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Oyedeji I. Osowole
University of Ibadan, Ibadan

Adebayo T. Bamiduro
University of Ibadan, Ibadan

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Oyedeji I. Osowole[1] and Adebayo T. Bamiduro[2]

Poverty analysis has relied heavily on data in summarized form and this has created dearth of knowledge on the statistical properties of Foster-Greer-Thorbecke (FGT) poverty indices. This study derived estimators of FGT poverty indices from first principles in an attempt to provide an insight into some intrinsic characteristics of FGT indices. The estimators are found to be reasonably unbiased and consistent. The estimates of the indices obtained from the estimators are approximately 53%, 22% and 12% for the head count, poverty gap and square poverty gap indices. From the conventional method, the estimates are approximately 52%, 21% and 11% respectively. The results therefore establish the validity of the derived estimators as adequate alternative measures of the three basic poverty dimensions of proportion, depth and severity.

Keywords*:* FGT poverty indices, First principles, Intrinsic characteristics, Poverty dimensions, Fundamental freedoms of action and choice**.**

JEL Classification: C13, O2

1.0 Introduction

Poverty amid plenty is the world's greatest challenge. Poor people live without fundamental freedoms of action and choice that the better off take for granted (Sen, 1999). According to the World Bank (1999), poverty is hunger; lack of shelter; to be sick and not able to go to school; not knowing how to read; not being able to speak properly; not having a job; fear for the future; losing a child to illness brought about by unclean water; powerlessness; lack of representation and freedom. These are all dimensions of poverty. Indeed, of the world's 6 billion people, 2.8 billion live on less than $2 a day, and 1.2 billion live on less than $1 a day. In rich countries less than 1 child in 100 does not reach its fifth birthday, while in the poorest countries as many as five children in hundred do not. Also while in rich countries fewer than 5 percent of all children under five are malnourished, in poor countries as many as 50 percent are (World bank, 2001).

[1] Department of Statistics, University of Ibadan, Nigeria. Email: dosowole@yahoo.com
[2] Department of Statistics, University of Ibadan. Email: adebayobamiduro@yahoo.com

Sanyal (1991) and Schubert (1994) saw poverty as either absolute or relative or both. Absolute poverty is that which could be applied at all times in all societies such as the level of income necessary for bare subsistence, while relative poverty relates to the living standard of the poor to the standards that prevail elsewhere in the society in which they live. However, there is no general consensus on the definition of poverty. This is not unconnected to its multidimensional nature, which affects many aspects of human conditions, including physical, moral, social, and psychological aspects. Hence, many criteria have been used to define poverty. While an economist would approach the subject from the view point of wants, needs and effective demand, the psychologist may look at it from the standpoint of deprivation, esteem and ego. But whatever perspective it is viewed, it is obvious that it is a condition of life that is so degrading as to insult human dignity (Omonona *et al*, 2008).

The great majority of Africa lives on barely $0.65 a day and this number is growing relentlessly. Moreover, a severe lack of capabilities (education, health, nutrition) among Africa's poor threatens to make poverty dynastic, with the descendants of the poor also remaining poor. The rural poor account for 80 percent of African poverty, but urban poverty is substantial and appears to be growing (World Bank, 2001, Nwaobi, 2000 and Collier and Gunning, 1999). Africa is not only poor; it also suffers from vast inequality in incomes, in assets, in control over public resources, and in access to essential services, as well as pervasive insecurity. These dimensions of poverty and deprivation are worsening in many parts of the region while in some areas there are indications of deterioration in the general health of the population, particularly among the poor and children. Not surprisingly, the elimination of deep poverty has emerged as the overriding objective of development in Africa (Nwaobi, 2003).

In Nigeria, widespread and severe poverty is a reality. It is a reality that depicts lack of food, clothes, education and other basic amenities. Severely poor people lack the most basic necessities of life to a degree that it can be wondered how they manage to survive. There are several effects and deficiencies associated with poverty in Nigeria. One of the main effects of poverty is poor health, as reflected in Nigeria's high infant mortality and low life expectancy. Poor people in Nigeria face several health issues as they lack basic health amenities and competent medical practitioners. Most children do not have the opportunity of being immunized and this leads to certain physical

defects in some of the children. Their health has become low priority and as they have little or no choices, they live with whatever they are provided with, whether healthy or not (Ucha, 2010).This poverty situation in Nigeria presents a paradox because despite the human and material endowments of Nigeria, a large proportion of her population is still poor (Soludo, 2006).

On measurement of poverty, Foster *et al.* (1984), Grootaert and Braithwaite (1998) and Ravallion (1996) observe that the most frequently used measurements are:

(i) the head count poverty index given by the percentage of the population that live in the household with a consumption per capita less than the poverty line;

(ii) poverty gap index which reflects the depth of poverty by taking into account how far the average poor person's income is from the poverty line; and

(iii) the distributionally sensitive measure of squared poverty gap defined as the mean of the squared proportionate poverty gap which reflects the severity of poverty.

This traditional poverty analytical approach which involves the setting of a poverty line, z, for classifying households into poor and non-poor, respectively, is adopted in this study with the poverty line defined as the 2/3 of mean per capita household expenditure, y. The three poverty indices above are commonly referred to as Foster-Greer-Thorbecke (FGT) poverty index (Foster *et. al*.(1984)). This is defined as

$$P_\alpha = \frac{1}{N}\sum_{j=1}^{N}\left(\frac{z-y_j}{z}\right)^{\propto} I(y_j \leq z)$$

where z is the poverty line, y_j is the per capita expenditure for household j, α is the sensitivity of the index to poverty and N is the total number of households. $I(y \leq z)$ is an indicator function such that

$$I(y \leq z) = \begin{cases} 1 \; if \; y \leq z \\ 0 \; if \; y > z \end{cases}$$

The index becomes head count index (HCI) when $\alpha = 0$, poverty gap index (PGI) when $\alpha = 1$ and square poverty gap index (SPGI) when $\alpha = 2$ in that order.

This paper attempts to derive the estimators of Foster-Greer-Thorbecke (FGT) poverty index in an attempt to reduce the gap in literature on the limited knowledge of statistical properties of these indices due to the fact that available data for measuring poverty are usually obtained in summary form. The characteristics of these estimators, as alternative measures of the three basic poverty dimensions will equally be considered.

2.0 Estimators of FGT Poverty Indices

2.1 Estimator of Head Count Index

The head count index, HCI is defined as

$$\text{HCI} = \frac{1}{N}\sum_{j=1}^{N}\left(\frac{z-y_j}{z}\right)^0 I(y_j \le z)$$

$$= \frac{1}{N}\sum_{j=1}^{N} I(y_j \le z) \qquad (1)$$

N is the number of individual households in the population, z is the poverty line. Let M be the number of individuals whose per capita income is below the poverty line obtained from N.

From (1), $$\text{HCI} = \frac{1}{N}\sum_{j=1}^{M}\left(\frac{z-y_j}{z}\right)^0$$

$$= \frac{1}{N}\sum_{j=1}^{M}(1) = \frac{M}{N} = P \qquad (2)$$

Let n be the size of the random sample selected from N and suppose m is the number of the poor in the sample, then the head count index, P, the proportion of the poor in the population will be estimated by $\hat{HCI}$ given by

$$\hat{HCI} = \frac{1}{n}\sum_{j=1}^{m}\left(\frac{z-y_j}{z}\right)^0 (1) = \frac{m}{n} = p \qquad (3)$$

2.2 Estimator of Poverty Gap Index

The poverty gap index, PGI is defined as

$$\text{PGI} = \frac{1}{N}\sum_{j=1}^{N}\left(\frac{z-y_j}{z}\right)^1 I(y_j \le z)$$

$$= \frac{1}{N}\sum_{j=1}^{M}\left(\frac{z-y_j}{z}\right)^1 (1) = \frac{1}{N}\sum_{j=1}^{M}\left(1-\frac{y_j}{z}\right)^1$$

$$= \frac{1}{N}\sum_{j=1}^{M}(1) - \frac{1}{Nz}\sum_{j=1}^{M} y_j$$

Let $\sum_{j=1}^{M} y_j = M\mu_{poor}$ where μ_{poor} is the mean expenditure of the poor in the population so that PGI= $\frac{M}{N} - \frac{M\mu_{poor}}{Nz}$

$$= P\left(1-\frac{\mu_{poor}}{z}\right) \quad \text{(from (2))} \qquad (4)$$

The poverty gap index will be estimated by

$$\hat{PGI} = \frac{1}{n}\sum_{j=1}^{m}\left(\frac{z-y_j}{z}\right)^1 (1) = \frac{1}{n}\sum_{j=1}^{m}(1) - \frac{1}{nz}\sum_{j=1}^{m} y_j$$

(from above) and by letting $\sum_{j=1}^{m} y_j = m\bar{y}_{poor}$, where $\bar{y}_{poor}$ is the mean expenditure of the poor in the sample. Therefore, the estimator of the poverty gap index is

$$\hat{PGI} = p_1 = \frac{m}{n} - \frac{m\bar{y}_{poor}}{nz} = p\left(1 - \frac{\bar{y}_{poor}}{z}\right) \qquad (5)$$

2.3 Estimator of Square Poverty Gap Index

The square poverty gap index, SPGI is therefore defined as

$$\text{SPGI} = \frac{1}{N}\sum_{j=1}^{N}\left(\frac{z-y_j}{z}\right)^2 I(y_j \le z) = \frac{1}{N}\sum_{j=1}^{M}\left(\frac{z-y_j}{z}\right)^2$$

$$= \frac{1}{N}\sum_{j=1}^{M}\left(1-2\frac{y_j}{z}+\frac{y_j^2}{z^2}\right)$$

But $\sum_{1}^{M} y^2 = M(\sigma_{poor}^2 + \mu_{poor}^2)$ where σ_{poor}^2 is the variance of the expenditure of the poor so that

$$\text{SPGI} = P\left(1-\frac{2\mu_{poor}}{z}+\frac{[\sigma^2_{poor}+\mu^2_{poor}]}{z^2}\right) \quad (6)$$

The square poverty gap index will be estimated by

$$\hat{SPGI} = \frac{1}{n}\sum_{j=1}^{m}\left(\frac{z-y_j}{z}\right)^1 (1) = \frac{1}{n}\sum_{j=1}^{m}\left(1-2\frac{y_j}{z}+\frac{{y_j}^2}{z^2}\right)$$

By letting $\sum_{1}^{m} y^2 = m(s^2_{poor}+\bar{y}^2_{poor})$, where $\bar{y}_{poor}$ and s^2_{poor} are the mean and variance of the expenditure of the poor in the sample, it follows therefore that the estimator of the square poverty gap index is

$$\hat{SPGI} = p\left(1-\frac{2\bar{y}_{poor}}{z}+\frac{[s^2_{poor}+\bar{y}^2_{poor}]}{z^2}\right) \quad (7)$$

Next we shall check whether these estimators are unbiased and consistent. An estimator is said to be unbiased if E (estimator of interest) = parameter to be estimated. Also, an estimator is said to be consistent if it is firstly unbiased and its variance tends to zero as n (the sample size) is increased indefinitely.

2.4 The Mean and Variance of Head Count Index

The mean of the head count index is defined as

$$E\left(\hat{HCI}\right) = E\left(\frac{1}{n}\sum_{1}^{n}\left(\frac{z-y}{z}\right)^0 I(y\le z)\right) = \frac{1}{n}\sum_{1}^{n}E(I(y\le z))$$

$$= \frac{1}{n}\sum_{1}^{n}P = P, \quad (8)$$

Since the indicator function follows a Bernoulli distribution with mean P and variance $P(1-P)$.

The variance of the head count index is defined as

$$V\left(\hat{HCI}\right) = V\left(\frac{1}{n}\sum_{1}^{n}\left(\frac{z-y}{z}\right)^0 I(y\le z)\right) = V\left(\frac{1}{n}\sum_{1}^{n}I(y\le z)\right)$$

$$= \frac{1}{n^2}\sum_{1}^{n}V(I(y\le z))$$

$$= \frac{PQ}{n}, \text{ (from above)} \quad (9)$$

2.5 The Mean and Variance of Poverty Gap Index

The mean of the poverty gap index is defined as

$$E(P\hat{G}I) = E[\frac{1}{n}\sum_{1}^{n}(\frac{z-y}{z})^{1}I(y \le z)]$$

$$= E[\frac{1}{n}\sum_{1}^{n}(\frac{z-y}{z})^{1}I(y \le z)] = \frac{1}{n}E[\sum_{1}^{n}I(y \le z) - \sum_{1}^{n}\frac{y}{z}I(y \le z)]$$

$$E(P\hat{G}I) = = \frac{1}{n}\sum_{1}^{n}E(I(y \le z)) - \frac{1}{nz}\sum_{1}^{n}E(yI(y \le z))$$

$$= \frac{1}{n}\sum_{1}^{n}\frac{M}{N} - \frac{1}{nz}\sum_{1}^{n}\frac{M\mu_{poor}}{N}$$

$$= (\frac{1}{n})\frac{nM}{N} - (\frac{1}{nz})\sum_{1}^{n}\frac{M\mu_{poor}}{N}$$

$$= (\frac{1}{n})\frac{nM}{N} - (\frac{1}{nz})\frac{nM\mu_{poor}}{N}$$

$$= \frac{M}{N} - \frac{M\mu_{poor}}{Nz}$$

$$= P(1 - \frac{\mu_{poor}}{z}) \qquad (10)$$

The variance of the poverty gap index is defined as

$$V(\frac{1}{n}\sum_{1}^{n}(\frac{z-y}{z})^{1}I(y \le z)) = V(\frac{1}{n}\sum_{1}^{n}(1-\frac{y}{z})I(y \le z)) = \frac{1}{n^2}\sum_{1}^{n}V[I(y \le z) - \frac{y}{z}I(y \le z)]$$

Recall that $V(A-B) = V(A) + V(B) - 2Cov(A,B)$ where $A = I(y \le z)$ and $B = \frac{y}{z}I(y \le z)$

Note that $V(A) = V(I(y \le z) = PQ$ and $\sum_{1}^{n}V(A) = nPQ$

$V(B) = \frac{1}{z^2}V(yI(y \le z) = \frac{1}{z^2}\{[E(y^2I(y \le z) - [E(yI(y \le z)]^2\}$ (Recall $V(X)=E(X^2)-\{E(X)\}^2$)

It should be noted that by letting $\sum_{1}^{m}y = m\bar{y}_{poor}$ and $\sum_{1}^{m}y^2 = m(s_{poor}^2 + \bar{y}_{poor}^2)$ as before, then

$$E(I(y \le z)) = \frac{M}{N}\ ,\ E(yI(y \le z)) = \frac{M\mu_{poor}}{N}\ \ and\ \ E(y^2 I(y \le z)) = \frac{M}{N}[\sigma^2_{poor} + \mu^2_{poor}]$$

Thus $V(B) = \frac{1}{z^2}\left\{\frac{M}{N}[\sigma^2_{poor} + \mu^2_{poor}] - [\frac{M}{N}\mu_{poor}]^2\right\}$

$$= \frac{1}{z^2}\left\{P[\sigma^2_{poor} + \mu^2_{poor}] - [P\mu_{poor}]^2\right\}$$

$$= \frac{1}{z^2}\left\{P[\sigma^2_{poor} + \mu^2_{poor}] - [P^2\mu^2_{poor}]\right\}, \sum_1^n V(B) = \frac{n}{z^2}\left\{P[\sigma^2_{poor} + \mu^2_{poor}] - [P^2\mu^2_{poor}]\right\}$$

Now

$$Cov(A,B) = E(AB) - E(A)E(B)$$

$$= \left[E\{I(y \le z).\frac{y}{z}I(y \le z)\} - E\{I(y \le z)\}E\{\frac{y}{z}I(y \le z)\}\right]$$

$$= \left[E\{\frac{y}{z}I^2(y \le z)\} - E\{I(y \le z)\}E\{\frac{y}{z}I(y \le z)\}\right]$$

$$= \left[E\{\frac{y}{z}I^2(y \le z)\} - \frac{M}{N}E\{\frac{y}{z}I(y \le z)\}\right] = \left[E\{\frac{y}{z}I^2(y \le z)\} - [\frac{M}{N}][\frac{M}{Nz}\mu_{poor}]\right]$$

$$= \left[E\{\frac{y}{z}I(y \le z)\} - PE\{\frac{y}{z}I(y \le z)\}\right] = \left[\frac{M}{Nz}\mu_{poor} - [P\frac{M}{Nz}\mu_{poor}]\right]$$

$$= P\frac{\mu_{poor}}{z} - (P)(P\frac{\mu_{poor}}{z})$$

$$= P\frac{\mu_{poor}}{z} - \frac{P^2\mu_{poor}}{z} = \frac{P\mu_{poor}(1-P)}{z} = \frac{PQ\mu_{poor}}{z}\ \ ,\sum_1^n Cov(A,B) = \frac{nPQ\mu_{poor}}{z}$$

Therefore variance of the poverty gap index, $V(\hat{p}_1)$ becomes

$$V(\hat{p}_1) = \frac{1}{n^2}\left\{nPQ + \frac{n}{z^2}\left\{P[\sigma^2_{poor} + \mu^2_{poor}] - [P^2\mu^2_{poor}]\right\} - \frac{2nPQ\mu_{poor}}{z}\right\}$$

$$= \frac{1}{n}\left\{PQ + \frac{1}{z^2}\left\{P[\sigma^2_{poor} + \mu^2_{poor}] - [P^2\mu^2_{poor}]\right\} - \frac{2PQ\mu_{poor}}{z}\right\}$$

$$= \frac{1}{n}\left\{PQ - \frac{2PQ\mu_{poor}}{z} + \frac{P\mu^2_{poor} - P^2\mu^2_{poor}}{z^2} + \frac{P\sigma^2_{poor}}{z^2}\right\}$$

$$= \frac{1}{n}\left\{PQ - \frac{2PQ\mu_{poor}}{z} + \frac{P\mu_{poor}^2(1-P)}{z^2} + \frac{P\sigma_{poor}^2}{z^2}\right\}$$

$$= \frac{1}{n}\left\{PQ - = \frac{2PQ\mu_{poor}}{z} + \frac{PQ\mu_{poor}^2}{z^2} + \frac{P\sigma_{poor}^2}{z^2}\right\}$$

$$= \frac{1}{n}\left\{PQ(1-\frac{\mu_{poor}}{z})^2 + \frac{P\sigma_{poor}^2}{z^2}\right\} \qquad (11)$$

Therefore the mean and variance of the poverty gap index are $P(1-\frac{\mu_{poor}}{z})$ and $\frac{1}{n}\left\{PQ(1-\frac{\mu_{poor}}{z})^2 + \frac{P\sigma_{poor}^2}{z^2}\right\}$ respectively.

2.6 The Mean and Variance of Square Poverty Gap Index

The mean of the square poverty gap index is defined as

$$E\left(SP\hat{G}I\right) = E(\frac{1}{n}\sum_1^n(\frac{z-y}{z})^2 I(y \le z)) = E[\frac{1}{n}\sum_1^n(1-\frac{y}{z})^2(I(y \le z)]$$

$$= \frac{1}{n}\left\{\sum_1^n E(I(y \le z)) - \frac{2}{z}\sum_1^n E(yI(y \le z)) + \frac{1}{z^2}\sum_1^n (E(y^2 I(y \le z))\right\}$$

$$= \frac{n}{n}\left\{\frac{M}{N} - \frac{2M\mu_{poor}}{Nz} + \frac{M}{Nz^2}[\sigma_{poor}^2 + \mu_{poor}^2]\right\}$$

$$= \frac{M}{N}\left\{1 - \frac{2\mu_{poor}}{z} + \frac{[\sigma_{poor}^2 + \mu_{poor}^2]}{z^2}\right\}$$

$$= P\left\{1 - \frac{2\mu_{poor}}{z} + \frac{\sigma_{poor}^2 + \mu_{poor}^2}{z^2}\right\} \qquad (12)$$

The variance of the square poverty gap index is defined as $V(\hat{p}_2) = V(\{1-\frac{y}{z}\}^2 I(y \le z))$. Using the approach under poverty gap index, we have that $V[\hat{p}_2] = E[(1-\frac{y}{z})^4 I(y \le z)] - (E[(1-\frac{y}{z})^2 I(y \le z)])^2$ so that:

$$\left\{\begin{array}{l} E[(1-\frac{y}{z})^4 I(y \le z)] = E(I(y \le z) - \frac{4y}{z} E(I(y \le z)) \\ + \frac{6y^2}{z^2} E(I(y \le z)) - \frac{4y^3}{z^3} E(I(y \le z)) + \frac{y^4}{z^4} E(I(y \le z)) \end{array}\right\}$$

$$= P - \frac{4P\mu_{poor}}{z} + \frac{6P(\sigma^2_{poor} + \mu^2_{poor})}{z^2} - \frac{4P\mu'_{3,poor}}{z^3} + \frac{P\mu'_{4,poor}}{z^4}$$

$$(E[(1-\frac{y}{z})^2 I(y \le z)])^2 = P^2(1-\frac{2\mu_{poor}}{z} + \frac{[\sigma^2_{poor} + \mu^2_{poor}]}{z^2})^2 \text{ (from (12))}$$

thus the variance of the square poverty gap index becomes

$$\frac{1}{n}\left(\begin{array}{l} P - \frac{4P\mu_{poor}}{z} + \frac{6P(\sigma^2_{poor} + \mu^2_{poor})}{z^2} - \frac{4P\mu'_{3,poor}}{z^3} + \frac{P\mu'_{4,poor}}{z^4} \\ -P^2(1-\frac{2\mu_{poor}}{z} + \frac{[\sigma^2_{poor} + \mu^2_{poor}]}{z^2})^2 \end{array}\right) \quad (13)$$

Therefore the mean and variance of the square poverty gap index are $P\left\{1-\frac{2\mu_{poor}}{z} + \frac{\sigma^2_{poor} + \mu^2_{poor}}{z^2}\right\}$ and

$$\frac{1}{n}\left(\begin{array}{l} P - \frac{4P\mu_{poor}}{z} + \frac{6P(\sigma^2_{poor} + \mu^2_{poor})}{z^2} - \frac{4P\mu'_{3,poor}}{z^3} \\ + \frac{P\mu'_{4,poor}}{z^4} - P^2(1-\frac{2\mu_{poor}}{z} + \frac{[\sigma^2_{poor} + \mu^2_{poor}]}{z^2})^2 \end{array}\right)$$ respectively.

3.0 Data Description and Numerical Application

The validity of the estimators derived above will be assessed via the Nigerian Living Standard Survey (NLSS, 2004) data obtained from the National Bureau of Statistics. This data provides a major survey framework for regular production, management and tracking of poverty programmes and policies. Data were collected on the following key elements: demographic characteristics, educational skill and training, employment and time use, housing and housing conditions, social capital, agriculture, income, consumption expenditure and non-farm enterprise.

Some of the variables captured in the survey included sector of the country, sex of the household head, age in years of the household head, marital status of the household head, religion of the household head, father's educational

level, father's work, mother's educational level, mother's work, household size, expenditure of own produce, household expenditure on food, occupation group the household head belongs, educational group for highest level attained by the household, literacy of the household head and educational age grouping. The survey was designed to give estimates at National, Zonal and State levels.

The first stage was a cluster of housing units called Enumeration Area (EA), while the second stage was the housing units. One hundred and twenty EAs were selected and sensitized in each state, while sixty were selected in the Federal Capital Territory. Ten EAs with five housing units were studied per month. Thus a total of fifty housing units were canvassed per month in each state and twenty-five in Abuja. The National Bureau of Statistics (Nigeria) (NBS) field staff resident in the enumeration areas were responsible for data collection for the survey. The total number of households with valid responses in the survey was 19,158. The proxy used for poverty in this study was the per capita expenditure of all the households. To obtain estimates for the estimators earlier derived, a random sample of the per capita expenditure of 5000 households was selected from the 19,158 households. From the whole and sampled datasets, the tables below are obtained:

4.0 Discussion of Results

Table 1: Estimates of FGT Indices obtained from P_α

z = ₦ 23,734		
P_0	**P_1**	**P_2**
0.52098	**0.21201**	**0.11406**

Table 1 gives the estimates of the FGT poverty indices obtained directly from the conventional P_α index while Table 2gives estimates of the FGT indices obtained from the derived estimators. The head count, poverty gap and square poverty indices are approximately 52%, 21% and 11% from the P_α index. From the estimators, the indices are approximately 53%, 22% and 12% respectively for the head count, poverty gap and square poverty indices in that order. The appropriateness of the estimators is not in doubt due to closeness of the estimates of the FGT poverty indices obtained from the two approaches. These estimators are indeed unbiased since in each case, since E (estimator) = parameter of interest. Also, they are generally consistent since the estimators

are firstly unbiased and their variances tend to zero as n is increased indefinitely.

Table 2: Estimates of FGT Indices obtained from the Derived Estimators

Index	Estimator	Estimate
$\mathbf{P_0}$	$\text{hci}=\frac{1}{n}\sum_{1}^{m}\left(\frac{z-y}{z}\right)^0(1)=\frac{m}{n}=\hat{p}$	**0.53240**
$\mathbf{P_1}$	$\hat{pgi}=\hat{p}_1=\frac{m}{n}-\frac{m\bar{y}_{poor}}{nz}=\frac{m}{n}\left(1-\frac{\bar{y}_{poor}}{z}\right)=\hat{p}\left(1-\frac{\bar{y}_{poor}}{z}\right)$	**0.21600**
$\mathbf{P_2}$	$\hat{spgi}=\hat{p}_2=\hat{p}\left(1-\frac{2\bar{y}_{poor}}{z}+\frac{[s^2_{poor}+\bar{y}^2_{poor}]}{z^2}\right)$	**0.11549**
where m=2662, n=5000, $\bar{y}_{poor}$ = ₦14103.2203, z= ₦23734, s^2_{poor} = ₦29437397.94		

5.0 Conclusion

This paper has attempted to fill some gaps in knowledge on the statistical properties of Forster-Greer-Thorbecke (FGT) poverty indices by deriving estimators for these indices. The estimators are found to be unbiased and consistent and the estimates from the derived estimators correlate well with estimates obtained directly from the P_α index. This confirms the validity of the derived estimators as an alternative computational approach in estimating the FGT poverty indices. Therefore an insight has been provided by this study into some possible characteristics of the FGT poverty indices.

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