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MIGRATION: AN INTEGER PROGRAMMING FRAMEWORK WITH EMPIRICAL RESULTS

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I. Introduction

The failure to recognize that migrants differ with respect to their past migratory experience is one of the basic objections to existing studies of migration. This less obvious criterion for the disaggregation of migrant cohorts has received only limited recent theoretical and empirical attention in the literature. Such a disaggregation would obviously reduce specification bias and allow for a more unique interpretation of the response coefficients to the explanatory variables. With only a few exceptions (Eldridge 1965 and Vanderkamp 1971) it has implicitly been assumed that the phenomenon of return and multiple migratory behavior is of little revelance to the analysis of the determinant of gross migratory flows in the United States. Vanderkamp has indicated that migration behavior differs between return and non-return migrants in Canada. The non-return classification, however, does not completely adjust for differences in the propensity to migrate. This lack of disaggregation is clearly unwarranted and seriously limits the interpretation of previous migration studies.

This paper is the first to classify migrants in the United States into three groups by race: (1) migrants returning to their state of birth; and non-return migrants

separated into (2) migrants moving for the first time (new migrants), and (3) migrants making at least their second move (repeat migrants).[1] This separation of non-return migrants corrects possible differences in the propensity to migrate and thus reduces specification bias. The purpose of this paper is to analyze for each type of migrant by race the determinants of labor mobility. Comparisons are made between migrant types to delineate differences in the relative importance of the explanatory variables on migration rates using Zellner's seemingly unrelated regression technique. Section II presents a migration model based on an integer programming process and describes the data and estimation techniques used in the paper. The empirical results with the relevant comparisons are discussed in Section III. Finally, Section IV contains some brief concluding remarks.

II. Model and Data

The migration process is viewed as an attempt by the migrant to incorporate both investment opportunities, such as a greater return on his human capital, and utility maximization into one objective function.

A migration decision is an all or nothing decision: one must decide whether to migrate and, if so, where. Thus, models of individual utility maximization where migration is modeled as a continuous variable are basically faulty. An alternate specification which allows for discontinuities is to view migration in an integer programming framework.

Integer programming allows for functions with discrete levels of variables and is particularly suited to situations in which fractional answers (e.g., 1/2 Los Angeles and 1/2 New York as a destination) are meaningless.

All potential destinations differ in terms of income which can be earned in that location. However, locations also differ in consumption bundles, since prices of goods vary among locations. Thus, it is not solely income which determines destination. Rather, for each destination the potential migrant will calculate expected utility; he will then choose that destination in which utility is the highest. An integer programming framework allows us to explicitly formalize this method of decision making.

Let $U = U(x_1, \ldots, x_n)$ (1)

be the utility function of the migrant; x_i, $i=1,\ldots,n$ are all of the goods which enter into this function. (1) is invariant with respect to destination. However, prices vary with each destination (ocean swimming is more expensive for a resident of Iowa than for a Californian, but housing may be cheaper). Income also varies with destination. Thus, for each destination j, $j=1,\ldots,m$ there will be a function (1) to be maximized subject to a constraint:

$$\Sigma_i \, x_i^j p_i^j - M^j = 0 \qquad (2)$$

where the p's are prices, M is income net of moving costs, and superscripts refer to destination. For each destination

we can form a constrained maximization problem:

$$L^j = U(x_1, \ldots , x_m) - \lambda^j \Sigma_i (x_i^j P_i^j - M^j). \tag{3}$$

The migrant can be viewed as forming m functions like (3), maximizing each, and choosing that which gives the highest value of U. Viewing the problem as an integer programming problem does not change this method of reaching a decision; but it does give us an analytical representation of the problem which is theoretically more pleasing.

Define a variable δ^j

$$0 \leq \delta_i \leq 1, \ \delta^j \text{ an integer} \tag{4}$$

Then the function which must be maximized is

$$L = U(x_1, \ldots, x_m) - \sum_{j=1}^{m} \delta^j \lambda^j \sum_{i=1}^{n} (P_i^j x_i^j - M^j) \tag{5}$$

subject to (4) and to the condition

$$\sum_{j=1}^{n} \delta^j = 1 \tag{6}$$

which is the constraint that only one destination will be chosen. δ^j for the destination actually chosen will be 1; for the other destinations, δ^j will be zero.

Thus the integer programming framework of equation (3) suggests that migration is an attempt to maximize utility subject to the constraints of income and prices for each possible destination. It is further assumed that the information available to each type of migrant is different

and that each migrant forms his own subjective prediction regarding the costs and benefits of migrating from his place of residence to the potential destination. One of the possible choices of location is the origin. Schwartz (1973) argued that the origin variables have no effect since the choice is among alternative destinations. This argument is not correct if all things were held constant in the destination regions; the factors at the origin might still influence the rate of migration. Equation (5) demonstrates that the decision to move is based on the interrelationships of income, moving costs, and prices. Thus a population with differing preferences and areas with the availability of alternative consumption bundles is why regions with significant money income differentials may not necessarily have more interregional migration.

The disaggregation of migrants is necessary because of differing response characteristics of the explanatory variables as the result of variation in the available information and uncertainty among migrant types. Without such a disaggregation, it is impossible to give a unique interpretation to any estimated relationship between migration and the explanatory variables. It is necessary to isolate, as much as possible, the variation in subjective predictions of expected utility gained from migration in order to obtain unbiased estimates of the influence that various explanatory variables have on the migration decision. This is done by limiting the empirical analysis to more homogeneous groups by separating the total out-migration into three types of migrants.

It is hypothesized that return migrants having once lived in the destination area have more information regarding the characteristics of that area. Repeat migrants may, through experience, have more efficient techniques in acquiring information and forming accurate expectations. However, this must be tempered by the fact that repeat migrants have moved several times possibly because of poor judgement concerning opportunities in the destination area. Both the lower cost because of experience and the inability to form accurate expectations lead to more migration by repeat migrants. New migrants would have little experience and probably less information available about the destination area as well as the costs of moving. Thus, they would have a lower propensity to change their place of residence.

The separation of migrants into white and black respondents will clearly reduce aggregation error. Blacks facing artificial barriers to entry and other forms of discrimination would experience, relative to whites, an entirely different set of prices for various consumption goods. Also, the uncertainty facing blacks may vary greatly with any given region. Both of the above combined with lower incomes will result in an entirely different set of response coefficients to the explanatory variables and thus necessitate the separation of the two groups.

This theoretical formulation of migration based on expected utility maximization for types of migrants by race is expressed in a system of simultaneous equations. The representative equation for migrant types is:

$$M_{ij}^{k} = f(I_i, I_j, U_i, U_j, T_i, T_j, PU_{ij}, Ed_i, Age_i, D_{ij}, MS_{ij}, \text{random errors}) \quad (7)$$

where:

M_{ij}^{k} = return, new, or repeat migrants who were residing in region i (origin) in 1965 and had migrated to state j (destination) by 1970 divided by the population at risk,[2]

I_i = mean family income at the origin, 1969,

I_j = mean family income at the destination, 1969,

U_i = mean unemployment rate at the origin,

U_j = mean unemployment rate at the destination,

T_i = the absolute deviation of the mean annual temperature from 65 degrees at the origin,

T_j = the absolute deviation of the mean annual temperature from 65 degrees at the destination,

PU_{ij} = percent urban population at the destination relative to the percent urban population at the origin, 1970,

Ed_i = median education level at the origin, 1969,

Age_i = mean age at the origin, 1969,

D_{ij} = the road distance in miles between the SMSA with the largest population in i to that of state j,

MS_{ij} = migrant stock for state j, i.e., number of persons born in region i and living in state j, 1960.

The dependent variables are specified according to race. Likewise, the independent variables, income, unemployment, education, and age are specific to the subgroups according to race.[3] Gross migration, rather than net, is used in this study as the dependent variable. Sjaastad (1962) has argued that the existence of cross

flows tends to render net migration data less meaningful than gross migration data. Thus, gross migration is probably the more appropriate dependent variable for this type of study. The migration flows for each type of migrant are divided by the population at risk in each region. In order for a migration rate to be interpreted as a probability measure, the base of the migration rate must include all persons, but only persons, eligible to be counted in the numerator. The population at risk for each type of migrant and for each ij combination should be different. For return migrants from i to j, the population at risk is all persons who were born in j and living in i in 1965. For a repeat migration rate, the population at risk is all persons who were born in a division other than i or j and who resided in i in 1965. The population at risk for the new migration rate is the number of persons who were born in i and resided in i in 1965. Because of data limitations the corresponding numbers for the denominator for each of the migration rates for 1960 were utilized in this study. Data for the respective populations at risk are not available other than at the year of the Census tabulation.

The resulting migration rates instead of the absolute numbers are used so that the dependent variable can be interpreted as a stochastic probability statement which makes it appropriate to estimate parameters by regression analysis. Such a division also corrects for the bias caused by variations in the size of the population at

risk (Nelson 1959; Sjaastad 1962; Levy and Wadycki 1974; Schultz 1971).

III. Empirical Results

Equation (7) is assumed to have a multiplicative form and is estimated using a multivariate regression analysis with a double-log transformation. Thus, the estimated coefficients are directly interpretable as elasticities. A set of equations for each of the three types of migrants is to be estimated and ordinary least squares fails to take account of possible disturbance correlation among the equations. Also, the origin areas differ greatly in population size so that the assumption that each equation possesses a homoscedastic disturbance term is doubtful. The variance of the disturbance for a particular observation might be expected to be proportional to the population at risk for each of the types of migrants. To handle this problem, the observation is transformed by dividing each variable by the square root of each of the appropriate population and then regressing on the transformed data. The resulting equations are equivalent to weighted least squares regression.[4]

Zellner's seemingly unrelated regression (SUR) technique was also applied to the set of transformed data in addition to the OLS and WLS.[5] This technique provides efficient estimates of the regression coefficients by taking disturbance correlation among the equations into account. Appropriate F statistics for testing the

significance in the response of each dependent variable to the independent variables across equations are also provided as a by-product of the analysis.[6]

When the seemingly unrelated regression technique is employed, the gain in efficiency varies directly with disturbance correlation and inversely with correlation among distinct regressors in the different equations. Significant levels of disturbance correlation between the equations were found and, after transforming the variables to correct for heteroscedasticity, regressors are distinct in each of the equations and most of the correlations between these regressors are less than .65. The significant residual correlations combined with low correlations between regressors indicate that the SUR technique should yield more efficient estimates of the equations. Since differences can be expected between the OLS, WLS, and SUR estimates, and since the latter are statistically the soundest, the seemingly unrelated regression estimates are the only set discussed. Tables I and II contain the Zellner estimates and associated F statistics for the model after it has been corrected for heteroscedastic disturbances for the white and black types of migrants.

Table I for whites and Table II for blacks contain the estimates of equation (7). The WLS regression estimates explain a substantial proportion of the variance in migration rates for each type of migrant. The adjusted coefficient of determination (R^2) is .84, .95, and .92 for return, new,

Table I

DETERMINANTS OF WHITE MIGRATION BY TYPE OF MIGRANT: 1965-1970
SEEMINGLY UNRELATED REGRESSION ESTIMATES[a]

Variable	Type of Migrant: Return	New	Repeat	F-Statistic[b]
Constant	-.003 (.001)	-.004 (.001)	-.006 (.001)	8.869
Income Origin (I_i)	-.493 (.812)	-.654 (.559)	.742 (.568)	2.798
Income Destination (I_j)	.771 (.247)	.274 (.144)	.512 (.139)	4.605
Unemployment Origin (U_i)	-.449 (.360)	.622 (.133)	.296 (.232)	4.937
Unemployment Destination (U_j)	.723 (.143)	-.180 (.067)	-.274 (.078)	22.827
Percent Urban (PU_{ji})	.035 (.178)	-.407 (.098)	.032 (.104)	12.752
Temperature Origin (T_i)	-.126 (.067)	.082 (.041)	.130 (.043)	4.323
Temperature Destination (T_j)	-.301 (.059)	-.117 (.026)	-.148 (.031)	4.856
Education Origin (Ed_i)	3.811 (1.989)	3.354 (1.237)	-5.326 (1.365)	24.553
Age Origin (Age_i)	-3.921 (1.702)	-2.070 (.873)	-2.817 (1.140)	.692
Distance (D_{ij})	-.279 (.099)	-.065 (.031)	-.030 (.034)	4.289
Migrant Stock (MS_{ij})	.108 (.042)	.884 (.020)	.668 (.022)	183.867

[a]For details of the estimation technique, see Zellner (1962). Each equation was estimated in double-log form, thus the regression coefficients are interpretable as elasticities. A correction for heteroscedasticity has been applied by weighting each observation by the reciprocal of the square root of the population at risk for each type of migrant. Each regression is based on 441 observations; parentheses contain standard errors.

[b]See footnote 6 for a discussion of the F-statistic.

Table II

DETERMINANTS OF BLACK MIGRATION BY TYPE OF MIGRANT: 1965-1970 SEEMINGLY UNRELATED REGRESSION ESTIMATES[a]

Variable	Type of Migrant: Return	New	Repeat	F-Statistic[b]
Constant	-.005 (.004)	-.003 (.0002)	-.003 (-.0003)	.628
Income Origin (I_i)	2.172 (.394)	-.059 (.130)	.517 (.199)	20.324
Income Destination (I_j)	-.201 (.313)	1.832 (.481)	1.481 (.260)	11.797
Unemployment Origin (U_i)	.017 (.162)	.189 (.145)	-.456 (.150)	2.454
Unemployment Destination (U_j)	-.181 (.043)	-.251 (.054)	-.102 (.062)	6.574
Percent Urban (PU_{ji})	.759 (.253)	.538 (.188)	.403 (.210)	.644
Temperature Origin (T_i)	-.097 (.133)	-.276 (.203)	-.080 (.101)	.492
Temperature Destination (T_j)	-.255 (.122)	-.148 (.049)	-.306 (.564)	3.353
Education Origin (Ed_i)	-1.706 (.958)	-.211 (1.670)	4.652 (.700)	16.435
Age Origin (Age_i)	-.896 (1.741)	5.226 (1.369)	-1.171 (.123)	59.829
Distance (D_{ij})	.241 (.087)	.048 (.046)	-.002 (.055)	3.129
Migrant Stock (MS_{ij})	-.238 (.035)	.673 (.031)	.554 (.033)	227.099

[a]See footnote a on Table I. Parentheses contain standard errors; each regression is based on 361 observations.

[b]See footnote 6 for a discussion of the F-statistic.

and repeat white migrants, respectively (based on the WLS estimates). Likewise, the R^2's are .61, .96, and .89 for the three types of black migrants. As can be seen in the tables, most of the estimated parameters have a significant influence on the migration behavior for the types of migrants in the hypothesized manner. Most of the coefficients are also significantly different across migrant types. These differences are as predicted and tend to confirm the hypotheses in almost all instances. All of the coefficients in the white estimates except age are significantly different at conventional levels. In the black equation, all of the estimated coefficients are significantly different except percent urban and origin temperature.[7] This indicates that previous studies have a specification bias due to aggregation error which seriously limits the interpretation of the estimated equations.

The income and unemployment variables are used as proxies for the economic opportunities in the origin and destination areas. The aggregate levels of income and unemployment are used to determine whether migration occurs from low to high economic opportunities and the magnitude of the relationship. The expected signs on the income variables are negative for the origin (I_i) and positive for the destination (I_j). It is expected that migration would be deterred by high unemployment rates at the destination (U_j) and increased by high unemployment at the origin (U_i). If return migrants have better information, then it is expected that the coefficients of these variables would be larger

in absolute value at the destination. Likewise, if new migrants have more information about the origin, then it is expected that the size of the coefficient would be largest for this type of migrant.

These hypotheses are supported by the empirical estimates. Migration in general tends to decrease with an increase in the average income level at the origin and increase with an increase in destination income. In every case except that of black return migrants, migrants are attracted by higher income levels. Previous research on the determinants of black migration has concluded that blacks tend not to be attracted by higher income at the destination.[8] The results presented in this paper indicate that aggregation error has probably led to this erroneous conclusion. This "wrong" sign for return blacks is probably the result of return streams from the north to the south. New migrants are the most deterred by higher income losses at the origin while return white migrants are the most attracted to income opportunities at the destination. Migration tends to increase with high levels of unemployment at the origin for each type of migrant except return white and repeat black migrant types. High levels of unemployment at the destination tend to decrease migration as was expected for all types of migrants except return whites. Both white and black new migrant types indicate the greatest response, as indicated by the size of the regression coefficient, to high levels of unemployment at the origin.

The a priori influence on migration of the level of percent urban population at the destination relative to the origin is difficult to determine.[9] Traditionally, it has been hypothesized that these factors would have an attraction for migrants because of the amenities, educational opportunities, greater job opportunities, etc., associated with urban areas.[10] However, current discussions concerning highly urbanized areas suggest that cities, because of high crime rates, congestion, and other negative externalities, possibly discourage migrants. Hence, this leads to the belief that current migration flows may be away from urban areas. Another aspect which must be considered is that, as the proportion of the population which resides in urban areas increases, the flows may be from urban areas to other highly urbanized areas. The signs associated with the regression coefficients on the relative percentage urbanization variables are thus indeterminant.

The results indicate that most migrant types are attracted by relatively higher percent urbanization. The only exception is the case of new white migrants which respond negatively to relatively higher levels of urbanization. It is interesting to note that black migrants consistently exhibit a greater response to higher levels of urbanization than white migrants as indicated by the size of the regression coefficients.

Moderate temperatures are more attractive and tend to possibly reduce the cost of living. The temperature variable included in this study represents a departure

from that used in previous studies.[11] The temperature is viewed as the absolute deviation of the mean annual temperature from 65°F, which measures the preference for temperate climates. This definition of temperature allows for the impact on migration of extreme variation at both ends of the scale. It is expected that the origin temperature would have a positive influence on migration while the destination temperature would be negatively related. These expectations are generally confirmed by the estimates since in all cases the destination temperature has a negative sign on the coefficient. The origin temperature variable has the correct sign for new and repeat white migrants. The origin temperature variable is insignificant for all black migrant types.

The individual's decision to migrate is probably influenced by a number of demographic characteristics. Among these characteristics are age and education levels. The conclusions of many studies on differences in migratory behavior of whites and non whites are misleading because of a failure to control for age and education. These influences on the propensity to migrate are controlled in this study by using the median age and education levels at the origin.

According to the investment theory of internal migration, the probability of migration will likely decrease as age increases. This follows since older persons have a shorter expected working life over which to realize the advantages of migrating. Hence, the expected rate of return

on migration is lower for the older migrant. Likewise, the costs of migrating probably increase as a result of job security and family ties being more important for older persons.[12] The results indicate that higher median age at the origin decreases the probability of migrating for all types of white migrants and for return and repeat black migrants. The only exception is the case of new black migrants on which the influence is positive.

Several explanations for the influence of education on migration have been suggested in the literature.[13] Education may increase the ability of a person to obtain more information about destination areas relative to origin areas. This increased information would reduce uncertainty and result in all destination areas being relatively more attractive. The educated may also face lower risk when moving since they are more adaptable both to changing environment and job opportunities. This would indicate that educated persons are more likely to migrate. The empirical estimates indicate that higher levels of education tend to increase the probability of migrating for return and new white migrant types while decreasing the probability for repeat migrants. The results for the black flows indicate that higher levels of education tend to reduce black return and new probabilities of migration.

Distance (D_{ij}) is used in the analysis as a proxy for time, psychic, and direct money costs of moving.[14] Greater distance may also increase the cost of acquiring

information which in turn increases uncertainty. All the above factors lead to the expectation that migration will be negatively related to distance. The distance variable has the expected negative influence for all types of white migrants as well as repeat black migrants. The influence is positive and insignificant for new black migrant types. Black return migration flows also exhibit a positive response. This unexpected result could possibly be caused by the relationship between previous migrants (migrant stock) and distance.

The greater the number of persons born in area i and living in area j, the more information that is likely to flow between the two areas.[15] The propensity of individuals to move to area j will be increased if relatives and friends live at the destination. Friends and relatives might provide information about the destination while at the same time increase the incentive to migrate by providing a reduction in the psychic costs of moving as well as providing lodging for a migrant. The introduction of the migrant stock variable is used to capture the effects of past migration flows on current migration. Of course, past migration is a function of the variables that influence current migration. It was argued by Nelson (1959) and expanded by Greenwood (1969) that the exclusion of the migrant stock variable tends to overstate the "true" relationships between current migration and various explanatory variables. As was expected, the migrant stock

variable had the greatest influence on new migrants both white and black. The results indicate that previous studies have overstated the importance of the migrant stock variables for a substantial proportion of the migrating population.

IV. Summary and Conclusions

The purpose of this paper has been to present some empirical evidence on the determinants of migration. Three types of migrants by race were classified and the influence of various explanatory variables were estimated. The three types of migrants were defined as those returning to their state of birth (return migrants), migrants living in their region of birth in 1965 but not in 1970 (new migrants), and migrants who have moved at least two times (repeat migrants). Such a disaggregation corrects the specification bias in previous migration studies and allows a unique interpretation of the estimated relationships between migration and the explanatory variables.

The migration process was assumed to be the result of the desire of the migrants to maximize their expected utility. An integer decision-making process was specified by integrating utility maximization with investment behavior. The behavior of the three types of migrants varies as a result of differing amounts of information and uncertainty. This theoretical framework was then estimated using Zellner's seemingly unrelated regression technique. The regression equations fitted to the data indicated that the migration rates were influenced differently across migrant

types with most of the variables influencing the migration flows in the expected manner.

The significantly different influences of the explanatory variables across types of migrants indicate that previous studies of internal migration in the United States suffer from specification bias due to aggregation error. The results from these previous studies are seriously limited as a result. By disaggregating migrants based on previous migratory experience, the estimated coefficients represent a more refined attempt at understanding the determinants of migration across race.

Footnotes

[1] Return migration was obtained from the Census of Population (1970), Table 11. This data is tabulated by migrants moving from one of the nine Census divisions to their state of birth. New migration was also obtained from Table 11 which represents the number of persons who were living in the division of birth in 1965 but had moved to one of the states by 1970. This "new" category is different from Vanderkamp's in that his was defined as any migrant not returning to the place of birth. Repeat migrants were calculated as a residual group from the total out-migration from the Census regions derived from Table 44 (1970). In this study there are nine origin areas (divisions) and 49 destinations (states) resulting in 441 possible streams of migration. Washington, D. C. is included as one of the destination areas while Alaska and Hawaii have been omitted. Data are not available in the published sources to allow for a disaggregation into types of migrants on a state to state basis.

[2] All migration data used in this study are from Lifetime and Recent Migration (1970) and Mobility for the State and the Nation (1970).

[3] The data were taken from the 1970 Census of Population. The origin variables were calculated as averages of the variables for the states in each division. Data on mean temperature and percent urban were taken from the U. S. Statistical Abstract. Road distance is from the Rand-McNally Road Atlas. The migrant stock variable was taken from the 1960 Census data.

[4] Since a multiplicative model is assumed and estimated in double-log form, the weighting consists of transforming the log of each variable by dividing by the square root of the appropriate population at risk for each type and then applying the appropriate regression analysis.

[5] For details of the estimation technique, see Zellner (1962).

[6] The F statistic is for a test of the hypothesis that the particular elasticity is the same across the three types of migration. The null hypothesis is $\beta_1 = \beta_2 = \beta_3$ where β is the regression coefficient for one of the explanatory variables and the subscripts represent the three types. This hypothesis implies two restrictions: $\beta_1 - \beta_2 = 0$ & $\beta_2 - \beta_3 = 0$. There are 2 and 1287 degrees of freedom for this where the latter represents the "free" observations from each of the three equations. For blacks

the degrees of freedom are 2 and 1047 since for some instances the migration flows were zero which were excluded from the sample. Critical values for the F statistic are 4.6, 3.0, and 2.6 for the 1, 5, and 10 percent levels of significance respectively.

[7]In addition to the F test discussed in footnote 6 and reported in Tables I and II, an alternative test was performed with the null hypothesis: $\beta_1 = \beta_2$, $\beta_2 = \beta_3$ & $\beta_1 = \beta_3$, where, again, β is the estimated coefficients and the subscripts refer to one of the three types. Of the 36 F values which this test yields for each of the white and black spatial flows, a majority of these were significant. This test helps to clarify which of the flows are different. These results are available from the authors in an appendix which contains the F statistics for this alternative hypothesis, the zero order correlations among regressors, and the residual correlation matrix.

[8]See, for example, the estimates by Cebula, Kolin, and Vedder (1973).

[9]Note that the urban variable has been defined in terms of a ratio of the destination to the origin (PU_j/PU_i). Such a specification uses up lesser degrees of freedom but more importantly it helps reduce the level of correlation among explanatory variables. This is particularly true since high levels of urbanization are highly correlated with high levels of income and education. One limitation for such a specification is that, when in log form, it hypothesizes that migrants respond to relative differences in the variables and that the elasticities are equal and opposite in size which might not necessarily be the case. However, such an assumption is common in the migration literature. See, for example, Greenwood (1969).

[10]See, for example, Greenwood (1969) and Cebula and Vedder (1973).

[11]See, for example, Greenwood (1969), Sahota (1967), and Levy and Wadycki (1974).

[12]See Langley (1974) for some estimates of the migration behavior of four age groups using data for England and Wales.

[13]For a discussion of the influence of education on migration, see Levy and Wadycki (1974), Sahota (1968), Greenwood (1969), Beals, Levy, and Moses (1967), and Bowles (1970). The paper by Levy and Wadycki (1974) provides an empirical test of the various hypotheses concerning the influence of education on migration of three migration flows classified by education levels for Venezuela.

[14] The role of distance in the migration decision has been explained by three hypotheses: diminishing information hypothesis, intervening opportunities hypothesis, and increasing costs hypothesis. Three recent empirical studies have attempted to interpret the influence of distance on migration with varying conclusions. See Miller (1972), Levy and Wadycki (1974), and Schwartz (1973).

[15] The influence of past migration and information flows between areas on migration was first advanced by Nelson (1959). It was tested by Greenwood (1969, 1971) using U. S. data. The variable was used in studies of migration in less developed countries with results comparable to those in the United States (Greenwood 1971; Levy and Wadycki 1973; Langley 1974). For additional discussions of this variable, see Laber (1972) and Renshaw (1974).

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