio* of residence, excluding those that make up the Metropolitan Area of Monterrey. The *municipio* is roughly comparable to the county in the United States. Second, a move is defined as crossing the boundary of a *zona,* 77 of which were delineated for Mexico. (The Comision Nacional de los Salarios Minimos under the direction of Gilberto Loyo originally established 111 *zonas* in Mexico. These were ranked on the basis of socio-economic criteria by Stern (1967), and reduced from 111 to 77 for use with the Monterrey Mobility Study data. See Browning and Feindt, n.d.) The criteria for the establishment of these *zonas*—economic function and geographic contiguity—are similar to those utilized for the Dutch regions. However, because of the greater overall size of Mexico, the *municipios* are probably more comparable to the Dutch zones in terms of area than are the Mexican zones.

In summary, with regard to the definitions of the populations sampled, forms of protocols collected, and definitions of moves utilized, the Monterrey data provide an opportunity for replication not often found in social science investigations. On the other hand, the very important demographic and ecological differences between The Netherlands and Mexico make the duplication of the research a meaningful step in the specification of the relationship of duration of residence to prospective migration.

To establish the proportion of moves for each duration status it is necessary to begin counting moves made and the associated duration status at some point in each person's migration history. Morrison (1967, p. 557) began counting moves for his Amsterdam sample in the year 1950 and calculating duration status from the year 1940. In order to provide comparability, the same initial dates are utilized in the present study. Also, the terminal date for the migration histories is again mid-1965, the time of the Monterrey survey. As with Morrison's data, this choice of dates allows up to 15.5 years of a migration career for each case in the sample, and a maximum possible duration status of 25 years. As an example, if an individual migrated in 1945 and 1951, both research designs would utilize only the latter move, and it would have been made after six years of residence.

The basic measure of migration probabilities is comparable in both studies. It is an *occurrence-time index* based on two kinds of units: (1) moves made, and (2) intervals lived in a community by persons in the sample. (A more extensive discussion of this research design is given in Morrison, 1969.) Morrison used a six-month interval whereas the present study utilizes a twelve-month interval. This is the only major difference in the research designs.

(Because of this difference in intervals of time, Morrison's semi-annual probabilities were doubled to give annual probabilities of moving comparable to those of the present study. The associated confidence intervals were adjusted accordingly. The reasoning for this adjustment is as follows. The same number of moves would be counted regardless of whether the interval is six or twelve months. Hence, the numerators of the indexes are comparable. However, twice as many intervals are counted in the denominator when the intervals are six rather than twelve months. Hence, doubling the six month probabilities will yield the twelve month probabilities. Finally, because the Monterrey study did not record moves of less than six months, the estimates of risk of moving from this sample are probably somewhat smaller than would be the case if all "permanent" moves had been recorded. It is assumed, however, that the basic pattern of the probabilities is adequately represented by the data even though some specific estimates are affected by the recording procedure.)

Each residential history was broken down into these two units of occurrence and time. The first type of unit involves information about the number of moves made by an individual; the second standardizes this number by the total number of intervals of risk. At this point, the units were recombined over all members of the sample into age- and duration-specific categories. This means that as an individual goes through his migration history from 1950 to 1965 he contributes successively to different age and duration status categories depending on his values on the two variables for each year in his migration record. The summation over the data for all migration histories yields two pieces of information: (1) the total number of intervals lived $Y(i, j)$ and (2) the total number of moves made $M(i, j)$ during the intervals, where the subscripts i and j cover the range of age and duration status, respectively. This leads to the definition of the age- and duration-specific probabilities of migration as:

$$P(i, j) = \frac{M(i, j)}{Y(i, j)} \qquad (1)$$

Findings

Table 2 shows the annual probabilities of migrating calculated in the above manner for the Monterrey sample in comparison with the probabilities reported by Morrison for the Amsterdam sample. (The probabilities reported in Table 2 for the Monterrey sample were computed on the basis of moves defined as a change of *municipio*. The probabilities for moves defined as a change of *zona* are highly comparable. The *municipio* probabilities were chosen for comparison because of greater comparability of geographic size to the economic-geographic areas of The Netherlands.) Note that the data in Table 2 corroborate the two basic findings of previous research. That is, within specific age categories, the probability of migrating for the Monterrey sample declines as duration status increases, and the exact

TABLE 2.—Annual Probabilities of Migrating, with Confidence Limits, for Males by Age and Residence Duration, for Monterrey *Municipios* and Amsterdam Economic-geographic Areas

Duration, years	Monterrey ages 21 to 24	Amsterdam ages 18 to 24	Monterrey ages 25 to 44	Amsterdam ages 25 to 44	Monterrey ages 45 to 60	Amsterdam ages 45 to 64
0-1 .	.223±.052	.272±.034	.190±.032	.116±.021	.087±.052	.120±.023
1-2 .	.096±.041	.328±.026	.131±.030	.108±.011	.058±.045	.094±.018
2-3 .	.080±.039	.236±.035	.089±.027	.108±.012	.044±.038	.076±.018
3-4 .	.048±.032	.244±.043	.044±.019	.096±.013	.027±.030	.044±.014
4-6 .	.058±.025	.174±.030	.064±.017	.090±.008	.026±.021	.038±.008
6-8 .	.044±.023	.106±.028	.045±.015	.080±.008	.018±.017	.036±.008
8-10.	.018±.013	.122±.004	.022±.008	.068±.010	.016±.016	.044±.009
10-15	.039±.012	.064±.006	.026±.005	.030±.003	.025±.010	.010±.001
15-20	.034±.011	.066±.008	.027±.006	.030±.003	.020±.007	.008±.001
20-25	.046±.017	.080±.013	.023±.007	.022±.009	.011±.005	.006±.001

Note: Confidence limits set at the .95 level.

Sources: Amsterdam data from Morrison, 1967, Table 1. Other data from records of Monterrey Mobility Study, Balan, Balan, and Browning, n.d.

form of the relationship differs from one age category to another. Thus, the axiom of cumulative inertia receives corroboration from the Monterrey sample, and age is seen to interact with duration status. Unfortunately, the size of the Monterrey sample does not allow an analysis of variance to test the significance of the interaction of age and duration status. However, the practical significance of the effect of age on migration probabilities is readily seen by a comparison of different age categories with the same duration status.

Although the main findings from the Monterrey data are similar to those for the Amsterdam data, there also are some differences which are of practical importance. First, concerning the relative decline in probability of migration with changing duration status, for the youngest age group, migration probability declines by a factor of about 4 for the Monterrey data and 3 for the Amsterdam sample when shortest and longest duration statuses are compared; in the 25–44 age group this factor is approximately 8 for the Monterrey sample and 5 for the Amsterdam data; for the oldest age category it is nearly 8 for the Monterrey sample and 20 for the Amsterdam data. In short, the sizes of the relative declines in migration risks for the two samples are most comparable for the two younger age groups and least comparable for the oldest age category.

A second set of deviations concerns those specific probabilities which are significantly different between the two samples. The probabilities for which the 0.95 confidence intervals of the Amsterdam and the Monterrey samples do not overlap have been underlined in Table 2. Although it is impossible to pin down the exact relationships in the present study, the differing demographic and ecological characteristics of the populations from which these two samples were drawn are probably relevant to these deviations. However, further cross-national comparisons of the relation of migration risks to residence duration are necessary to determine the extent to which specific probabilities are affected by population characteristics.

Turning to the pragmatic issue of transforming data on duration status into estimates of migration risk, the relationships shown in Table 2 have been summarized quantitatively in six regression equations of the form:

$$Y = a + b_1X + b_2X^2, \qquad (2)$$

where Y is the best estimate of the probability of migrating on the basis of X, the logarithm of duration status in months (Morrison, 1967, p. 560). The parameters a, b_1, and b_2 have been estimated for each age interval for both the Amsterdam and Monterrey samples, and Table 3 gives the fitted polynomials.

TABLE 3.—Age-specific Regressions of Probability of Migrating on Duration Status for Monterrey (MON) and Amsterdam (AMS)

Location and age	Equation, Y =
MON, 21-24	$.5048 - .1960X + .0203X^2$
AMS, 18-24	$.2961 + .0277X - .0133X^2$
MON, 25-44	$.3844 - .1244X + .0106X^2$
AMS, 25-44	$.0709 + .0409X - .0091X^2$
MON, 45-60	$.1742 - .0565X + .0050X^2$
AMS, 45-64	$.1922 - .0405X + .0012X^2$

Note: Computed from probabilities in Table 2. Y is the probability of migrating; X the logarithm of duration status in months.

These equations summarize the relationships found in both sets of data. It can be seen from Table 3 that the equations for the two samples are most comparable for the oldest age interval. On the other hand, the equations for the youngest and the 25–44 age intervals are quite different for the two samples. Specifically, the regression constant is larger for the Monterrey data for both age intervals, and also the initial drop in probability of migrating due to the X component of the regression equations is greater than in the comparable Amsterdam equations. In brief, these equations indicate that the functional relationship of migration risk to duration status is nonlinear. On the basis of these two samples, we conclude that the absolute values of the regression coefficients may vary considerably across populations. That is, not only the regression constants but also the regression slope coefficients may differ according to the characteristics of the populations studied.

Discussion

The research reported in this paper corroborates previously reported findings on the negative nonlinear relation of duration status to the prospective probability of migration. Furthermore, the comparisons provided through a replication of previous research give some indication of the cross-national variability of the functional form of the relationship of duration status to migration risk. The findings of this research are also of importance to the evaluation of the Cornell model. They demonstrate, for example, that there may exist a functional relationship of migration probability and duration of residence which holds across populations with very different ecological and demographic characteristics. However, this functional relationship may be altered considerably by other factors which vary for different populations. Hence, the exact form of the axiom that is assumed in simulation studies of the migratory experience of real populations should be adapted to such varying population characteristics.

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