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CANONICAL CORRELATION ANALYSIS OF POVERTY AND LITERACY LEVELS IN EKITI STATE, NIGERIA

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ABSTRACT
Literacy is seen as antecedent of poverty. This paper has assumed that literacy has a direct influence on poverty level. Poverty is the lack of income necessary to ensure access to a set of basic needs while literacy is the ability to read and write.
This paper aims at investigating the extent to which selected poverty related variables correlate with literacy related variables and the pattern of such correlation. The poverty levels was categorized into poverty by expenditure, household size, per capita expenditure while literacy levels was categorized into years of formal education, educational age group. These variables were analyzed using the multivariate analysis technique known as the canonical correlation analysis, first described by Hotelling (1935), which is used in a wide range of disciplines to analyze the relationships between several independent and several dependent variables. Statistica software package was employed in running the analysis.
The results reveal that there is a significant positive correlation between the levels of poverty and literacy.
In addition, some of the levels of literacy had a significant correlation with that of poverty levels when correlation matrix was employed.
The results show that literacy is one of the strong factors that determine poverty.

INTRODUCTION
To date there is no single definition of poverty. The concept of poverty is defined according to individual's perception looking at different circumstances. According to Ajakaiye (1998) a review of the massive literature on poverty shows that a standard concept of poverty remains elusive because of its multidimensional nature as well as its dynamic properties. It is viewed metaphorically as an elephant and complex to define as Aboyade (1975) noted that, poverty, like an elephant, is more easily recognized than defined.

In view of that, poverty becomes a global challenge for the international community and the quest to eliminate poverty is one of the greatest human endeavors of our time. However, finding ways to reduce poverty is a daunting challenge for local, national, and international decision makers. In this regards, poverty has been largely measured by a population's income level and food security, this phenomenon has gained a broader sense. Today, poverty alleviation means improving the access of the population to basic resources to include land, water, education, employment, and health care delivery services, ensuring equal rights for men and women at all levels, meeting needs for infrastructural development and utility services, improving sanitary and hygienic conditions and proving adequate living standards for the entire populace. Hence, poverty is referred to as the 'minimum standard of income or resources to meet basic needs' and as 'the inability to attain the minimum standard of living'.

According to the World Bank, poverty is hunger. It is lack of shelter. Poverty is being sick and not being able to see a doctor. It is not being able to go to school, not knowing how to read, not being able to speak properly. Poverty is not having a job, and is fear for the future, and living one day at a time. It is losing a child to illness brought about by unclean water. And lastly, but by no means exhaustively, it is powerlessness, lack of representation and freedom.

With the passage of time the concept of poverty has been redefined to mean not only the lack of income, but also the lack of access to basic needs of life, like good health, education and other services. In the recent decade the definition of poverty has expanded to include aspects such as powerlessness (a feeling of being unable to change circumstances for better)

INCIDENCE OF LITERACY

Literacy, the ability to read and write, has long been considered by statisticians and non-statisticians alike as a useful indicator of the individual's potential for effective participation in the modern economy and society, but the policy relevance of the literacy-illiteracy dichotomy has always depended in part on which country or group of countries one is talking about.

Literacy statistics have long contributed to the world's appreciation of the scope of the challenge to eradicate poverty, ignorance and disease. The national literacy rate, together with measures such as GNP per capita and life expectancy, is widely accepted today as one of the main indicators of development. Education provides people with basic knowledge and skills needed to have improved quality of life. Thus policies and programmes that help to increase access and the proper utilization of educational opportunities assist greatly in reducing poverty. It is incontestable that education increases the livelihoods of households through increased capabilities, assets and activities.

Literacy has been so prominent in many studies that it can no longer be overlooked when assessing the welfare of a country, a region or even a household unit. By generating direct benefits such as reduced fertility rates, enhanced productivity or better maternal health and by conferring indirect effects such as lower infant and child mortality, improved children's nutritional status, health and schooling, literacy clearly appears to have the great potential of significantly alleviating poverty and vulnerability. The importance of literacy has been recently demonstrated by Basu and Foster (1998) who provide a new way of measuring literacy that accounts for the externality associated with the presence of a literate member in the household. This new measure is not only superior to the conventional literacy measure which overlooks the benefits that may accrue to proximate illiterates but, it is also relevant to less developed countries in which the literacy rates tend to be low.

In the case of Ekiti where over 60% of the adult population is illiterate in 2002, a WorldBank report (1996) has revealed that 80% of rural women aged 15-39 are illiterate. The same report shows, for that age cohort, that the female illiteracy rate has ranged as high as between 80 and 90% in the four regions.

In this paper, Poverty was categorized into a set of variable which were measured like poverty in rural and urban areas, household sizes, income level and poverty by occupation. While the other set of variables in literacy level includes years of formal education and Average number of years of formal education per child.

However to measure the relationship between these pairs of sets of data, canonical correlation analysis was used to measure the relationship if any all that exist between poverty variables and literacy variables. While the multiple correlation analysis was used to measure the relationship between all categories of poverty and literacy levels.

CONCEPTUAL AND THEORETICAL ISSUES

There is no universally accepted definition of poverty. At the same time, there is always the difficulty in deciding where to draw the line between the "poor" and the "non poor". According to World Bank Report (2002), poverty is the inability to attain a minimum standard of living. The report constructed some indices based on a minimum level of consumption in order to show the practical aspect of poverty. These include lack of access to resources, lack of education and skills, poor health, malnutrition, lack of political freedom and voice, lack of shelter, poor access to water and sanitation, vulnerability to shocks, violence and crime, political discrimination and marginalization. Similarly, the United Nations Human Development (UNHD) has introduced the use of such other indices such as life expectancy, infant mortality rate, primary school enrolment ratio and number of persons per physician to measure poverty in a country(UNDP HDI:2002). Why many Nigerians live below poverty line is as a result of low growth rate of per-capita expenditure, lack of basic facilities, poor education, large household size, pre-occupation with peasant agriculture, unemployment gender of household heads, population size, poor health and nutrition, inadequate per-capita health spending, mis-use of oil wealth and inefficiency and lack of accountability(F.O.S. Newsletter, Jan-Mar2000)

Cash income is the most commonly used indicator of poverty but it is widely recognized that this inadequate for some families; cash current receipts constitute only a small portion of the available sources of economic welfare. In addition, family size, location of residence, income variability and age are often introduced to modify the rankings that result from using either cash income alone or an expanded definition of economic welfare. Some researchers argue families operating within the same sources constraints are at lower levels of economic welfare if they have large family size, live in urban area than rural areas or resides in certain regions of country (Institute for research on poverty monograph, 1979).

There is an inadequate level of consumption such as rise to insufficient food, clothing and shelter. He notes that the conventional notion depicts poverty as a condition in which people are below a specific minimum income level and are unable to provide or satisfy the basic necessities of life needed for an acceptable standard of living. The explanation, however failed to provide the graphic picture of those who are poor, how to change their conditions and what to do.

According to Shaffer (2001:9) the concept of poverty has undergone four changes over the past decade. First, there has been a shift from a physiological model of deprivation to a social model of deprivation. The social model is about incorporating issues of political and economic rights and social justice into the anti-poverty programmatic framework. Second, there has been renewed emphasis placed on the concept of vulnerability and its relationship to poverty. Third, the concept of inequality and its relationship to poverty has re-emerged as a central concern. Fourth, the idea that poverty should be conceptualized as the violation of basic human rights has been painstakingly argued by UN system.

According to Hettne(2002:2) poverty is classified into two types. First, absolute poverty that occurs when human beings live in a state of deprivation due to meager income or lack of access to basic human needs which include food, education and information. Second, relative poverty defines poverty from a comparative point of view, i.e. poverty is not absolute but relative relative. Relative refers to the position of household or individual.

Several scholars have argued that the money metric measures of poverty are too restrictive and thus recommended the use of non-income social indicators such as life expectancy, literacy, infant mortality to measure poverty (Sens, 1976, UNDP,1990, Ajakaiye and Adeyeye, 2001 and 2001a).

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RESEARCH METHODOLOGY

This paper employed the descriptive designs and canonical correlation analysis of levels of poverty which is sub grouped into the following variables: household size, income level and occupation type, while the literacy levels will be sub grouped into variables: years of formal education, average number of years of formal education per child. Each of these levels will be compared against one another. The descriptive factor considered here is the correlation matrix which involves the level of poverty and level of literacy.

BACKGROUND TO THE ANALYSIS

Canonical analysis is able to analyze two sets of data simultaneously to see if there are strong and meaningful links between the data. The analysis undertaken in this paper has been carried out to investigate the correlations between poverty and literacy level. Canonical correlation analysis has been selected as the statistical procedure for the analysis in this research paper because it permits the analysis of two sets of variates simultaneously. It allows the examination and testing of the significance of the correlations between the sets of data. The purpose of the analysis is to investigate whether poverty level and literacy are related to one another. Canonical correlations analysis using the SAS (1985) computer program is the preferred analytical tool as it is able to demonstrate clearly whether significant correlations exist between the two sets of measures.

Canonical variate analysis is a multivariate analytical procedure that was first developed about 1935 by Hotelling but remained largely unused because of the complexity of the computations involved in the analysis. With the advent of electronic calculators and computers, canonical variate analysis emerged as the procedure that has become the general analytic method from which parametric statistical procedures such as analysis of variance, principal components, factor analysis and regression have been derived. The term ‘variate’, first used by Bartlett (1941), refers to observed measures and the term ‘variable’ to latent constructs that are formed from measured observations (Keeves & Thompson, 1997).

Canonical variate analysis is particularly useful in the study of the correlation between sets of variates. The procedure is able to analyze not only the correlation within a set, but also the correlations between the sets as well as the degree of overlap or redundancy between the sets of variates. One set of variates may also act as a predictor for the other set of variates. Moreover, canonical variate analysis may be used when either or both sets contains variates that are continuous, categorical or mixed (Keeves & Thompson, 1997). In canonical analysis, the variates on each set

are weighted to form the first pair of variables. The canonical correlation between this pair of variables is the highest. The second canonical correlation is the highest that can be found between the *X* and *Y* weighted composites that are uncorrelated or orthogonal with the first pair of variables. The significance of each pair of correlations may be tested using Wilks' lambda and an *F* ratio. Likewise, a third or more pairs of canonical variables may be identified and tested to assess whether they are significantly related. The canonical correlation coefficient between each pair of canonical variables describes the strength of the correlation between the pairs of latent variables. The square (R_) of this correlation estimates the amount of variance of one latent variable that is predictable from the other latent variable in the pair. The correlation between the two latent variables that form a pair may be viewed as causal and therefore unidirectional, whereby the latent *X* variable forms a causal link with its paired *Y* latent variable. Measures of redundancy are used to examine commonality between blocks of variates in an analysis (Cooley & Lohnes, 1971, 1976; Keeves, 1975, 1986; Keeves & Thompson, 1997; Pedhazur, 1997).

Canonical correlation analysis (CCA) is a way of measuring the linear relationship between two multidimensional variables. It finds two bases, one for each variable, that are optimal with respect to correlations and, at the same time, it finds the corresponding correlations. In other words, it finds the two bases in which the correlation matrix between the variables is diagonal and the correlations on the diagonal are maximized. The dimensionality of these new bases is equal to or less than the smallest dimensionality of the two variables. H. Hotelling, who initially developed the technique, provided the example of relating governmental policy variables with economic goal variables and relating college performance variables with pre-college achievement variables.
Canonical correlation analysis focuses on the correlation between a linear combination of the variables in one set and a linear combination of the variables in another set. The idea is first to determine the pair of linear combinations having largest correlation. Next, we determine the pair of linear combinations having the largest correlation among all pairs uncorrelated with the initially selected pair, and so on. The pairs of linear combinations are called the CANONICAL VARIATES, and their correlations are called CANONICAL CORRELATIONS.

Canonical correlation is also effectively useful in measuring the relationship between our social activities, which is the influence of one to another. Also it can be used to measure the impact of one limitation on our reactions to other vices. Take for example, the impact of our limited resources to enlightening like literacy level.eg. years of formal education,etc. To make up for this poverty, a prediction can be made if a linear combination of poverty and literacy levels is made. We can easily forecast what happens when poverty is reduced.

Also canonical correlation is useful in area of education to consider a certain linear combination of say scores obtained by a student in high school. A simple relationship can be measured and forecast is also possible. It is also useful in applied economics. Since canonical correlation determines the relationship between two correlates variables, it carefully selects weighted sum of variables from each of two sets, so that the correlation between the new variables in different sets is maximized while the new variable within each set are constrained to be uncorrelated with mean zero and variance one.

RESULT OF ANALYSIS

Table1: Canonical Analysis – Test of Successive Latent Roots

Roots Removed	Canonicl R	Canonicl R-sq	Chi-sqr.	df	P	Wilks Lambda
0	0.410449	0.168469	42.28590	18	0.001014	0.780917
1	0.201538	0.040618	10.73876	10	0.023267	0.939132
2	0.145287	0.021108	3.64814	4	0.005727	0.978892

Table 1 shows the result of the test of successive latent roots for statistical significant. All the three possible roots are found to be significant when p is less than 0.05. The remaining roots are not significant at the 0.05 level has been removed.
The testing of latent successive roots, the first pair shows a significant relationship and a moderate degree of correlation (0.41). The second pair of variables is significantly correlated (0.20) and it set orthogonal to the first pair. The third pair is also orthogonal to the other two pairs and the two latent variables are significantly correlated (0.15). The canonical correlation (R) describes the strength of the relationship between the latent variables. The square of

this relationship (R_) describes the proportion of variance of one latent variable predictable from the other latent variables in the same set.

INDICATORS.
NFPINDEX-Non- Food Price Index
FDTOTBY-Annual total Monetary value of purchased foods in current local prices.
FDTOTPR- Annual household food expenditure in regionally deflated current prices.
FDTOT- Total annual household expenditure
FDTOTDR- Annual household food expenditure in regionally deflated current prices
EDTEXP- Total expenditure on education RENTHH- Household rent

$R^2(U_1\ V_1) = 0.16$ $R(U_1\ V_1) = 0.41$ $\lambda_1 = 0.17$
$R^2(U_2\ V_2) = 0.04$ $R(U_2\ V_2) = 0.20$ $\lambda_2 = 0.04$
$R^2(U_3\ V_3) = 0.02$ $R(U_3\ V_3) = 0.14$ $\lambda_3 = 0.02$

Redundancy
The results recorded in table above shows that the largest contribution to the explained variance for the poverty variables is 25 per cent for the first canonical loading U1, 29 per cent for U2, and 3 per cent for U3. The largest variance for the literacy variables or the second set of canonical variable is 37 per cent for U1, followed by U3 which is 34 per cent and finally 27 per cent of the variance by U2. The redundancies of the literacy variables given the poverty are ten, two and 0.8 per cent respectively. This indicates that the poverty factor explains ten per cent of the variance of the three literacy variables.

Table2: Canonical Analysis – Test of Successive Latent Roots

Roots Removed	Canonicl R	Canonicl R-sq	Chi-sqr.	df	P	Wilks Lambda
0	0.919733	0.845910	361.4468	36	0.000000	0.117803
1	0.369389	0.136448	45.3801	24	0.005275	0.764509
2	0.277523	0.077019	20.5877	14	0.012753	0.885307
3	0.202034	0.040818	7.0429	6	0.316926	0.959182

Here we see that the three out of the four possible roots are found to be significant when P is less than 0.05. The fourth root is not significant at the 0.05 level. To interpret the results using latent roots, the first three pairs show a significant relationship and a moderate degree of correlation 0.91, 0.37 and 0.28 respectively. The canonical R shows the strength of linear relationship that exists between the two sets of variables.
The results recorded in table above shows that the largest contribution to the explained variance for the poverty variables is 14 per cent for the first canonical loading U1, 7 per cent for U2, 19 per cent for U3 and 7per cent for U4. The largest variance for the literacy variables or the second set of canonical variable is 48 per cent for U1, followed by U2 which is 24 per cent, 20 per cent for U3and 8 per cent of the variance by U4. The redundancies of the literacy variables given the poverty are thirty nine, forty two, three and one per cent respectively. This indicates that the poverty factor explains forty two per cent of the variance of the four literacy variables.
As expected the table shows that as people get more educated in the state, we expect them to get out of the poverty level. That is why all the loadings are positive.
In general, the larger the weight, the greater is the respective variable's unique positive or negative contribution to the sum.

$R^2(U_1\ V_1) = 0.83$ $R(U_1\ V_1) = 0.91$ $\lambda_1 = 0.83$
$R^2(U_2\ V_2) = 0.14$ $R(U_2\ V_2) = 0.37$ $\lambda_2 = 0.14$
$R^2(U_3\ V_3) = 0.08$ $R(U_3\ V_3) = 0.28$ $\lambda_3 = 0.08$
$R^2(U_4\ V_4) = 0.03$ $R(U_4\ V_4) = 0.18$ $\lambda_4 = 0.03$

Table3: Canonical Analysis – Test of Successive Latent Roots

Roots Removed	Canonicl R	Canonicl R-sq	Chi-sqr.	Df	P	Wilks Lambda
0	0.909470	0.827136	341.3286	32	0.000000	0.133489
1	0.368751	0.135977	43.8139	21	0.002484	0.772217
2	0.276788	0.076612	19.0405	12	0.027620	0.893
3	0.179168	0.032101	5.5304	5	0.354648	0.967899

After removing one of the related variables in table 2, we also see that the three of the four possible roots are still significant. This indicates that whether we use them together doesn't make any different. In terms of latent variable roots, the first three pairs have the following 0.90, 0.36 and 0.27 degree of correlation respectively. This also shows that there is no much difference between the two variables.

$R^2(U_1\ V_1) = 0.85$ $R(U_1\ V_1) = 0.92$ $\lambda_1 = 0.85$
$R^2(U_2\ V_2) = 0.14$ $R(U_2\ V_2) = 0.36$ $\lambda_2 = 0.14$
$R^2(U_3\ V_3) = 0.08$ $R(U_3\ V_3) = 0.27$ $\lambda_3 = 0.08$
$R^2(U_4\ V_4) = 0.04$ $R^2(U_4\ V_4) = 0.20$ $\lambda_4 = 0.04$

DISCUSSION OF RESULTS.

Canonical correlation analysis was used to determine the degree to which the literacy variables were related to the poverty. Canonical correlation analyses provide indices of both statistical significance and practical significance. The canonical analysis revealed that both canonical correlations combined were statistically significant ($P< 0.05$). However, In table1, when the first canonical root was excluded, the remaining roots were still significant but the reverse is the case in table 2 and 3 where the root removed is not statistically significant. Together, these results suggested that the first canonical function was statistically significant but the second canonical root was not statistically significant. Indeed, the first canonical correlation in table 1 ($R_{cl} = 0.41$) was moderately significant, contributing 16.8% (i.e. R^2_{cl}) to the shared variance. The remaining canonical correlations are also significant.

However, In table 2 and 3 respectively, the first canonical correlation (R_{cl} =0.92, 0.37, 0.28, 0.91, 0.37, 0.28) was moderately significant, contributing 85%, 14%, 8%, 82% , 14%, and 8% (i.e. R^2_{cl}) to the shared variance. Moreover, the fourth canonical correlation ($R_{c4} = 0.20, 0.18$) did not appear to be significant. Consequently, only the canonical correlation that were significant was interpreted. With respect to the literacy set in table1, secondary education (0.97), primary education (0.99) and higher education (0.62) made important contributions to the composite set, with primary and secondary education making by far the largest contributions respectively. The factor structure indicated that both secondary and primary education made important contributions to the first canonical variate. While, table 2 reveals that age years (0.93), size of household (0.73), educational age grouping (-0.87) and fathers education (1.91) also made important contribution to the poverty variables with fathers education and age years making the largest contribution respectively. With respect to the literacy set, age years, size of household, educational age grouping and fathers education made noteworthy contributions, with size of household and educational age grouping making the largest contribution- both explaining 24.06% of the variance.

Comparing the standardized coefficients and factor structure showed that size of household, educational age grouping, age years and fathers education served as suppressor variables because their standardized coefficients were large, whereas their structure coefficients were relatively small.

SUMMARY

The result of the analyzed data starting with the correlation matrix shows that some literacy levels are highly correlated with some categories of poverty. It also shows that some of the literacy levels have no significant correlation with the others and levels of poverty.

For instance, it revealed that total expenditure has a positive significant correlation with household rent, household size. However, food price index had no significant correlation with household size. Specifically, it has a significant correlation with age years, father's education and age group five. Household size is negatively correlated with poverty identification, per capita expenditure in local prices but positively correlated with total annual expenditure of own produce and total expenditure on education.

The second aspect of the data analysis focused on group comparisons comparing the independent variables which is

literacy rate with the dependent variables which is the level of poverty. Using the canonical correlation on a group of literacy against the categories of the level of poverty also reveals that some of the grouping had no significant correlation. However, the first grouping, annual total monetary value of purchased foods in current local prices, annual household food expenditure in regionally deflated current prices, total annual household expenditure, total annual expenditure on education, household rent against level of literacy of people classified according to their educational attainment that is up to primary school, secondary education and higher education had a positively significant correlation. In addition, another grouping per capita expenditure, share of food expenditure, food price index, poverty identification, total annual household expenditure and literacy by age, household size. Educational age grouping, fathers education level had a significant correlation with each other.

Actually, we expect this because as people get more educated, we expect them to get out of the poverty level. We also see that all the canonical loadings are positive which suggests the contribution of each variable in each set to the respective weighted sum (canonical variate). In terms of canonical factor, we discovered that variables that are highly correlated with a canonical variate have more in common.

This suggests that improved literacy to a large extent reduces poverty.

CONCLUSION

Canonical correlation analysis has shown that two seemingly disparate areas of study, namely, poverty and literacy may be analyzed and interrelated. The results of the analysis undertaken are statistically significant. This study shows that in general, literacy is a good measure of human development. The correlation levels of literacy with levels of poverty serves as a good measure for manifestations of poverty. Education is a fundamental human right as entrenched in United Nations Charter. Education enhances people's ability, increases the supply of skilled labour, improves adaptability and quality of workers and increases workers' efficiency and productivity In addition, a high educational attainment for a household head significantly reduces the likelihood of a household remaining poor. Similarly, the educational level of mothers has a direct relationship with the education of the children and significantly determines the status of the entire household.

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