MIGRATION AND THE ECOLOGICAL COMPLEX[1]

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Following the suggestions of Hawley, Duncan, and Schnore, this paper investigates the possibility of viewing the variables subsumed under the population rubric of the ecological complex as dependent variables. The demographic processes of fertility, mortality, and migration are defined as a set of alternative means available to populations which seek an equilibrium between their size and sustenance organization. Focusing on migration, a general model is developed which suggests that neither environmental nor technological factors affect migration directly; but rather, that their effect on migration is produced through changes in organization which they generate. A modest empirical test of the model is carried out through an examination of Southern black migration rates, and general support for the model is obtained.

INTRODUCTION

In his volume on community structure and ecological theory Hawley (1950) focuses on organization and develops the strategy that changes in the organization of populations are to be sought in the population's technology and environment. While this work has been a bench mark for most ecological theory and research, it has been criticized by ecologist and nonecologist alike. The latter's criticisms have been aimed at ecology in general and have added little to its theoretical development (Wilhelm, 1964).

The most fruitful refinements have come from the former. These began with Duncan's (1959) specification of the "ecological complex." One of his major points, and the one we will focus on, concerned Hawley's argument that ecology was interested in ". . . the development and organization of the community" (1950:73). Duncan, in specifying the four major axes of the ecological complex (population, organization, environment, and technology), noted that Hawley tended to view organization as the sole dependent variable of interest to the ecologist. Duncan argued that organization was only one of the problems that could be approached within the broader context of ecology. He takes the position that variables subsumed under any of the rubrics can be treated as dependent. Following this lead, Schnore (1958; also see Duncan and Schnore, 1959) argued that many problems are best approached by treating organization as an independent variable.

This paper builds on the ideas of Hawley, Duncan, and Schnore. It develops a model for migration analysis which suggests that migration is a population demographic response to differences in sustenance organization and is unaffected directly by either technology or environment. A modest test of the model based on data on Southern Negro migration for the decades 1940–1950 and 1950–1960 and using correlation and path techniques is offered.

THE ECOLOGICAL VIEW OF MIGRATION

Migration may be defined as either an individual or a population phenomenon. Viewed as an individual phenomenon, the focus tends to be on individual migrants rather than on the social process of migration. (For example see Zipf, 1946 and Lee 1966) This leads to arguments that migrants are mobile because they possess certain characteristics or that migration can be explained by reference to the motives or values of the migrants. In the former case we end up with "descriptive propositions" of the sort sug-

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gested by Lee (1966) or Miller (1966). For instance, it may be argued that people in the labor force are more likely to migrate than people out of it.

Explaining migration in terms of motives or values puts one in a similar situation. In this case one locates the causes of migration in the individual and only secondarily in the social structure. Typical of such "propositions" is Dorothy Newman's (1965a; 1965b), that migrants move because they have higher aspirations for upward mobility. While it is legitimate to approach migration analysis from this "individual perspective," one must bear in mind that values and motives are themselves part of the behavior, and as such, should be explained rather than be used as the explanation (Davis, 1963: 354). "Characteristic types" of explanations likewise are seldom tied to more general frames of reference and tend to be ad hoc, descriptive or ex post facto.

Ecologically, migration may be viewed as a component of areal population change (Hawley, 1950:328–332); it is a response through which a population can maintain an equilibrium between its size and sustenance organization. When migration is viewed from this perspective, the important questions become whether it increases or decreases populations, what the size of the population change is in relation to changes in sustenance activities and what the other factors affecting sustenance organization are.

Thus, migration is the other than natural increase or decrease in areal population size. This definition bases population geographically (or areally). If it did not, population size could change through such processes as annexation or consolidation. Furthermore, viewing migration as a population response forces us to seek the causes of movement in the physical and social environment. This means for our purposes individuals, characteristics, values, and motives need not enter the analysis. It does, however, restrict us to specifying the *conditions* under which migration takes place.

THE ECOLOGICAL COMPLEX AS A FRAME OF REFERENCE

Population: Human ecology assumes that populations are reference points for all analyses. It directs our attention to the aggregate which may be described in terms of location, size, composition and territorial distribution. Ecological units may be identified by these static attributes of populations. While it is possible to describe a population at any point in time by any or all of these attributes, it is also possible to follow populations through time and the changes it brings. Changes in physical location result from either an expansion or contraction of a population's physical base; while changes in size, distribution, and composition result from demographic processes: fertility, mortality, and migration.

It is assumed that location, size, distribution, and composition represent (or move toward) an equilibrium which is a balance of the ecological complex (Hawley, 1967). The demographic processes are then a set of alternative responses available to a population seeking equilibrium.

Organization: Populations organize in many different ways, and several definitions of organization exist which embrace a number of organizational dimensions. We have selected a *narrow view of organization* realizing that this will limit what can be said about it. Our definition derives primarily from the work of Gibbs (1959:29–36; 266–277).

Organization is viewed as a property of population and refers to the constellation of its activities which provide its livelihood. These activities we call sustenance activities, and Gibbs argues that they ". . . are abstracted from the total human behavior and specifically exclude all activities not directly related to livelihood" (Gibbs and Martin, 1959:30). Thus, the important question is whether the activity helps the population to sustain itself. The organization of activities is of prime interest to the ecologist. In modern societies where money is the medium for sustenance, any activity yielding money is a sustenance activity. With this definition, activities, not individuals, are relevant; and the activities and their organization are the units of analysis.

A population's sustenance organization can vary along two interrelated dimensions: (1) the number of occupational niches and the population's distribution among them, and (2) the degree of interdependence be-

tween occupations. The latter is conceived of as depending on the former because we assume that as the number of occupations increases, the degree of specialization in each increases. Thus, to study changes in population organization, we must focus on changes in the structure of the occupational pyramid and changes in the interdependence among occupations.

Environment: Hawley has defined environment as ". . . all external forces and factors to which an organism or aggregate of organisms is actually or potentially responsive . . . environment refers to the medium in which an organism exists" (1950:12). This medium includes other populations. Schnore (1966:31–58) refers to those factors directly related to the population's physical location as site factors, and those related to a set of external exigencies not directly related to physical location as situational factors.

Schnore's major situational variable is population potential which is best conceived of in terms of the size of other populations, their level of development, and the distance separating populations. Thus, it refers to the potential for contact between populations and the potential of other populations to threaten the population under observation.

Technology: The definition of technology used in most ecological discussions focuses on a population's tools and techniques for adapting to its environment. Technology varies with respect to (1) the volume and variety of tools and techniques in use, and (2) their efficiency (Cottrell, 1955). Tools and techniques which lower the amount of energy expended by the population to accomplish a given adaptive task are viewed as more efficient. A population's technological structure at a point in time can be described in terms of these two dimensions.

THE ECOLOGICAL COMPLEX AND POPULATION MIGRATION

The preceding paragraphs merely specify the broader concepts of interest to human ecology and their variable properties. The major shortcoming of the ecological complex is that, other than specifying the interdependency of the four concepts, little has been done to relate them and their properties to one another systematically (Duncan 1959:681–685). Hence, we have few testable ecological propositions. Furthermore, as noted above most ecological studies tend to view organization as the dependent variable. In accordance with Duncan's (1959:683–684) observation that any of the rubrics can be treated as the dependent or independent variable, we think it feasible to view population as the dependent variable. We have defined migration as a demographic response, and noted that it can be viewed as a variable property of population structure. We will now discuss the place of migration in the ecological complex.

Hawley has argued that populations seek equilibrium between each population and organizational property and that while no causative power can be assigned to population: "Demographic structure contains the possibilities and sets the limits of organized group life" (1950:78). Thus, while the potential (for) and limits (of) organization are self contained in the population, "The place of occupance poses the basic problem of adaption" (Hawley, 1950:80).

The fundamental question seems to be how do such imbalances come about? To view imbalances, we must examine the interdependence between rubrics. Every population must adapt to its environment; and we assume that adaption is mediated through the population's organization and technology. The environment contains site and situation factors, both of which influence the population's sustenance organization. Site factors limit the sustenance organization because they dictate a population's activities (E→O). That is, if there is no iron there can be no extraction, production, and distribution of steel. Likewise, there can be no steel plow (E→T); and agricultural organization will be restricted to small, selected plots of cultivated land (E→T→O). Furthermore, restricted land cultivation influences the size of the population which can be supported (E→T→O→P).

Now assume some new technological breakthrough makes raw material available from another population (T→E); this time, however, the environmental factor is a situ-

ation factor. This means that steel production and distribution become possible (T→E→O); creating a larger sustenance organization makes possible the support of a larger population (T→E→O→P).

These overly simple examples illustrate Hawley's (1967) argument that all changes in a population's functioning organization result from changes in the environment or technology. To this we now add that changes in a system's organization produce disequilibrium between population and organization. Remembering that population is a mere abstraction lacking causative power, we see that only one thing can happen internally when such an imbalance exists. The population can alter itself through a demographic component of change—that is, a demographic response.

This is not to say that demographic components of change cannot influence organization. For instance, certain technological (contraception, for example) or environmental (disease) factors can operate directly on the demographic processes; and these in turn can influence organization by changing population structure, setting new *limits on and potential for* organization. Here we have a second situation in which a demographic response effects equilibrium between population and organization. Whether the demographic response is positive (to increase population size) or negative, depends on whether the change expands or contracts the organization, whether the change in environment or technology directly increases or decreases population, and what the state of equilibrium between population and organization happens to be.

Thus, the same kind of change in two different equilibrium situations will not elicit the same degree of demographic response. For instance, a new technological invention in population "A" which is in a state of equilibrium may expand the organization, and thus elicit a demographic response increasing population; however, the same invention in population "B" which is already too large for its organization may elicit no response, or a lesser response.

We have noted that each demographic component of change can be viewed as a demographic response, and we have observed the types of situations eliciting a demographic response. Our next question is, under what conditions does a population employ the migration response.

Populations can respond demographically by changing their birth and death rates or by migrating. It is important to realize that demographic responses are highly interrelated: if one changes the others change also. This interdependence often makes it difficult to specify which demographic response is primary. We know that the time involved for a specific effect to occur varies depending on which response is used. The time available primarily determines which response is most heavily relied on. However, we know that to achieve a given effect with any response also requires a certain level of technology.

In the short run, migration appears to be the most efficient response. It can increase or decrease population more rapidly than can changing fertility and is more efficient in that it can be selective. Its selective aspect also indicates that population composition and distribution can be changed more rapidly through migration than through the fertility response. A simple example should make this clear. Let us assume that a population's sustenance organization expands as the result of a technological discovery. To fill these niches by increasing fertility would require many years. The pace of change, particularly in modern societies, demands that populations respond more rapidly than this. Moreover, migration saves the population the cost of sustenance and training for new members; whereas, with the fertility response the population must absorb these costs until new members can occupy the new positions.

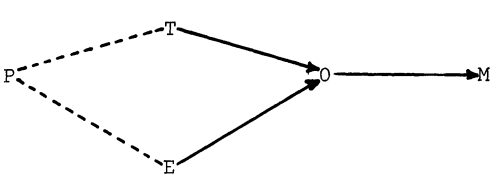
This simple example does not account for many complexities of change. For instance, technological discovery may destroy old niches in creating new ones. In this case, the population may redistribute its members in the new niches. However, if the activities of the new niches differ sufficiently from those of the old, the population may accept migration with the requisite capacity to perform the activities of the new niches. Moreover, if the sustenance organization has no niches open for those left without a niche by the new technology, the population must remove members or provide free sustenance

for them. *Population migration* then, is the effect of these counter patterns, and results from an imbalance in the relationship between population and organization.

While the major reason for reliance on migration may be timing, a prerequisite for its use is a technology sufficient to affect the response. That is, a population must have a technology which can put it in contact with other populations. It would seem that as technology improved, and made such contact easier, the migration response would be used more often, for less threatening changes. That is, a population can be less discriminating with respect to the magnitude of change needed to elicit the response.

Populations do respond directly to changes in the environment; however, such responses are always reactions to cataclysmic changes like wars or epidemics. Environmental change of a lesser magnitude effects migration by altering the population's ecological organization. Populations never respond directly to technological change because technology is effective to the extent that it alters organization. Thus, where increasing control over the environment is attained, demographic responses increasingly effect organizational change.

The above discussion suggests a model having two major propositions. First, we shall test Hawley's proposition that the causes of organizational change can be found in a population's environmental and technological conditions. Second, we shall test our proposition that migration is a response to changes in population organization. In short, our model argues that environment and technology do not operate directly on migration but effect migration through changes in organization. Thus, variations in the migration rates of small and large aggregates alike can be explained by observing the effects of variations in the external factors on population organization. Schematically, and ecologically this model may be represented as follows:



where T represents technology, E represents the environment, O represents the organization, M migration, and P the population. Note that no causative power has been assigned to population. The lines connecting P with T and E specify only that the population exists under these conditions.

SOUTHERN NEGRO MIGRATION: A PRELIMINARY TEST OF THE ECOLOGICAL MODEL

To test this model we have focused on a relatively unexplored, but socially significant, population movement: The migration of the Southern Negro population from the "old cotton belt."

To be included in the sample a county had to have 25,000 acres in cotton as reported in the 1890 census. This criterion yielded a sample of 253 counties stretching in a nearly contiguous belt from South Carolina to Texas. The continued rural character of this area is indicated by the fact that by 1960 only eight percent of the counties contained a city larger than 50,000. Estimates of net migration were calculated for two decades (1940–1950 and 1950–1960) for each county's black male population, using the forward census survival ratio technique.[2] The estimates were converted into rates per thousand population at the beginning of each decade, and each rate was multiplied by a negative one for the statistical analyses.

The latter operation merely transposes the values and allows us to refer to those areas having the largest relative losses as having the highest net migration rates.

The above model focuses on relationships between rubrics; and thus, we selected the most salient organizational, environmental, and technological factors suggested by others to test our model. (Vance, 1929; Thomas, 1934; Johnson, Embree and Alexander, 1935; Vance, 1936; Lively and Taeuber, 1939; Street, 1957; Hamilton, 1964; Rose, 1964; Dillingham and Sly, 1966; Woafter, 1967; Stinner and De Jong, 1969). Under the *organizational rubric* we included

[2] A complete discussion of the procedure used to select the survival ratios and the technique used to estimate net migration can be found in Sly (1972).

(1) the differential stability of positions in the agricultural labor force, and (2) lack of access to nonagricultural employment; under the *environmental rubric* we included (1) the exigencies of cotton production, (2) acreage control programs, (3) competition from whites, (4) concentration of land holdings and (5) increasing farm size; and under the *technological rubric* we included the mechanization of agriculture.

The southern agricultural labor force is grossly composed of laborers, croppers, tenants, and owners. These positions increase in stability as one moves from laborer to owner. Laborers work fewer days out of the year, are offered no residence while employed, and their position can be created or removed as the situation dictates. Croppers, on the other hand, while susceptible to exploitations are guaranteed housing and are employed for the entire growing season. For their labor they receive a fixed proportion of the crop. Tenants rent their land for cash value and receive full benefit for their labor.

We obtained a crude indicator of the structure of the agricultural labor force by affixing an arbitrary value to each position, which can be isolated from data in the 1940 and 1950 agricultural censuses. Thus, we multiplied the total number of owners by one, the total number of tenants by three, the total number of croppers by five, and the total number of wage laborers by seven. We obtained a grand total by summing the resulting four values, and this was divided by the total number of persons employed in the four categories. The resulting figure we refer to as the "Index of Agricultural Structure." [3] This index gives us an idea of the instability of the agricultural organization of each county population. As the number of cropper and laborer positions increase, the instability of the organization increases and the value of the index changes accordingly.

Lack of access to nonagricultural employment can have two different meanings. It can imply that there are simply no jobs outside of agriculture, or it can imply that other jobs are available from which blacks are systematically excluded. With the measure suggested below there is no way to distinguish these possibilities. However by lack of access we simply mean being unable to secure a position outside agriculture i.e., we refer to the fact that blacks are concentrated in only a few positions.

The index developed here is based on the classification of employed black workers by major occupation groups in the 1940 and 1950 censuses. The classification "major occupation groups" was slightly different in 1940 than in 1950. For maximum comparability, we combined the 1940 categories "professional workers" and "semi-professional workers" into one category more closely corresponding to the 1950 category "professional, technical, and kindred." Likewise, the 1950 categories "clerical and kindred workers" and "sales workers" were joined to more closely correspond to the 1940 category "clerical, sales and kindred workers." Combining these categories left us with eleven categories of major occupation groups for each census.

At each census date the percent distribution in each occupational category was compared with the percent expected on the assumption that if workers had equal access to all occupations, they would be equally distributed among categories. The "index of occupational dispersion," then, is obtained by taking the difference between the actual and expected percent in each occupational category, squaring the differences, summing the squared differences, and extracting the square root of the sum.[4]

[3] It is important to recognize that this index does does not account for changes in the structure of the agricultural labor force. We use the term stability to refer to the relative permanence of the various types of niches. Thus, owners' positions are more stable than tenants', tenants more stable than croppers, and the position laborer least stable in that it is created and removed most easily. The referent then is to the position and number of positions, not to individuals occupying the positions. The index value is arbitrary and a function of the values assigned each position. The major point to note is that we assume equal intervals between niches.

[4] One could use an index of dissimilarity, but this would require adapting some arbitrary standard population. While assuming an equal distribution among categories is also arbitrary, it seems more expedient than to argue that all counties in our sample should resemble some standard when we know so little about organization. That is, we know very little about what an ideal distribution would be.

The index of occupational dispersion tells us the relative degree of population dispersion among occupation categories. The alternative to measuring nonagricultural employment opportunities would have been to work with the single category percent of workers in agriculture or its residual. However, counties with a minimum distribution among the eleven categories tend to have a very large concentration in the agricultural category. Counties with successively lower proportions in agriculture tend to have higher proportions in each of the other categories, thus reducing the amount of variance for all categories. If we work with the single category, say the proportion of workers in agriculture, we would be working only with the variance for a single category. Thus, if a large proportion of workers are concentrated in another category (say laborers) this is not taken into account. With the technique proposed here each category makes an "actual" contribution to the overall score for any single county; and if blacks move out of agriculture and are merely segregated in another single category of occupations, this is taken into account.

The environmental indicators are relatively straight-forward and require little elaboration. The first we used was simply the percent of whites living in each county during 1940 and 1950. It assumes that the white population constitutes an external threat to the black which varies with the relative size of the white population. Our second environmental indicator is the white-nonwhite acreage ratio. This ratio was calculated from data in the 1940 and 1950 Censuses of Agriculture which reported acreage cultivated by color of operator.

At first glance this may seem merely another indicator of white-black competition, and it probably is to a large extent; however, we also expect it to reflect the exigencies of cotton production, acreage control programs, the increased concentration of land holdings, and the increasing size of farms because each of these tends to create a preference for white tenants and owners over black croppers and tenants.

Two technology indicators are also used. These are the average number of tractors per farm in each county and the average per farm expenditure for gasoline. Both averages were calculated from data reported in the 1940 and 1950 Censuses of Agriculture.

THE HYPOTHESES AND THEIR TEST

The six specific hypotheses to be tested are listed below. Each states a relationship between one of our indicators and the migration rate:

1. The higher the index of agricultural structure, the higher the net migration rate.
2. The higher the index of occupational dispersion, the *lower* the net migration rate.
3. The larger the proportion of whites occupying the same area as blacks, the higher the net migration rate.
4. The higher the ratio of white to nonwhite land in agricultural production, the higher the net migration rate.
5. The larger the average number of tractors per farm, the higher the net migration rate.
6. The larger the volume of gasoline consumed for agricultural purposes, the higher the net migration rate.

The hypotheses are not stated in causal terms because they are designed to examine differences in net migration between populations. Despite this, they do carry a causal implication in that they state how Southern Negro migration varies with each factor purported to be responsible for it.

If our model is to receive support, four of the hypotheses (3, 4, 5, and 6) should reduce toward zero when the appropriate controls are introduced. Note that we are not concerned with the variance explained by the particular set of variables under consideration, but with testing a research model which states that relationships between environment and migration, and technology and migration can be reduced when examined, with other organization factors controlled for.

Our model implies several additional hypotheses. Each of these relates an environmental or technological factor to our organization indicators. While these relationships are not explicitly stated above, they will be discussed below. Table 1 shows the mean and standard deviation for each variable included.

To test the six above hypotheses the rates of male net migration have been correlated

Table 1. Means and Standard Deviations for the Dependent and Independent Variables: 1940-1950 and 1950-1960

Variable[a]	1940-1950		1950-1960	
	Mean	Standard Deviation	Mean	Standard Deviation
Net migration	.441	.311	.683	.232
I.O.D.	.936	.152	.861	.136
I.A.S.	4.71	.72	4.12	1.07
W.N.A.R.	27.5	10.9	43.3	14.9
%W	57.5	21.4	60.2	20.5
GAS	16.8	12.5	96.9	67.7
TRACT	.06	.04	.30	.20

[a]The following notation is used to designate the independent variables in this and successive tables: I.O.D. = the index of occupational dispersions; I.A.S. = the index of agricultural structure; W.N.A.R. = white-nonwhite acreage ratio; %W = percentage white; GAS = farm per capita gasoline consumption for agricultural purposes; and TRACT = the average number of tractors per farm.

with each independent variable as measured at the beginning of the decade (Table 2). The coefficients are all in the predicted direction, though low or moderate in magnitude. The model is supported to the extent that during the two decades, the index of occupational dispersion is the first and second most highly associated factor with migration. It is not supported to the extent that the environmental and technological factors are also related to migration.

If the environmental and technological factors operate as predicted, we would expect them to be more closely associated with the organization indicators than with migration. As we see, (Table 3) this tends to be the case. Moreover, these relationships have a definite pattern. During each decade the environmental variables are more closely associated with the index of occupational dispersion and the technological variables with the index of agricultural structure.

Furthermore, this pattern indicates where the environmental and technological variables are more closely associated with migration than with the organization variables. That is, the white-non-white acreage ratio and the percent white tend to correlate higher with the index of occupational dispersion *and* migration than with the index of occupational dispersion.

While this may simply result from a selection of variables, it appears to support our general model in that we would expect

Table 2. Zero-order Correlation Coefficients between Rates of Male Net Migration and Six Independent Variables: 1940-1950 and 1950-1960

Period	Organization		Environment		Technology	
	I.O.D.	I.A.S.	W.N.A.R.	%W	GAS	TRACT
1940-1950	-.492[1]	.177[2]	.086	.167[2]	.229[1]	.314[1]
1950-1960	-.302[1]	.154[3]	.160[2]	.435[1]	.117	.248[1]

[1]F ratio significant at the .001 level.

[2]F ratio significant at the .01 level.

[3]F ratio significant at the .05 level.

Table 3. Zero-order Correlation Coefficients between Two Environmental Indicators, Two Technology Indicators, and Two Organization Indicators

Environment and Technology	1940-1950			1950-1960		
	I.O.D.	I.A.S.	MIG	I.O.D.	I.A.S.	MIG
White-nonwhite acreage ratio	-.160[1]	.117	.086	-.448[2]	.102	.160[1]
Percentage white	-.404[2]	.117	.167[1]	-.319[2]	.165[1]	.435[2]
Gasoline consumption	-.160[1]	.504[2]	.229[2]	-.027	.471[2]	.117
Tractors	-.220[2]	.499[2]	.314[2]	-.190[1]	.377[2]	.248[2]

[1]F ratio significant at the .01 level.

[2]F ratio significant at the .001 level.

farm technology to have greater impact on the organization of agriculture in particular than on sustenance organization in general. Furthermore, we would expect those environmental variables indicating white dominance to be more closely associated with the occupational dispersion of Negroes, since Negroes compete from a disadvantaged position and since whites dominate in more developed areas.

These considerations appear to support the idea that controlling for organization variables will reduce the association between technology and environmental variables and migration. To test our model further, we performed a partial correlation analysis. Since our organization indicators are crude and because they measure only the sustenance dimension of organization, we decided that to expect the partials to reduce to zero was unrealistic. We therefore anticipated merely a reduction toward zero.

The partial correlation analysis allowed us to examine the association between each environmental factor and migration, and each technological factor and migration, controlling for each organization indicator individually and in combination.[5]

Table 4 shows that the partials all reduce in the predicted direction at each successive level of control. Applying a statistical criterion, we find that during the 1940–1950 intercensal period statistically significant zero-order associations existed between one environmental (the percent white) and both technological factors and migration. The partial correlation analysis reduced two of these associations (those between the percent white and migration, and gasoline consumption and migration) below the level of significance. During the 1950–1960 period the partial correlation analysis reduced only one of three statistically significant zero-order associations (that between the white-nonwhite acreage ratio and migration) below the level of significance. In short, with the argument that the observed relationships should merely move toward zero, we find total support for our model, while with the more stringent argument we find only partial support for the model.

DISCUSSION

The above analysis leads us to conclude that broadening our concept of organization to include more than sustenance may have further reduced the zero-order associations between environment and migration and technology and migration. For instance, certain legal tactics have been used to keep Negroes on the land; perhaps in more mechanized areas where the need for croppers and laborers is less, such legal restraints are reduced as the need for black labor is reduced. Or, perhaps new laws promote migration, e.g., new welfare laws.

The technology indicators and the index of agricultural structure were most highly

[5] All the zero-order correlation coefficients needed to reconstruct complete matrices are included in Tables 2 and 3 above and path diagrams I and II below. We opted to present the zero-order coefficients in table form because this helps make more salient the theoretical considerations which are the paper's major focus.

Table 4. Zero-order Correlation Coefficients between Four Independent Variables and the Rate of Male Net Migration, and First- and Second-Order Partial Correlation Coefficients Controlling for the Index of Occupational Dispersion and the Index of Agricultural Structure: 1940-1950 and 1950-1960

Correlation Coefficient between the Rate of Male Net Migration and:	1940-1950			1950-1960		
	Zero-order	First-order Partial	Second-order Partial	Zero-order	First-order Partial	Second-order Partial
White-nonwhite acreage ratio	.086			.160[1]		
Controlling I.O.D.		.008			.029	
Controlling I.A.S.		.066			.157[2]	
Controlling I.O.D. & I.A.S.			.008			.019
Percentage white	.167[1]			.453[3]		
Controlling I.O.D.		-.040			.375[3]	
Controlling I.A.S.		.149[2]			.446[3]	
Controlling I.O.D. & I.A.S.			-.153			.371[3]
Gasoline consumption	.229[3]			.117		
Controlling I.O.D.		.174[1]			.116	
Controlling I.A.S.		.164[1]			.051	
Controlling I.O.D. & I.A.S.			.116			.059
Tractors	.314[3]			.248[3]		
Controlling I.O.D.		.242[3]			.204[1]	
Controlling I.A.S.		.264[3]			.206[1]	
Controlling I.O.D. & I.A.S.			.194[1]			.171[1]

[1]F ratio significant at the .01 level.

[2]F ratio significant at the .05 level.

[3]F ratio significant at the .001 level.

associated during the 1940–1950 period. This could support Hawley's argument that the sources of change in organization are external, because it was during this period that the mechanization of Southern agriculture really began. It does, however, raise the question of how technological and environmental factors are to be handled once they are introduced in a population. Hawley argues that they are always external. It appears, however, that every population has a "technology in use" which is part of the system and cannot be defined as external to it.

What appears important, however, is that our research demonstrates the feasibility of viewing the population rubric as the dependent variable in the ecological complex. A next step would be to investigate the possibility of viewing the other demographic processes as responses to organizational change. This step poses several problems. For instance, we already know that mortality can be substantially reduced among certain populations by mere technological intervention from others. However, at a certain point organizational change seems necessary to further reduce mortality. In certain populations where infanticide or gericide is practiced, mortality can be viewed as a response to organization.

Nor does this research clarify the situation with respect to migration. We have applied our ideas to a specific, non-typical, situation. What would have happened with areas of high in-migration or with a population not specifically Negro?

It will be fruitful to apply this model to relatively small areas with fairly large in-migrations. For instance, we could apply our ideas to the northern and western cities which have experienced large in-migrations of Negroes, or to areas associated with the rise of the space program. In these situations we would, of course, need to specify different sets of environmental and technological factors; but the general idea that these effect migration through their effect on the areas' organization could be tested.

While we cannot extend our analysis to other areas and situations, one other approach is open to us.

We have throughout our work followed the "Blalock methodology" (1960:337–343; 1968b, 1968c:155–198), and Duncan (1966:1) has noted that path techniques are particularly well suited to clarify the types of linear causal models Blalock suggested.

The path diagrams should not be expected to add anything new to what we have said, but as Duncan (1966:7) noted, they are invaluable, "As a pattern of interpretation . . ." [6]

The path diagrams, however, will allow us to consider more variables simultaneously, and to specify more clearly *how we see them* as operating. The reader should not overemphasize the import of these diagrams. They are based on cross-sectional data; and therefore, the time referent is inferred.

With this in mind we applied a multiple regression program to the data for all 253 counties, using the total Negro male net migration rate as our primary dependent variable. The path coefficients in the diagrams (see Figure 1: Path Diagrams I and II) correspond to the standard partial regression coefficients obtained through the multiple regression equation. The residual factors operating outside the system are the coefficients of alienation of the multiple regression on each intervening variable and the dependent variable, and indicate the variance in those variables left unexplained, with the system's variables accounted for.

The independent variables' intercorrelations (indicated by the curved, symmetrical arrows) on the one hand, tend to validate the rubrics and their variables. That is, each rubric's variables are more closely associated than the variables under different rubrics.

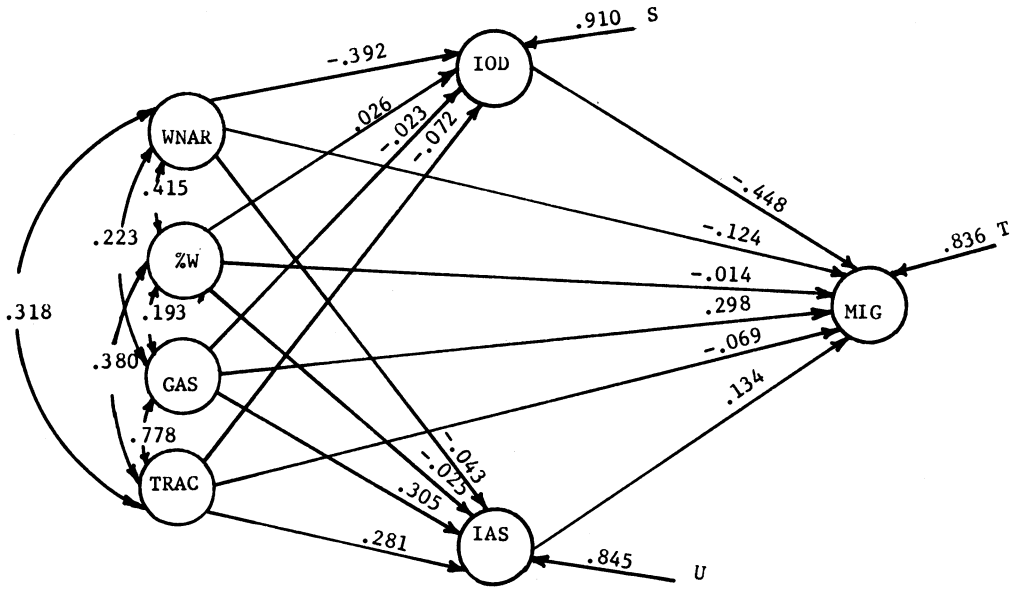
On the other hand, the high intercorrelations among variables under the same rubric violates the independence assumption of multiple regression analysis, and as we will see below causes interpretation problems.

If we draw from both diagrams, several interesting observations can be made. In general both tend to support the model. For during both decades the paths connecting environmental and technological factors are stronger than those connecting these factors to migration. Note in particular the relative strength of the paths from the environmental factors to the index of occupational dispersion, compared to the paths connecting environmental factors and migration. Similarily, much stronger paths connect technological factors to the index of agricultural structure than connect technological factors to migration. Also at this general level, the occupational dispersion of the black population has a much stronger effect on the migration rate than does the agricultural structure. The latter observation suggests that where niches are available outside agriculture, Negroes are less prone to leave an area. Thus, perhaps not simply the structure of agriculture has been responsible for the out-migration of blacks as much as the lack of access to niches outside agriculture. If we compare the two diagrams, we can make several added observations. First, for the index of occupational dispersion we see that in the '40's only the white-nonwhite acreage ratio appreciably effected occupational dispersion; whereas in the '50's the percent white and the two technological factors had the greater effect. Thus in the '40's, where whites had relatively more land, blacks were more dispersed in the sustenance organization; however, in the '50's, it is among counties with the greatest relative number of whites that we find the greatest dispersion of blacks. It could be that modernization is more likely to occur where whites predominate, and blacks pose a lesser threat when relatively fewer in number. These possibilities are further suggested by the positive path connecting tractors to occupational dispersion. That is, in counties where tractors have been most strongly adopted, blacks are less occupationally dispersed; and the sign of the relationship actually changes over the two decades.

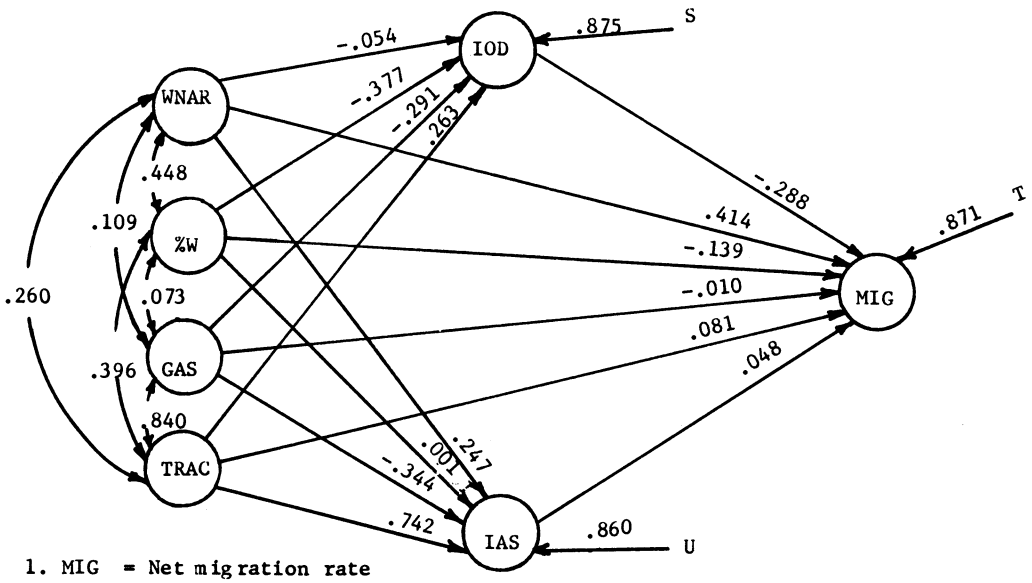
The structure of agriculture yields similarly interesting observations. For both

[6] The path technique is particularly useful for the goals we set for ourselves earlier; namely, looking at the pattern of relationships between variables to decipher how the various factors act on the dependent variable. More ambitious projects such as trying to explain a large proportion of the variance or to reproduce the original correlation matrix, should await more rigorous operational indicators.

FIGURE 1.[1] PATH DIAGRAM I: 1940–1950.



PATH DIAGRAM II: 1950–1960



1. MIG = Net migration rate
WNAR = White-nonwhite acreage ratio
% W = Percent white
GAS = Gasoline consumption
TRAC = Tractors
IOD = Index of occupational dispersion
IAS = Index of agricultural structure

decades the agricultural sustenance structure is most strongly influenced by technological factors; however, note the change in sign between decades of the paths between "GAS" and "IAS." Given the high correlation between "GAS" and "TRACT" for both decades, one can assume that the bulk of gasoline consumed goes into tractors; and this raises the question of how gasoline use could have different effects during the two periods.

This is perhaps best approached by

noting the "WNAR's" increased effect on the structure of agriculture in the '50's.

That is, we can see that the ratio of white to nonwhite land greatly effects the organization of agriculture; and it could be that where this ratio has increased more laborers are employed and mechanization less needed. Note also the relatively low correlations in the '50's between the "WNAR" and "GAS" and the "%W" and "GAS."

Perhaps a more plausible explanation is that some counties diverted more gasoline to self-propelled cotton pickers and adopted more tractor accessories, reducing the need for wage laborers, croppers, and tenants. That is, land holdings became increasingly concentrated in white hands; and with increasing mechanization fewer blacks were needed in traditional roles.

Finally, we can see that for both periods the general sustenance organization has a greater effect on migration than does the agricultural organization. In the '40's, the only path from an environmental or technological factor to migration stronger than one of the organizational factors comes from "GAS"; whereas in the '50's the "WNAR" has the greatest effect. The reduced paths from the organization factors to migration in the second diagram indicate a leveling off effect from the '40's. This could, in fact, partly indicate the effectiveness of the migration response in the '40's.

Separate analysis of migration estimates for these counties, however, indicates that the average rate of migration continued to rise, and that the standard deviation continued to decrease. Thus, we are led to believe that perhaps migration in the '50's was more random and less a response to organizational differences. Spilerman (1971) reported more discontent among Southern blacks in general in the '50's, and this may indicate that migration is relatively less a response to organizational change.

Finally, we would note that attributing Southern Negro migration to a decline in agriculture greatly oversimplifies a complex problem. In fact, perhaps we confront not a decline but a reorganization of agriculture and a concomitant lack of opportunity outside of it. In this sense the areas studied and their subpopulations resemble many underdeveloped areas of the world.

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