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DETERMINANTS OF THE RURAL EXODUS IN ZAMBIA: A STUDY OF INTER-CENSAL MIGRATION, 1963-1969

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DETERMINANTS OF THE RURAL EXODUS IN ZAMBIA: A STUDY OF INTER-CENSAL MIGRATION, 1963-1969[1]

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I. Introduction

The second complete census in the history of Zambia furnishes numerous opportunities for the study of social and economic change. In this paper, we analyse district-level changes in population which have resulted from internal migration. We focus upon the question: What are the determinants of migration in Zambia? In particular, we ask: What are the determinants of the exodus of people from the rural districts of Zambia?

II. The Data and Method

Factors Determining Migration

As the purpose of our research was to isolate and examine the factors determining migration in Zambia, we searched the literature to compile a list of factors for consideration. We included in that list several additional variables which are of particular interest to students of Zambia. These additional factors pertain to aspects of the government's rural development program, and we devote a section of our paper to an analysis of their impact upon rural depopulation. In the following table, we categorize the variables, indicate their measures, and note the sources from which they were taken. All measures pertain to districts units and most pertain to the year 1963 so that they can be related to changes in district populations over the subsequent period 1963-1969.[2] In the body of the paper we determine which combination of these variables allows us best to account for the changes in population due to migration from the various districts in Zambia.

Variable	Measure	Source
1. Demographic		
(a) District population, 1963	Total population	1963 census
(b) Population density, 1963	People per sq. mi.	1963 census
(c) Male/female ratio, 1963	Males/females	1963 census
(d) Percent educated, 1963	(No. "in" or "have attended" school /total population) x 100	1963 census
Indirect measures of income		
(a) % males "working for cash," 1963	(No. persons with work/total males) x 100	1963 census
(b) % males "seeking work," 1963	(No. persons seeking work/total males) x 100	1963 census
(c) Brick rooms per capita, 1963	No. brick rooms/ total population	1963 census
Measures of rural income		
(a) No. ploughs per capita, 1963	No. ploughs/total population	Native Affairs Report; 1963 Census
(b) No. cattle per capita, 1963	No. cattle 'total population	Native Affairs Report; 1963 Census
(c) % males deriving income from agriculture or fishing, 1963	(No. persons in farming or fishing/ total males) x 100	1963 census
Measures of distance and transport		
(a) Road miles improved, 1963-68	Miles	Annual Reports, Dept. of Transport and Communication
(b) Distance from boma to nearest town	Miles	Various maps

Variable	Measure	Source
Measures of governmental performance		
(a) Per capita capital expenditure, 1963-68	Total capital exp. / total population	Estimates of capital fund; 1963 census
(b) Per capita capital expenditure on agriculture, 1963-68	Capital exp. on agr. /total population	Estimates of capital fund; 1963 census
(c) Per capita capital expenditure on health facilities, 1963-68	Capital exp. on health facil. / total population	Estimates of capital fund; 1963 census
(d) Per capita capital expenditure on transportation, 1963-68	Capital exp. on transportation/ total population	Estimates of capital fund; 1963 census

Measure of Migration

Throughout the paper, we examine migration through the use of an index first applied to Zambia by Mary Elizabeth Jackman. The index is an estimate of the percent of the population change in a district between 1963 and 1969 that can be attributed to migration (Jackman, 1972). It is calculated by determining the percent level of population change in Zambia over the period 1963-1969 (K), adding that level of change to the 1963 population totals for each district, and determining the percent population change over 1963-1969 that is not accounted for by this estimate of the natural, per-district increase. More simply:

$$Y_i = \frac{Pop._i 1969 - (Pop._i 1963 + K \times Pop._i 1963)}{Pop._i 1963} \times 100,$$

where i is any district, Y_i is the estimate of the percent population change of that district that is caused by migration in the period 1963-1969, and K is the natural rate of increase in the population of Zambia as a whole.

Where in-migration has taken place, then this measure is positive; conversely, out-migration yields negative values of this index. Similarly, factors promoting in-migration--such as high district income--will be positively related to this measure; those that encourage out-migration will bear negative relationships with it.[3]

Method of Analysis

In selecting the set of variables that best account for changes in population due to migration in Zambia, we utilize a least squares regression model. As we wish our readers to be able to comprehend and critically evaluate our results, we will briefly explain this statistical method.

Linear regression is based upon a model of the relationships between phenomena. It states that a phenomenon, Y (in this case the percent of population change due to migration), is a function of one or more independent variables, $X_1 \ldots X_n$; and that this function is linear and so can be expressed as an equation of the form

$$Y = A + B_1X_1 + \cdots + B_nX_n + E,$$

where A is the intercept value of Y and E is the error, that is, the amount of the phenomenon that is accounted for by factors not included in our explanation. The B_i's are the regression coefficients and tell us the effect of any X_i on Y, while the other measured factors (other X_i's) are controlled. When we infer such effects, we do so by observing concomitant variations. Thus, the B_i's tell how Y will change when a given X_i varies, other things being equal.

In practice, we do not know the true effects of X_i upon Y and can only estimate them. The linear regression model makes such estimates according to the principle that the best estimate is one

which enables us, when given a value for each X_i, to predict the value for Y with minimum error, where the error is measured in terms of the difference between the predicted value and the observed value for Y.[4]

Our estimated equations, then, will be of the linear form, as above, and will tell us the estimated effects of the X_i's upon Y. Associated with these equations will be information regarding the quality of our estimates. One such indicator is the multiple correlation coefficient --R^2--which tells us the proportion of the total variation in Y which we have explained with our equation. Another indicator is the F-ratio, which tells us whether the factors we have selected and combined in a linear form achieve a significant ratio between the variation in Y which they do predict and the variation in Y which they fail to predict-- the error. Lastly, there will be a t-score associated with each of the regression coefficients (the B_i's). The t-score tells us the degree to which the variable (X_i) produces changes in migration (Y) which are significantly different from 0. When we state that the coefficient measuring this change (B_i) is significant, we mean that the likelihood of producing by chance a value for the coefficient as far from 0 as the value we have obtained is 1 or fewer times out of 100; that is, that the value of the coefficient is significant at the .01 level. Alternatively, we may state that the value of the coefficient is significant at the .05 level; the meaning is then analogous to what we have just set out above.

Applying regression analysis, we therefore attempted to isolate that group of variables from our list that had the greatest affect upon migration, as measured by their ability to produce the most significant changes in our index of migration; and which, when combined in a linear form, produced a high proportion of explained variation in rates of migration --a high R^2 --and a high ratio of explained to unexplained variance --a high F-statistic.[5]

To utilize linear regression, it is necessary to make several assumptions about the data. One of these assumptions is of particular relevance to the study of migration. A requirement of the significance tests is that the different observations be independent of each other; the value of a given variable in one district must be independent of its value in another. But in the cases of our migration data, outflows of persons from rural districts become inflows of persons into urban areas; our measures of migration in the different districts are thus interdependent. In searching for the group of variables which best account for variations in the index of migration, we therefore restrict our attention to the rural subset of districts from which there are predominantly outflows of persons.[6] We will note this shift in our attention in the analysis below.

III. Data Analysis

The Pattern of Migration

As would be expected, the pattern of relationships across all the districts in Zambia strongly suggests that recent migration was from the rural areas to the towns. Thus, pair-wise correlations reveal high rates of in-migration to districts of high wage employment, high population density, and a high ratio of males to females. These, of course, are the classical attributes of urban centers in Africa (Hanna and Hanna, 1971). In turn, out-migration correlates with the percent of males in agriculture and fishing; the number of cattle and ploughs; and the distance of the district from town. The redistribution of the population from the rural to urban centers could not be more vividly captured by the data.

Table 1 near here

While this analysis, utilizing both urban and rural districts, suggests the direction of migration flows, we hesitate to use it to

Table 1

All Districts:

Pair-wise correlation coefficients with index of migration

Population density	+ .6513*
Male/female ratio	+ .6938*
Percent males employed for cash	+ .8101*
No. of ploughs per capita	- .1589
No. of cattle per capita	- .1804
Percent males in agriculture and fishing	- .4008*
Distance to nearest town	- .6194*

*Significant at the .01 level of confidence, two-tailed test.

infer the determinants of their magnitude. The reasons for this are the constraints that we face when attempting to analyse our data through the use of regression analysis, as set out above. Nonetheless, we can take a different tack. Utilizing all the districts for which the estimated changes in population due to migration represent outflows, we can proceed with the analysis.[7] By shifting our research question to -- What determine the differences in the rates of out-migration from districts in Zambia? -- we can avoid the problem of interdependence and still investigate a critically important subject: the determinants of the exodus of people from the rural sector in Zambia.

The Determinants of Out-Migration

From the list of factors suggested in the literature, we seek a collection of variables with the following properties: each included variable would have a stronger effect upon migration than any variable not in the set; each, by being in the equation, would produce a significant reduction in the unexplained variance in migration; and collectively the set of variables would have a high F-ratio and R^2. Our search results in the following equation:

(a) The 'best' equation

$$Y = 28.24 - 34.42(x_1) - .6697(x_2) + 10.75(x_3) + 16.75(x_4) + .4833(x_5)$$
$$(-1.851)^{*} \quad (-3.748)^{**} \quad (4.510)^{**} \quad (2.049)^{*} \quad (1.758)^{*}$$

The t-ratios are in parentheses; t-ratios significant at .05 level, one-tailed test, are denoted with *; **--t-ratios significant at .01 level, one-tailed test.

$R = .8011$ $R^2 = .6418$

F-ratio = 7.882, which is significant at the .01 level.

The standard error of the estimate is 4.55% change in population due to migration, over a mean change in population due to migration of - 11.9 % and a standard deviation of 6.86%

Number of districts — 28.

Y = estimated percent change in district population due to migration, 1963-1969.

x_1 = ratio of males to females, 1963.

x_2 = percent of total population in or having attended school, 1963.

x_3 = No. of cattle, per capita, 1963.

x_4 = No. of brick rooms, per capita, 1963.

x_5 = No. of persons working for cash as a percent of males, 1963.

b. Discussion of the 'best' equation.

This set of factors, combined in a linear form, explains nearly two-thirds of the variance in the district level rates of migration, as measured in terms of Jackman's index.

Two of the demographic factors suggested in the literature, -- the percent of the population which has been educated and the male-female ratio--enter the 'best fitting' equation. The regression coefficients indicate that the more educated the population of the district, the greater the tendency to migrate. Indeed, if one district had 10% more of its population with some education than did another in 1963, then our equation suggests that it subsequently lost almost 7% more of its population in the form of out-migration. The coefficient of the sex ratio variable indicates that the greater the ratio of males to females in 1963, the greater was the out-migration in the inter-censal period. This is an intriguing finding, for it strongly suggests that, as was historically true in Zambia, out-migration from the rural districts of Zambia in in the 1960's represented principally an exodus of men to town. Had inter-censal migration resulted from women of districts of historically high labor migration following their men to town, as Jackman suggests (p. 45), then we should have found that the lower the male-female ratio in 1963, the higher the out-migration. Instead, as shown by our negative coefficient, having a higher ratio of males to females in 1963 led to greater out-migration, other things being equal.

The coefficients for the remainder of our variables, all positive in sign, underline the finding that the greater the level of economic opportunity in the rural districts in Zambia, in 1963, the lower was the subsequent level of out-migration. Of these variables, the per capita number of brick rooms (x_4) is used merely as a surrogate for direct measures of prosperity. The presence of this variable is significant, but it is difficult to discuss its importance beyond noting the support it lends our general findings. The importance of cash employment as a determinant of migration is underlined by the coefficient of (x_5). With less than 20% of the jobs in Zambia located in the rural areas in 1963, these few opportunities for wage employment nevertheless significantly decreased the levels of out-migration in the inter-censal period. Other things being equal, districts with 10% more males in cash employment in 1963 experienced more than 4% less out-migration. The last of these variables is the per-capita number of cattle. Its coefficient is positive and large, and suggests that, *ceteris paribus*, an increase in the herd size of a district of one head per person in 1963 would have produced nearly an 11% decrease in out migration. At several points in this paper, we shall return again to the effects of cattle on migration. Here we merely emphasize that this variable appears to have been the strongest single determinant of differences in district rates of out-migration in Zambia in the 1960's.

In making this assessment, we have used two procedures. The first is to convert each of our measures into standardized, and

therefore comparable, units; by converting the variables into similar units, we can compare their importance as determinants of migration by comparing the magnitudes of their regression coefficients.

$$Y = -.3489(x_1) - .6521(x_2) + .8018(x_3) + .3459(x_4) + .3209(x_5)$$

The relative size of the coefficients strongly suggest that cattle is the most important variable; the percent population having attended school, second in importance; and the remaining variables roughly of similar importance as determinants of out-migration.[8]

A similar ordering is conveyed when we compare the t-scores of the several coefficients. The square of the t-score can be regarded as a measure of the gain in explained variation that is obtained by including the variable in the regression equation.[9] The relative size of the t-scores can, therefore, be used to suggest the relative importance of the variables in reducing unexplained variations in the rates of population change due to migration. Applying this criterion, we can see that the number of cattle per capita again comes first; persons in school, second; and our indirect measure of prosperity--per capita number of brick rooms--third in importance as determinants of out-migration.[10]

Regional Variations in Migration

It is interesting to determine if there are significant variations in the patterns of migration between the provinces in Zambia. This question breaks down into two separate inquiries. The first is: Are there differences in the tendencies toward migration from the several provinces which are significant enough that we must take them into account in attempting to explain the overall pattern of rural out-migration in Zambia? The second is: Do the determinants of out-migration behave in a significantly different fashion in the various areas of the nation?

a. First inquiry

The first question involves an examination of the intercept term. Hitherto, we have employed a single intercept. Here we will split the term and calculate separate intercepts, one for each province. Different values for the intercept term could arise if, for example, one province contained unique features--e.g., particularly poor land, or unusually favorable agricultural conditions--or if some provinces were more strongly affected than others by some unmeasured factor--proximity to routes of labour migration to the south, for example, or to theatres of guerilla war. To determine if such possibilities were realized, we generated the following equation:

$$Y = 14.10\ (\text{Luapula}) + 16.94\ (\text{Northwestern}) + 19.91\ (\text{Northern}) +$$

$$20.75\ (\text{Southern}) + 23.75\ (\text{Eastern}) + 24.80\ (\text{Central}) +$$

$$27.67\ (\text{Western}) - \underset{(-\,0.9943)}{24.96(x_1)} - \underset{(-\,3.722)^{**}}{.8074(x_2)} + \underset{(3.142)^{**}}{10.52(x_3)} +$$

$$\underset{(3.012)^{**}}{36.71(x_4)} + \underset{(1.095)}{.3942(x_5)}$$

The t-ratios are in parentheses; **–t-ratios significant at .01 level, one-tailed test; no t-ratios are significant at .05 level, level, one-tailed test.

$R = .8745, \quad R^2 = .7648$

F - ratio = 4.730, which is significant at the .01 level.

Two properties of this equation are notable. The first is that the intercept terms do vary. Thus, for example, Luapula, having

the lowest positive value for the intercept term, has the greatest tendency to out-migration. We know that the sudden non-convertibility of Congolese currency in the early sixties wiped out earnings from the fish trade to Katanga (save those that could be reconverted into Zambian currency by smuggling) and thereby undermined the principal source of prosperity in this area; we can speculate that this, in turn, engendered high levels of out-migration. The high value of the intercepts in the Central and Western Provinces indicate that they have the smallest tendency to lose population through migration. In the case of the former, proximity to the copperbelt and line of rail could account for its relative attractiveness. In the case of the latter, the repatriation of labor migrants from the south and the influx of refugee populations from Angola are the most likely causes of its high intercept value.

To return to the principal question, however, we must note that despite these provincial differences, applying an F-test of inclusion in this group of intercept terms indicates that taking account of the different provincial tendencies toward migration does not significantly reduce the unexplained variations in the district level rates of migration in Zambia. Demonstrably, the provinces do have different levels of migration. Our finding, however, is that these differences largely arise from their containing to different degrees the factors which we have included in our model.

b. Second inquiry

Our second inquiry concerns the stability of the coefficients of our variables. For example, we seek to determine whether the effect of cattle upon the magnitude of out-migration is the same everywhere in Zambia, or whether it varies in its effects from one province to another.

We utilize a straightforward method. For each province, we estimate the relationship between our several independent variables and migration for all the districts falling outside that province. We then determine whether this relationship enables us to predict the level of migration from each of the districts in the province on the basis of our knowledge of the value in those districts of the several independent variables.

Essentially, we are creating, for each district in the province, a variable $(y - \hat{y})$, where y is the observed rate of migration from that district and $\hat{y}$ is the level of migration that should take place from that district if the factors determining migration behave within the district in the same way as they do in the other provinces in Zambia. When this variable acquires a significant coefficient, then our prediction is erroneous. In that case, we have determined that the factors influencing migration behave outside of the province within which that district falls in a way that is significantly different from the way in which they behave within it.

In the case of the districts in four of the provinces--Western, Eastern, Luapula, and Northern--we were able to predict accurately the levels of migration on the basis of the coefficients estimated from data taken from the other provinces in Zambia. Only in the case of two districts--Chinsali and Sesheke--did the differences between the predicted and observed levels of out-migration approach significance. In the case of the first, more out-migration was observed than we had predicted; no doubt the exodus of people following the Lumpa uprising contributed to this finding. Despite this turmoil, the level of out-migration from Chinsali was nevertheless insignificantly greater than what we would expect, given the sex-ratio, level of education, and so forth, in Chinsali in 1963 and our knowledge of how these factors effected subsequent levels of migration in the other provinces in Zambia. In the case of Sesheke, we find that there is less out-migration than we would have expected, given the value of the independent variables in the district. Evidence

contained later in the paper indicates that the most likely cause of the discrepancy was the level of government spending in Sesheke and not any variation in the behavior of the determinants of migration between the Western Province and the other provinces in Zambia.

In the case of districts in Southern, Northwestern, and Central Provinces, we obtain significant differences between the estimated and observed rates of out-migration. To illustrate these results, we present the equation for the Southern Province.

$$Y = 17.38 - \underset{(-1.917)^{*}}{30.23(x_1)} - \underset{(-3.793)^{**}}{.6030(x_2)} + \underset{(5.229)^{**}}{19.17(x_3)} + \underset{(3.582)^{**}}{26.35(x_4)}$$

$$+ \underset{(2.488)^{*}}{.7726(x_5)} - \underset{(-2.314)^{*}}{12.43(\text{Choma})} + \underset{(0.9581)}{3.807\ (\text{Gwembe})}$$

$$- \underset{(-2.997)^{**}}{16.29\ (\text{Kalomo})} - \underset{(-2.495)^{*}}{13.07\ (\text{Mazabuka})} - \underset{(-2.755)^{**}}{21.05\ (\text{Namwala})}$$

The t-ratios are in parentheses; t-ratios are significant at the .05 level, one-tailed test, are denoted with *; **--t-ratios significant at .01 level, one-tailed test.

$R = .9014, \quad R^2 = .8125$

$F = 7.371$, which is significant at the .01 level.

On the basis of our knowledge of the number of cattle per capita, etc. in the rural districts of the Southern Province in 1963, we have attempted to predict the subsequent levels of out-migration from these districts; our prediction is based upon our knowledge of the relationships between these factors and levels of out-migration from the districts of the other provinces of Zambia. The coefficients of the district estimates indicate that by using this procedure, we in most cases significantly underestimate the level of out-migration in the Southern Province. In the case of Namwala, for example, we underestimate the loss in population by a full 21%. This suggests that the factors promoting out-migration are much stronger, or the inhibitors much weaker, in their effects in the Southern Province than is true elsewhere in Zambia.

A comparison of the coefficients in this equation with our national level equation suggests the factors responsible for our poor predictions. In the case of cattle, it is apparent that when we exclude Southern Province data while estimating the effect of cattle upon migration (as we have done in the last equation), then the coefficient is much stronger than when we include the Southern Province data (as we did in the national level model). The coefficient of the employment variable shifts in a similar fashion.[11] These shifts suggest that we split both variables and allow them to have different effects, one in the Southern Province and one elsewhere.

A similar analysis of the results from the Northwestern Province indicates that the education variable differs in its effects between that province and elsewhere. Specifically, education less strongly promotes out-migration from the Northwestern Province than it does elsewhere in Zambia. Comparing the coefficients between the Central Province estimates and the national-level model fails to reveal any coefficient shifts that would explain our inability to predict accurately the district level rates of out-migration from that area. This is not too surprising, however, given that our predictions are based upon an equation that we now know to be defective.

On the basis of this reasoning, we re-estimated our equation, splitting the coefficients for education, cattle, and wage employment.

Let x_2' be the percent population educated for the districts in Northwestern Province, 1963, and x_2'', the percent educated for the districts in the other provinces in Zambia; x_3', the number of cattle per capita 1963 for the districts of the Southern Province, and x_3'' the per capita number of cattle for the districts elsewhere in Zambia; and x_5', the percent of males working for cash, 1963, for the districts in Southern Province and x_5'', the value of this variable for the districts elsewhere in Zambia. Our new equation is:

$$Y = 15.81 + 27.73\,(\text{Southern Province}) - 26.29\,(\text{Northwestern Province})$$

$$\underset{(-1.726)}{-\,23.39(x_1)} + \underset{\substack{(3.154)^{**}\\ \dagger}}{1.403(x_2')} - \underset{(4.628)^{**}}{.6984(x_2'')} + \underset{\substack{(-2.600)^{**}\\ \dagger}}{7.02(x_3')} + \underset{(5.738)^{**}}{17.16(x_3'')}$$

$$+\,\underset{(3.063)^{**}}{20.97(x_4)} - \underset{\substack{(-2.419)^{*}\\ \dagger}}{.0819(x_5')} + \underset{(2.706)^{*}}{.7103(x_5'')}$$

The t-scores are in parentheses; t-ratios significant at the .05 level, one-tailed test, are denoted with *; ** — t-ratios significant at the .01 level, one-tailed test; † — t-scores measuring significance of differences between coefficients of x_i' and x_i''.

$R = .9393, \quad R^2 = .8823$

F-ratio = 12.75, significant at the .01 level

In this case, the t-scores for variables x_2', x_3', and x_5' indicate that the value of the coefficients for these variables differ significantly in the Northwestern and Southern Province, respectively, from the values they take on elsewhere in Zambia.

Use of this modified equation enables us now to predict accurately the levels of out-migration from the districts of the Central Province.

In Table 2 we present the size and the significance of the errors of our predictions for the rural districts in Central Province, using the old and revised equations.

Table 2 here

We have determined, therefore, that in the vast majority of cases the factors we have examined do not significantly differ in their effects upon migration in the different areas of Zambia. What of the exceptions to this rule? Two of these are associated with the Southern Province. Wage employment had significantly less effect upon migration from the Southern Province than it had upon migration from elsewhere in Zambia; indeed, applying a t-test to the value of the coefficient to (x_5') suggests that wage employment had no statistically significant effect upon out-migration from the province, when other factors were controlled. We can speculate that the employment for wages was, in the Southern Province, tied to the agriculture of the area; and that with the effect of agriculture upon migrations controlled, wage employment *per se* became insignificant as a determinant of migration. The relationship between cattle and migration was also much weaker in the Southern Province than in the other provinces of Zambia. In interpreting this finding, we can note that the mean number of cattle per capita in the Southern Province in 1963 was 1.331; whereas, in the rest of Zambia, the mean number of cattle per capita was 0.225. It is therefore not surprising that the marginal effect of a change in the number of cattle would be relatively small in the Southern Province, given the large numbers of cattle already there. To be noted is that most of the total effect of cattle on migration nonetheless results from cattle in Southern Province; it is the marginal, not the average, effect which is weaker in this area.

Table 2

Rural Districts, Central Province:

Difference between Obtained and Estimated

Levels of Out-Migration, using

	Old Equation		New Equation	
	%	t-scores	%	t-scores
Mkushi	7.61	1.410	2.65	0.5249
Mumbwa	8.06	1.781	4.66	1.389
Serenje	-5.77	-0.1248	-0.258	-0.0793

As to why increased educational levels in the Northwestern Province in 1963 should have led to less out-migration, whereas the reverse was true elsewhere in Zambia, we do not know. This is the one result that, to us, defies plausible explanation. Perhaps those more familiar with the area could offer hypotheses to explain this finding.

The Effect of Governmental Programs

The government has noted the exodus of persons from the rural areas and has attempted to restrain it through a variety of measures. The government furnishes services to the rural areas--schools, hospitals, clinics, transport facilities--and finances increased agricultural production, thus increasing the level of real income and reducing the incentive to migrate. While we lack information on important aspects of these expenditures--the magnitude of agricultural loans, or the level of recurrent expenditures of the extension services in each district--we nonetheless do have a record of actual capital expenditures for a variety of relevant programs.

The question we ask is: Are governmental expenditures on rural development programs as significant in their effects on migration as are the non-governmental determinants of migration? And if so, what are the magnitudes of their effects? To answer these questions we entered the public sector variables into our data pool and again selected out those factors that were the most important determinants of differences in the district level rates of migration and which collectively yielded a strong F-ratio and R^2.

Before presenting our results, we must register a major point of caution. Given that significant expenditures in the rural sector commenced only after independence, we needed to collect data on government expenditures from 1963 to 1968 in order to achieve a reliable number of observations. The difficulty with this procedure is

that since we measure expenditure and migration over nearly identical time periods, if we do find a positive relationship between the two, it can plausibly be interpreted as reflecting the tendency of the government to expend capital funds in areas into which people are moving. As there is clearly a logical relationship between increases in the magnitude of government services and increases in the numbers of people, this is a plausible counter interpretation. By using expenditure data as recent as 1968, we therefore run the risk of losing our ability to infer any causal impact associated with rural development programs.

This argument notwithstanding, we feel justified in offering our results. Firstly, we feel that problem would indeed be a significant one had we included the urban districts in our sample. Then we certainly could not rule out the possibility that increased expenditures were, for example, resulting from the inflow of persons into town. But as we have noted, we have excised these districts from our data set. In all of the districts we use, there is instead a loss of people due to migration. It therefore makes little sense to interpret a positive relationship between migration and expenditure as showing that increased government expenditure results from in-migration. Rather, it seems more plausible to view such a positive coefficient as revealing the capacity of government expenditure to retard out-migration.

Moreover, to anticipate our results a little, we find that a close inspection of the expenditure variable that makes the most significant difference on migration--per capita capital expenditure on health facilities--reveals that it takes its highest values in areas with the greatest out-migration (Luwingu and Mpika, for example) and its lowest values in areas with the least out-migration (the rural districts of the Central and Southern Provinces, for example). This pattern hardly supports an interpretation of our results in terms of the proposition that the government spends where people go; but it does support an interpretation suggesting the capacity of public expenditure to retard out-migration.

A re-analysis of our results leads to the following equation:

$$Y = 35.36 + .7850(x_1) + 3.405(x_2) - 37.43(x_3) - .7058(x_4)$$
$$(1.340) \quad (3.084)^{**} \quad (-2.472)^{*} \quad (-4.526)^{**}$$

$$+ 11.79(x_5) + 16.68(x_6) - .4259(x_7)$$
$$(5.924)^{**} \quad (2.327)^{*} \quad (-2.060)^{*}$$

The t-ratios are in parentheses; t-ratios significant at .05 level, one-tailed test, are denoted with *; **—t-ratios significant at .01 level, one-tailed test.

$R = .8679$ $\quad R^2 = .7533$

F-ratio = 8.722, which is significant at the .01 level.

The standard error of the estimate is 3.96% change in population due to migration, over a mean change in population due to migration of - 11.9% and a standard deviation of 6.86%.

Number of districts—28.

Y = estimated percent change in district population due to migration, 1963-1969

x_1 = government capital expenditure on agriculture, per capita, 1963-1968

x_2 = government capital expenditure on health, per capita, 1963-1968

x_3 = ratio of males to females, 1963

x_4 = percent of total population in or having attended school, 1963

x_5 = No. of cattle, per capita, 1963

x_6 = No. of brick rooms, per capita, 1963

x_7 = No. of persons seeking work as a percent of males, 1963

All of our previous variables re-enter the equations, save for cash employment; instead, its near converse--persons seeking work as a percent of males--replaces it. Of our several public expenditure variables, one--per capita capital expenditure on health facilities--becomes the third most important variable in the equation, lagging in significance only behind cattle and education; another, per capita agricultural expenditure, is significant at the .10 level. We have retained it in the equation because it is of substantive interest and because it is strong by comparison with all the variables that remain outside of the equation. It is much closer in its level of significance to the included than to the excluded variables.

In both cases, the coefficients of the expenditure variables are positive. We feel justified in concluding, therefore, that expenditures by the public sector can retard the flow of persons out of the rural areas. However, from the point of view of public policy, it is unfortunate that both of the coefficients are small. The coefficient of (x_1) suggests that it would take an expenditure of approximately 2 kwacha on the agriculture of a district for every man, woman, and child to produce a 1.5% decline in out-migration. The returns to health care expenditures are somewhat higher, the coefficient of variable (x_2) suggesting that a 1 kwacha per capita expenditure for new hospitals and clinics can result in a decline in out-migration of almost 3.5%. In both cases, ceteris paribus conditions must obtain. We tested for the stability of these coefficients across the several provinces and found no significant changes in their magnitude.

We have therefore shown that migration is demonstrably responsive to government expenditures and that, for a price, the government can produce significant percentage decreases in the exodus from the rural sector. Ironically, this optimistic conclusion pales when conjoined with the evidence concerning the pattern of the allocation of government funds between rural and urban districts in Zambia. For, on balance, it is likely that the government, despite its goals, has done more to promote the exodus than to stem it by concentrating its expenditures so heavily in the urban zones in Zambia.[12]

IV. Discussion

By reviewing the literature, we have selected a set of variables which, it has been suggested, affect rates of migration. Through the use of regression analysis, we have isolated the subset of these variables that best account for the different levels of migration from the rural districts in Zambia. And we have determined that this subset of variables operates, by and large, uniformly throughout the vast majority of the districts in Zambia. Up to this point, however, we have not attempted to speculate as to the nature of the migration process. We have been empirically oriented, and have not ventured into the realm of explanation.

On the basis of our empirical work, however, we are led to appreciate the possible power of economic explanations of migration. Consider the nature and behavior of the variables that made it into our last equation. Our measures of governmental performance (x_1 and x_2) are measures of expenditures by government; and where government expenditure increases, out-migration goes down. Where rural economic activity increases, through the use of cattle (x_5), out-migration decreases. Where the rural area is prosperous, as measured by the standard of housing (x_6), then migration again decreases. The incentives for out-migration are also amenable to an economic interpretation. Most obviously, as shown in (x_7), when persons cannot find employment locally, they tend to leave. Less obvious, but also important, persons with schooling are more likely to expect higher incomes; being educated, they may have an even stronger economic incentive to leave the rural areas. Thus, the behavior of (x_4).

Given the pervasive plausibility of an economic interpretation of our analysis, we attempted to construct several "economic" models to explain rates of out-migration.[13] We began simply by proposing that the more people can increase their probability of wage employment by migrating from a rural district to the urban areas, the greater the rate of migration from that district.

Our model is simply

$$Y_i = a + b(P_{\overline{u}} - P_i)$$

where Y_i = the estimated change in population of district i due to migration, 1963-1969; P_i = the probability of cash employment in district i, as measured by the percent males in cash employment in the district in 1963; and $P_{\overline{u}}$ = the mean probability of cash employment in the urban sector, as measured by the mean per cent of males in cash employment in the several urban districts in 1963.

We find that

$$Y = 1.287 - \underset{(-1.431)}{.4068}(P_{\overline{u}} - P_i).$$

t-score in parentheses, not significant at conventional confidence interval. F = 2.046, not significant. R = .2701, R^2 = .0730.

The sign of the coefficient is in the expected direction and its magnitude is nearly significant. But the low level of significance and the low R^2 do not engender much confidence in our proposition.

As a second attempt, we hypothesized that the prospective migrant will discount the costs of migration before deciding to move. As a surrogate for these costs, we used the distance to the nearest town (D_i).

Our model is:

$$Y_i = a + b_1(P_{\overline{u}} - P_i) + b_2(D_i).$$

We find that

$$Y = 0.8711 - \underset{(-1.167)}{.3748}(P_{\overline{u}} - P_i) - \underset{(-0.2308)}{.0022}(D_i).$$

t-scores in parentheses, not significant at conventional confidence level. F = 1.013, not significant. R = .2737, R^2 = .0749.

This model is even weaker than its predecessor; and its predictions also fall within the range that could be created by chance a significant percent of the time.

At this point, we decided to allow our prospective migrant to discount as well the opportunity costs of migration. In calculating whether to leave a district, the migrant, we felt, does not merely assess the relative probabilities of employment and the costs of migration; he also assesses the level of income which he most forgo upon leaving the district. We indexed the standard of prosperity of the district by the number of cattle (C_i) and the number of brick rooms (BR_i) per capita.

Our model is:

$$Y_i = a + b_1(P_{\bar{u}} - P_i) + b_2(C_i) + b_3(BR_i) + b_4(D_i).$$

We find that

$$Y_i = -9.950 - 0.07962(P_{\bar{u}} - P_i) + 5.239(C_i) - 6.359(BR_i) - .0011(D_i).$$

$$(-0.2353) \qquad (1.735)^{*} \qquad (-0.5941) \qquad (-0.0987)$$

t-scores in parentheses; *significant at .05 level. F = 1.779, not significant. R = .4861, R^2 = .2363.

Again, this model performs little better than chance.

As a last attempt, we inserted the term expressing the differences in the probability of employment into the last equation presented in Section III, substituting it for the "old" measure of rural employment (percent males seeking work). In this case, the F-ratio remained highly significant and the R^2 remained impressive; but our new term was not as significant as the percent of persons seeking work.

V. Conclusion

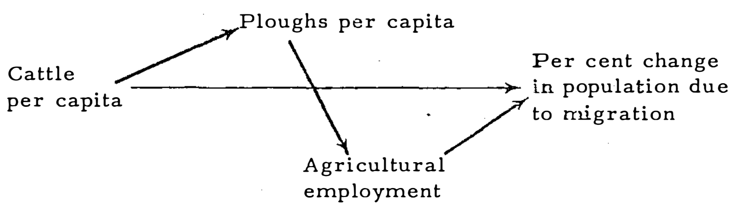
In conclusion, we would like to discuss two important questions. Why should cattle be so important a deterrent to out-migration? And, secondly, why does the variable of distance perform so poorly in our prediction equations?

All that we have seen leads us to be highly suspicious of any "cultural receptivity" explanation of the effect of cattle on urban migration.[14]

Migration appears simply to be too responsive to economic factors for a cultural, value-based explanation to be of any power. In some crucial sense, it would appear, cattle figure into the rational calculus of the migration decision in a way that makes migration less attractive to the village resident. We feel that cattle do so in at least two ways.

Urban migration can be seen as a form of investment (Herrick, 1970; and Sjaastad). We can view residents as educating and training their children in preparation for wage employment and then attempting to tax a portion of the children's earnings in the city in the form of cash remittances as a means of gaining income in their old age. Any such investment is risky, however, as migrants may be "lost," and thus the expenditure on their training and education lost as well. Any form of storable wealth--wealth that can be dissaved in old age--promises a return that under many conditions may be greater than the discounted rate of return from investments in unpredictable and possibly fickle children. In societies where there are cattle, therefore, the returns from cattle will compete with the returns from investments in children, and there will be less support for a system of urban migration.

Secondly, cattle are also directly productive. They form the basis for more profitable farming, and thus a basis for generating income in the rural areas. Given this income, there is less of an incentive to migrate to the cities.[15] There is strong evidence in our data for this interpretation of their role. Thus, there is a highly significant relationship between the numbers of cattle and the numbers of ploughs per capita [r = .890; t = 9.959, df = 26), and a significant relationship, in turn, between the number of ploughs per capita and the percent of males in agriculture (r = .333; t = 1.799, df = 26). The result of these relationships is a decline in the rate of out-migration, resulting in part directly from cattle and in part from the indirect effect of cattle on agricultural employment. The structure of the relationships appears to be as follows:[16]



What about distance? Why does distance fail to achieve significance in our equation, especially given its reported power in so many other studies?[17] The primary reason is that distance itself so powerfully correlates with factors that promote migration in Zambia. As is shown in the equations above, distance is in fact negatively related to changes in population due to migration, indicating that the farther the district is from the urban centers, the greater the out-migration. The reasons for this are suggested in our pair-wise correlations, which show that to be far away from the cities is to have less government expenditure, fewer ploughs and cattle, lower levels of cash employment, more persons seeking employment, and lower rural income, as revealed by the per capita number of brick rooms.

In keeping with our economic interpretation of the materials, we can treat distance as a cost item. To be far away from the urban markets is to operate any productive enterprise, agricultural or industrial, at a higher level of costs; reduced profitability will result, thereby accounting for lower incomes, less plentiful jobs, and the relative absence of

superior agricultural technologies, such as those based on the use of cattle.[18] Similarly, the further the district from the urban centers, the greater the costs to government of programs in that area. We should, therefore, expect the government, insofar as it is economically motivated, to make fewer capital expenditures in the remoter areas.

The reason we failed to obtain significant relationships with our distance variable is, therefore, that distance is so intimately related with other factors that promote out-migration in Zambia that it has no independent effect upon the phenomenon. Nothing could better underline the geographical patterns of development and prosperity in Zambia over the period 1963-1969 than this finding; nor could anything better emphasize the relative impoverishment of the off the line of rail districts and the response of their residents to their relative lack of well-being.[19]

Notes

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Consideration of the size and density of population is suggested by Ohadike (1969a), Colson (1960), Beals et al. (1967). For the male/female ratio, see Kay (1971), Jackman (1972), Kapferer (1966) and Bogue (1961). For the effect of education on migration, see Beals et al. (1967), Herrick (1969), Greenwood (1969), Caldwell (1969). For the use of employment variables, see Ohadike (1969a), Harris and Todaro (1970), Greenwood (1969). And for the importance to migration of income and income differentials, see Okun and Richardson (1961), Ravenstein (1885, 1889), Sahota (1968), Colson (1960), Friedlander (1965), Gugler (1968), and Caldwell (1969). The distance variable has featured in Ohadike (1969a, b), Stouffer (1940), Makower et al. (1938), Beals et al. (1967), and Caldwell (1969). For bibliographies, see Pryor (1971) and Hanna and Hanna (1971).

In all, data were gathered from 43 districts. To be noted is that Lusaka urban and rural were combined into one district; Kawambwa was not subdivided to take account of the recent change in administrative structures. These and other such compromises were made so as to yield comparable boundaries over several years and several data sources.

In estimating distances from towns, it was assumed that the governing distance was the length of the major shortest motor road and not the direct distance overland. Towns and peri-urban districts (e.g., Ndola rural) were assigned one unit of distance from the nearest town.

As the census was conducted after the harvest--15 May to 30 June, 1963--it is likely that various population statistics are misleading for the rural districts; in the case of the sex-ratio, for example, it is well known that at this time of the year, many of the women would have gone to town. Nonetheless, we are interested in relative values of the population statistics across the various districts and not in their absolute values; and there is little reason to feel that the time of the census will have affected these relative values, as the harvest time is fairly uniform throughout the nation.

Confining ourselves to district data means that we lack finer-grained data pertaining to areas within districts. It is our conviction that could we re-estimate the strength of the relationship between our factors and, say, rates of migration from the different chieftaincies or villages in Zambia, then we would obtain even stronger results.

3. Several properties of this index warrant close scrutiny, as they bear upon the validity of much of our analysis. The first is the failure of the measure to distinguish between international and domestic migration. In the case of our study, as we look only at the rural exodus and not at the redistribution of the total population, this weakness is not critical. Put another way, it is not crucial to our analysis that the values of this index "total to unity."

Secondly, the measure is based upon K, an estimate of the natural rate of increase of the population of Zambia in the intercensal period. In this study, following Jackman, we adopt 16.2

percent as the figure for K. The reader should understand that it is <u>not</u> critical that this be the correct figure; any debate over it, and any modification of the estimates by the census office, will have no bearing upon our results. For this natural rate of increase influences only the constant term in our linear models, and not the coefficients of our independent variables. And when we do analyse the values of the constant terms, we are interested in their relative and not their absolute values.

Lastly, by applying a national level estimate of the natural rate of increase to district level data, the index assumes that the natural rate of increase of the population is invariant across the districts of Zambia. We do not know to what extent this assumption is erroneous. But data from a generation ago suggest regional variations in fertility in Zambia (Mitchell, 1965), and it is more plausible to assume that these differences have persisted rather than disappeared. In regression analysis, such measurement errors as this are critical only if they strongly correlate with the measures of the other terms. In no case is it apparent that our independent variables distribute in a patterned way along a northeastern axis in Zambia--the axis of fertility differences detected by Mitchell (1965); and so this source of error in our index of migration should not influence our results.

Other potential sources of error arising from the use of 1963 census data are noted in Ohadike (1969b). We have tried to avoid the pitfalls he points out.

In actual computation, the criterion of minimum error is observed by fitting the line so that the sum of the squared errors for all the observations approaches 0; this is the actual meaning of minimum error.

In determining which of our set of variables to include in our final equation, we employed an F-test to determine whether the inclusion

of that variable produced a significant (at the .05 level) reduction in unexplained variance in the district level rates of migration.

6. Migration is still an international phenomenon in Central Africa, but not enough of one to minimize this problem of inherent interdependence. For a study of foreign migration, see Ohadike (1969b).

7. The application of a "non-negative" criterion for eliminating districts removes all the urban districts, plus Ndola Rural, Kabwe Rural, Solwezi, Senanga, and Kaoma. These last three districts have received large inflows of refugees from Angola, and removing them eliminates a major source of error in our analysis of the rural determinants of population change due to migration.

8. Iversen (1971) discusses standardized regression coefficients (pp. 68-70) and the problem of inferring the relative effect of variables from their regression coefficients when there is significant intercorrelation among the independent variables (pp. 53 and 76), a problem which we encounter in our data. See also Cain and Watts (1970).

9. For single variables, it is basically the same as the F-test of inclusion, discussed in note 5 above.

10. Naturally, we experimented with different ways of representing the variables and their interrelations. These experiments could in general be termed tests for non-linear effects. For example, we thought it plausible, in the case of the sex-ratio, that it might be the degree of imbalance in the ratio that related to out-migration. That is, where either men or women were in excess, then the area might "export"

people. The relationship between the sex-ratio and migration could therefore be quadratic. We found, however, that a quadratic estimate of the relationship between this measure of "demographic imbalance" and migration does not improve our linear estimates in a significant manner.

We also examined the possibility of non-linear effects due to multiplicative relationships among our independent variables. For example, we entertained the possibility that distance could have accelerating effect on the relationships between, for example, the number of cattle per capita and the reduction of out-migration; that is, the effect of cattle upon out-migration might be stronger the further the district from town. We were not able to detect significant relationships of this kind with the distance variable. We probed for similar kinds of relationships with the population density variable. In particular we sought to determine whether when farming intensified in areas of high population density, it produced rates of out-migration greater than those that resulted from the intensification of farming in areas of low population density. Using the number of cattle per capita as an index of farming, we found no effect of this kind that was statistically significant. Using the number of ploughs per capita as our index, however, we found the following:

$$Y_1 = -13.54 + \underset{(2.426)}{155.0(x_1)} - \underset{(-1.506)}{3.425(x_2)}$$

The t-ratios are given in parenthesis. The first is significant at the .05 and the second at the .10 level with a one-tailed test. F-ratio: 3.176, nearly significant at the .05 level. $R = 0.4501$; $R^2 = .2026$.

Y_1 = the percent change in the population of any district due to migration over the period 1963-1969

x_1 = the number of ploughs per capita, 1963

x_2 = the number of ploughs per capita 1963, multiplied by the population density

Several things are notable about this equation. The first, of course, is that it is not significant at the levels of confidence within which we operate in the rest of this paper. This notwithstanding, the equation is exceedingly interesting. For, as one would expect, the greater the intensity of farming, as measured by our index, the greater the stability of the rural population; indeed, immigration takes place as farming increases. However, this relationship completely reverses as population density increases. As farming develops, the greater the population density, the greater the out-migration. Under conditions of high population density, intensification of farming drives people off the land. Nonetheless, because the introduction of population density in this form into our more complex equations did not meet the standards of significance which we conventionally observe, we did not incorporate multiplicative treatments of the density variable into our subsequent analysis.

11. There is also an increase in the strength of the coefficient of the number of brick rooms, per capita; but this shift proved insignificant.

12. Our figures indicate that in 1964-1968, the average annual total capital expenditures was allocated in a ratio of 7 to 3 in favor of the urban districts. Two other observations relate to our discussion of the public sector. The first is that it is important to remember the sign and the magnitude of the education variable: the strongest correlate of out-migration in the equation. This element of the government's services obviously works against its goal of population

stabilization. The second is that when we utilize the equation which incorporates government expenditures to predict rates of out-migration, we no longer are bothered by our inability to forecast the rate of migration from Sesheke.

13. In this section, we were completely stymied by the lack of data on wage rates in different districts. We heartily concur with Herrick (1965) who decries the "lack of comparable regional wage data by which to measure, however roughly, the income alternatives facing potential migrants. This gap in the desirable data is one of the first which should be filled by any future research in this area" (p. 102). The senior author has attempted to gather data on the cash earnings of village dwellers in Kawambwa that would help to fill this gap; but, viewing the problem on a national scale, this will represent an infinitesimal increment in our knowledge.

14. For a strong counter-argument to the cultural interpretations of pastoralist conservatism, see Gulliver (1969).

15. Earlier evidence for the fall of migration in areas of mixed peasant farming in Zambia is given in Colson (1960).

16. To test for this structure, we have determined: (a) there is a significant relationship between "cattle" and "migration," controlling for the other two variables; (b) there is no relationship between the number of ploughs per capita and the percentage change in population due to migration when agricultural employment is controlled; (c) the relationship between cattle and agricultural employment drops to zero when the number of ploughs per capita is controlled.

17. See note 2 above.

18. For the responsiveness of Zambian cultivators to economic incentives to technological innovation, see Baldwin (1966), pp. 163-165.

19. What we are suggesting is that as distance increases, the benefits to a person of migrating (these being a function of the increased well-being he could obtain in the city as compared with remaining in his district) increase more rapidly than the costs of migrating (which are a function of the distance to the city).

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