



Intricacies of Poverty, Inequality and Welfare Measurement: A Statistical Approach. (A Case Study of Kaltungo Local Government, Gombe State-Nigeria)

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Abstract

This paper examines the intricacies of how measurement assumptions shape our understanding of poverty and inequality and their link to aggregate welfare. Using household survey data from Kaltungo LGA of Gombe State. Three approaches were compared: monetary poverty lines, poverty indices and inequality index. Various degree of analyses were carried out and the result show that 90% and above of respondent are living under poverty line, Gini coefficient showed that the inequality is significant and a model is developed, verified and tested. Jarque-Bera was used to carry out normality test of residuals.

Key words: Poverty, inequality and modelling.

4. Introduction

This paper attempts to explore the intricacies of monetary measure of poverty, inequality and welfare. It examines poverty as “capability deprivation not just low income” Sen, A (1999), how inequality hurts economic growth and social welfare J. E. (2012). The reality surpassed the “63% of Nigerians are multidimensionally poor” National Bureau of statistics, Nigeria(2022).

Why should anyone care about measuring poverty, inequality and welfare today? Despite decades of poverty reduction programs, 712 million people still lived in extreme poverty in 2022 world bank (2022), yet headline figures often mask who is left behind and why. Hence this statistical work. Monetary and multidimensional measures can rank countries differently. (Alkiri *et al.*, 2015) The world bank’s \$2.15/day line (2017), \$3/day line(2021), national poverty lines and multidimensional indices like the MPI can produce starkly different portrait of the same country. These differences are not mere academics: They determine eligibility for social programs, international aid flow and whether inequality is seen as rising or falling. The paper therefore asks: How do alternative meas-

urement approaches to poverty, inequality and welfare interact and what are the implications as it relates to policy formulation? Drawing household survey data from Kaltungo local government and examining it enrich us with the tools to navigate through the global economic disruptions. It has been established by this paper that poverty, inequality in distribution and welfare measurements are multi-dimensional. The first phase of this paper is centered on introduction while the second phase is centered on methodology. The third phase is centered on result. More so, the final phase is on discussion and conclusion.

2. Materials and Methods

2.1. Data

Questionnaires were designed, primary source of data collection was adopted at a point. More so, personal interview and observational methods were used to sample opinion. Secondary source of data collection was also used to collect data on PPP, salary structure, poverty line and so on. During this paper work, 384 households was captured. The number 384 was arrived at using Yamani formular, though Yamani formular gave 396 household and 10% is added to make the number, only 384 responded. 2025 population projection, and the average family size of 7(from the data collected) were also used.

2.2. Measure

Poverty is measured using:

- i. Word bank poverty line.
- ii. Inequality index
- iii. Size of family

2.3. Analytical Strategy

The average family size was obtained from table 1. It was used to calculate the average monthly income in dollars using purchasing power parity (PPP) for both 2017. In verifying if a given income is below poverty line, it is assumed that all the given income goes to consumption and is split equally. In reality, school fees, utility bills, and health are basics but exempted. The analysis is confined to monetary measures, poverty, size of family, employment status and skill acquired. It does not incorporate subjective welfare (how people feel about their well-being).

4. Results and Discussion

Size of Family	Frequency
1	13
2	15
3	10
4	12
5	40
6	58

7	34
8	60
9	116
10	26
Total	384
Mean	7.007813

Occupation	Frequency	Average Monthly income (₦)	PPP 2017	PPP 2021	Average Daily Income (\$ 2017)	Average Daily Income (\$ 2021)	Poverty line 2017	Poverty line 2021
Civil Servant	09	₦120833	\$1059.9	\$514.2	5.0	2.4	Above	Below
Business Owners	30	₦300000	\$2631.6	\$1276.6	12.5	6.1	Above	Above
Farmers	192	₦50090	\$439.4	\$213.1	2.1	1.0	Below	Below
Other Skills	49	₦48008	\$421.1	\$204.3	2.0	1.0	Below	Below
Unskilled, Uneducated and Ide	89	₦21200	\$186.0	\$90.2	0.9	0.4	Below	Below
Skilled, Ed-ucated but Unemployed	15	₦30850	\$263.6	\$127.9	1.3	0.6	Below	Below
TOTAL	384							

Note: PPP = Purchasing power parity

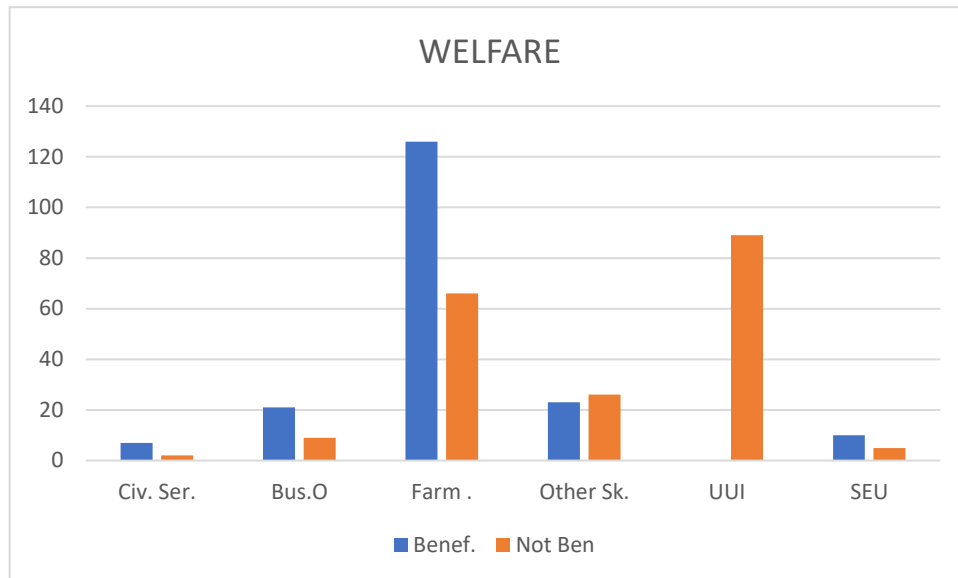
Occupation	Income
Civil Servn.	2.4
Bus.O	6.1
Farm .	1.0
Other Sk.	1.0
UII	0.4
SEU	0.6

Gini = 0.49

Interpretation: The inequality is high

Occupation	Benef.	Not Ben
Civ. Ser.	7	2
Bus.O	21	9
Farm .	126	66
Other Sk.	23	26

UUI	0	89
SEU	10	5



Occupation	Income	Ben
Civ. Ser.	2.4	7
Bus.O	6.1	21
Farm .	1.0	126
Other Sk.	1.0	23
UUI	0.4	0
SEU	0.6	10

Y= Income

X= Welfare.

Slope= $b_1 = -0.0052408$,

Intercept= $b_0 = 2.08$

Model= $2.08 - 0.00524x$

Test Normality of Residuals (Jarque-Bora Test)

For normal distribution: Skewness = 0, kurtosis = 3

Mean of e = 0

Second Moment = 3.8570

Third moment = 10.3147

Fourth Moment = 50.66395

Skewness = 1.3618(right-skewed)

Kurtosis = 3.4056

JB statistics = 1.8957

Decision

JB Follows a chi square distribution.

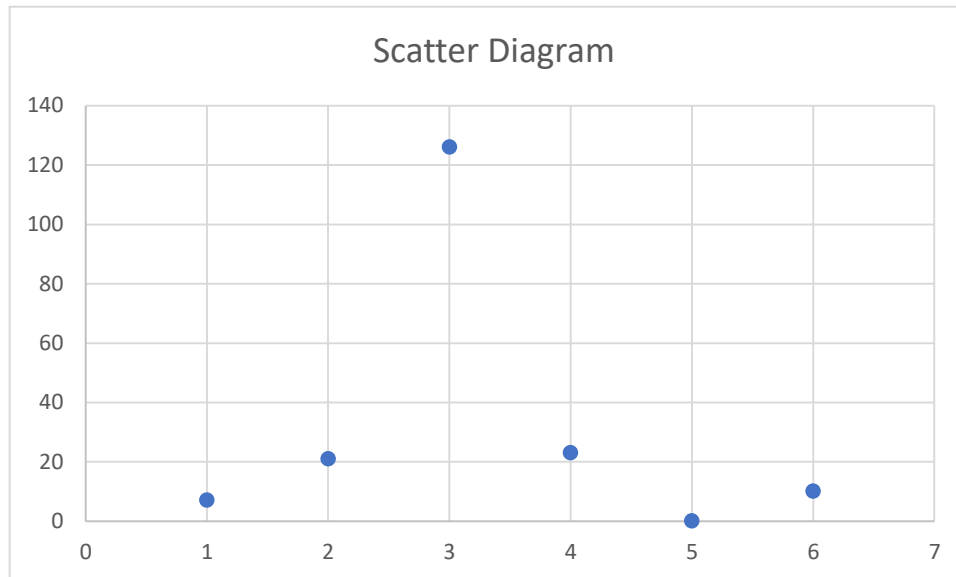
Conclusions: Residuals are approximately normal.

Discuss: Residuals do not deviate significantly from normality. Therefore, t-statistics and confidence intervals from OLS are appropriate.

Testing The Validity Of The Model

We need to test the OLS assumptions (Gauss-Markov)

Assumption 1(Linearity)



Result 1

The model fails this test.

ASSUMPTION 2 (No Autocorrelation)

It was tested using Durbin-Watson test.

DW = 1.55

Result 2: The model passed this test.

ASSUMPTION 3 (Homoscedasticity)

Breuch-Pagan test was run.

P = 0.481

Since $0.481 > 0.05$, it implies that the model passed the test.

ASSUMPTION 4 (Normality Of Error)

Jarque-Bera was used

JB = 1.896

Result

Residuals are approximately normal.

ASSUMPTION 5(No perfect multicollinearity)

We just need to check if the independent variables are a perfect linear combination of each other. With only 1 regressor X, perfect multicollinearity cannot happen unless X is constant. Matrix rank also showed no perfect multicollinearity.

Result

The model passed this test.

Check Overall model fit

R-Squared was tested

$$SSR = 23.1414$$

$$SST = 23.4353$$

$$SSE = 0.2939$$

$$R^2 = 0.0125$$

$$\text{Adjusted } R^2 = 1 - (1 - 0.0125) \left(\frac{5}{4} \right)$$

$$= -0.234$$

Interpretation

Only 1.25% of the variation in Y is explained by X. 98.5% is unexplained by the model.

The negative adjusted R^2 also tells us the model fits worse than just using the mean of Y.

F-test For overall Significance Of The Model

Source	SS	df	Ms	F
Regression	0.2940	1	0.2940	0.0508
Residual	23.1413	4	5.7853	
Total	23.4353	5		

$$F = 0.0508 \quad p = 0.832$$

Result

Since $0.832 > 0.05$ and $0.0508 < 7.71$

We say that X has no effect on Y. The overall model is not statistically significant.

RUNNING T-TEST FOR THE SLOPE

Coefficient = β

Estimate = -0.00524

SE = 0.02141

Absolute Value of T = 0.245 < 2.776.

Result

X is not statistically significant in explaining Y. The slope is essentially Zero.

RESIDUALS DIAGNOSTICS

Shapiro-Wilk Test

W = 0.809 P = 0.058

Result

Residuals looks approximately normal.

ROBUSTNESS CHECH

Leave-one-out cross validation LOOCV

LOOCV RMSE = 3.41

RESULT

The model is unstable at overfits to noise.

B Influence/outliers

Cook's distance X = 21 Y = 6

Max = 1.89 This point is highly influential.

RESULT

The model is not robust.

C PARAMETER STABILITY

SE = 0.00214

T = 0.245

P = 0.818

95% CI

RESULT

- i. The sign is not stable.
- ii. The model has no predictive validity.
- iii. It has poor fit.
- iv. It is not significant.
- v. It is not robust.

OVERALL FIT

Passing 4 out of the five OLS assumptions means OLS was not safe to use since the remaining one is linearity. The remaining test were about predictive performance. It failed this test. As such, the model is poor.

CORRELATION TEST FOR INTERACTION BETWEEN POVERTY AND WELFARE

PERSON CORRELATION

$r = -0.1144$

Interpretation

1. The negative sign indicates that as x increases, y tends to decrease but very weak
2. The magnitude 0.11 implies that no linear relationship.

RESULTS

It was observed that about 90% of persons withing the scope of this study are poor going by PPP 2017 and 92% of persons are poor going by 2021 PPP. The average family size is 7. This is relatively high. It was also observed that the inequality is high, the degree of relationship is weak and a model obtained.

CONCLUSIONS

Educational interventions will reduce the rate of idleness. Even distribution of resources will reduce inequality and more interventional programs will enhance the overall wellbeing of people in Kaltungo.

The standard and alternative measurement approaches to poverty, inequality and welfare were investigated. Applicable education plus skills will go a long way to enhance the standard of living.

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