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New Approach to Education Inequality Estimations: The Aggregate Index

Folorunso Obayemi Temitope OBASUYI
Department of Economics, Bamidele Olumilua University of Education, Science and Technology, Ikere-Ekiti, Nigeria; Email: obasuyi.tope@bouesti.edu.ng ORCID: 0000-0001-6499-0574

Abstract
This paper developed a new approach to the measurement of education inequality analysis. An aggregate measurement instrument for estimating education inequality across households named as aggregate education inequality (AEI) index was developed from existing methodologies. It integrated the previous models of educational inequality into a single measuring instrument. The AEI index was developed by using educational attainment, enrolment and literacy dimensions as indicators, for cumulative understanding of the inequality. Statistically, the proposed index integrated models comprising education inequality Gini (EIG) and Herfindahl Hirschman Index (HHI) into the geometric mean of the logarithm inequality (GMLI) to account for aggregate inequality of education. Although the index was not tested to real economic and educational data, the proposed AEI index would provide overall statistical knowledge of the magnitude of inequality in education distribution within an economic year. In other words, the index defined the aggregation of deprivation or the magnitude of inequality existing in education distribution across households.

Keywords: *Educational Inequality Gini coefficient, Herfindahl Hirschman Index, Enrolment, Educational Attainment, Market Share*

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I. INTRODUCTION

In an economic understanding, wage differential in the labour market arises from differences in educational distribution (Sullivan &Smeeding, 1997; Budría& Pereira, 2005; Dabla-Norris, Kochhar, Suphaphiphat, Ricka&Tsounta, 2015). In most cases, unequal education limits people from earning high income caused by low status, thereby recycling poverty (Luo& Bhattacharya, 2009; Lindley &Machin, 2011; Petcu, 2014). As such, from previous literatures, various approaches were used to analyze educational inequality, which as it is, do not explain aggregate inequality of education across households. Hence, this study was initiated to challenge these previous educational inequality measurements. In other words, an aggregate method of analyzing educational inequality is proposed to understand the magnitude of inequality within an economic year, was missing in the previous studies.

To start with, in the theory of comparative advantage, knowledge and skill play a prominent role in development (Leitch, 2006) which placed emphasis on principle of exchange. Higher education acquired is exchanged with higher income at labour market. Due to the importance of knowledge and skill, education for all (EFA) became a universal position for all countries' educational development policy since 2000. The assumption was that by 2015, all school-age children would have access to equal education. The reason for this assumption was premised on education as a tool for innovation, new technology and development (Thomas, Wang & Fan, 2001; Ibourk & Amaghouss 2012; Barro & Lee, 2010). However, the assumption could not be achieved totally because not all enrolled children fully completed primary grade levels in 2015 of that age cohort. Instead, since the early 2000 and until now, empirical evidence showed that inequality existed in the distribution of education across countries and households (Thomas et al., 2001; Yang, Huang, & Liu, 2014; Obasuyi& Rajah, 2019).

As shown earlier, different methods were used to analyse the inequality of education. These include income inequality Gini (Ibourk & Amaghouss 2012; Crespo-Cuaresma et al., 2012), Lorenz curve, standard deviation, regression, linear probability model using enrolment variable (Crespo-Cuaresma et al., 2012; Maas & Criel, 1982; Lu, Cui, Shi, Chang, Mo, Rozelle, & Johnson 2016). Instead of using enrolment variable to account for inequality, Thomas et al. (2001) analysed inequality of education with educational attainment by developing education inequality Gini (EIG), which became a practice in education distribution studies (Agrawal, 2014). Likewise, during the period of education distribution, dropout often triggers inequality. Thus, dropout coefficients had been estimated with different methods such as t-test, OLS, descriptive and qualitative analytical techniques (Balfanz & Legters, 2004; Burrus & Roberts, 2012). By definition, a dropout is any student who

leaves school for any reason before graduation or completion of a programme of studies without transferring to another elementary or secondary school (Bonneau, 2019; Krstic, et al., 2017). Abandoning schooling that could be caused by socioeconomic factors is a form of deprivation in education distribution.

Finally, the issue of literacy versus illiteracy had been studied to understand the level of inequality in education distribution (Joshua, Loromeke & Olanrewaju, 2014; Martinez & Fernandez, 2010). In this case, literacy studies showed that instead of placing emphasis on educational attainment and enrolment, emphasis was placed on whether the household is able to read and write; and at what level could such household achieve literacy.

While we do not out-rightly penalize the previous methodologies in estimating education inequality, however, to an extent, this paper argued for their insufficiency. In other words, we doubt whether these methodologies truly capture the aggregate estimation of education inequality across households and countries by a single indicator at time t (e.g. educational attainment), to bring about aggregate educational policy. For example, educational attainment and school enrolment were previously used to analyse educational inequality, an estimation conducted independently (Maas & Criel, 1982; Thomas et al., 2001; Agrawal, 2014). In these studies, it was somewhat doubtful if separate outcome results, having one construct (enrolment or educational attainment) as predicting variable, could explain the volume of educational inequality over time and across households. Meanwhile, what do enrolment and educational attainment measure? The enrolment variable measures access to education while educational attainment measures the stock of knowledge (Maas & Criel, 1982). Because educational attainment measures stock, experts in education distribution argued that educational attainment is the most preferred indicator (Thomas et al., 2001; Agrawal, 2014). However, an aggregate measure with the ability to capture all the associated educational inequality indicators is missing in the economics of education literature.

Nevertheless, to set the limit, we like to establish that this paper was not designed to empirically investigate the proposed measurement instrument. Instead, the objective of this paper is to construct an aggregate measurement instrument for estimating educational inequality which integrates previous methods into an aggregate index. In other words, this study was motivated by covering the gap arising from the singular analytical variable in measuring educational inequality in the previous studies. This new approach will capture both major and distinctive components influencing education distribution. So, the study is organized into five sections and subsections.

II. ARGUMENTS ON EDUCATIONAL INEQUALITY MEASUREMENT

Let begins with the basics. Education is a public good and government is the distributor (Anomaly, 2018). In other words, education is not a privilege but a right that every household should have equal access and to be non-rivalry. However, evidence shows that not everyone has a chance of equality in the distribution. For example, each country has systems of education peculiar to it, which sometimes makes education unequal. In practice, Nigeria has sixteen (16) years of schooling to fully complete educational levels uninterrupted. The 16 years are split into four levels of education, that is, 6-3-3-4 systems – with the exclusion of pre-primary education. It means a child has a total of 6 years in primary, 3 years in junior secondary, 3 years in senior secondary and 4 years in the university. So, the proposition is that at age 22, *ceteri paribus*, the child is fully ready for the labour market. We assumed that any child that graduates on the 22nd birthday are not, in any way, educationally deprived leading to unequal education. However, if a child graduates after the 22nd year of his lifetime, then he had, either small or large, experienced educational deprivation. Then, it is crucial to determine aggregate children's education inequality in the distribution.

To capture inequality and adopt the coding system of the Demographic Health Survey (DHS) dataset, educational attainment data are coded with six (6) levels as presented in Table I.

Table I: Demographic Health Survey Educational Attainment Levels

Description of level	Weight
No education	0
Incomplete primary	1
Complete primary	2
Incomplete secondary	3
complete secondary	4
Higher	5

Source: *Table prepared by Author and the content belong to Demographic Health Survey (DHS).*
Note*: Barro and Lee (2010) presented "incomplete tertiary" as the seventh level.*

Table I shows that DHS has six levels of the education distribution. A child that is in the 6th level is assumed to have fully completed university education. However, though the child completed all levels, there is no clear indication that such graduates experience any form of education deprivation in their educational lifetime. Such graduates would have spent 20, 25 or more years before attaining the sixth level instead of the

expected 16 years of schooling plus six (6) years preprimary. In such a case where a student graduated after the 22nd year of his lifetime, the child had experienced one form of education deprivation at one point in time which could have been undermined during education attainment statistical analysis. Although the child might attain the highest level of education, this study argues that educational attainment cannot provide aggregate deprivation that child witnessed before graduation. There could be a combination of deprivation elements that resulted in being susceptible to unequal education during the years of schooling.

Furthermore, from the DHS coding, 'No education' could imply illiteracy which is associated with an inability to read and write (Martinez & Fernandez, 2010). The concept, illiteracy, depicts that a household was educationally unequal. Then, we argue that using only the vector of literacy to measure whether a certain group was educationally unequal seems insufficient. A child may achieve reading and writing but no ability to complete the formal education that would earn him higher wages. Also, some households with private learning could read but were not able to write. In some developing countries, like Nigeria, experience has shown that certain numbers of students were failing external exams due to a number of factors associated with poor test scores and grades (Berktold et al., 1998). In this scenario, many children attain their highest education at secondary grade level. Then, it is highly essential to determine cumulatively and gain a full understanding of education inequality arising from different deprivations rather than employing literacy vector only.

Also, previous studies used enrolment to capture educational inequality (Maas & Criel, 1982). The Gini versus Lorenz curve (using enrolment) was based on a district sample to account for the inequality of education and restricted to primary education. Also, it is doubtful if just a segment (e.g. enrolment) that was limited to primary level education is enough to draw inference for unequal education in the distribution. Besides access to schooling as argued against by Thomas et al., 2001, the principles behind enrolment included equal distribution, standard, maintaining required school population and maintaining social order within the available space (Joshua et al., 2014). However, admission criteria such as quota system might set eligible candidates to education deprivation for a certain group and affect them economically throughout their lifetime (Krstic, et al., 2017). Equally, the inequality existing in gender education distribution is usually associated with 'the make' of a girl. The 'make' in question refers to the nature of a girl (student or pupil), which is attributed to the 'easy life of a girl' that is natural to women. Any rigorous task given to a girl, sometimes, is repulsive to her. In other words, ladies usually decline or express emotional displeasure over difficult tasks which could trigger inequality of admission leading to education inequality if inequality is considered per course of study. In that situation, enrolment/admission at all levels may skew positively to the boys' who are ready for such hard activities. (Krstic et al., 2017) Beside socioeconomic indicators, cultural, psychological and religious beliefs were evidence that were responsible for gender education inequality (Cooray & Potrafke, 2011).

Enrolment and Educational Attainment Argument – The Position of Thomas and Associates

Although there was a controversy for using enrolment to account for inequality of education by Thomas et al. (2001) which was later accepted by the economics of education experts, the position against enrolment is subject to further criticism and reconsideration. Thomas et al. (2001) argued that enrolment does not explain cumulative knowledge. However, deprivation in enrolment at the initial school age (age 6 and primary 1) excludes children from formal education which places the child in the 'No Education' group (See Bowman, 2007; Thomas et al., 2001). On the other hand, suppose the child got admission at the primary level but could not secure admission into the secondary level (due to certain educational constraints), the child would low category of educational attainment thereby affect the stock of human capital. Whereas the stock of knowledge is achieved through four corners of educational institutions which provides an opportunity for labour participation, explain the wage bill and maximize welfare, if and only if, initial and continuous enrolment are provided (Acemoglu &Autor, 2011; Todaro & Smith, 2012). Otherwise, no enrolment into primary school or failure to secure post-primary admissions guarantees the probability for recycling education inequality for subsequent generations. Also, initial enrolment is a critical stage of schooling that a child should not be denied, particularly in child development. As such, through social exclusion, the child would be deprived of having the ability for critical thinking. The consequence of lacking critical thinking would make the child susceptible to poverty in later life. So, enrolment is a crucial indicator for inclusion in constructing estimation for education inequality aggregately (Maas & Criel, 1982).

III. CONCEPTUALIZING THE AGGREGATE EDUCATION INEQUALITY INDEX

This section explains the conceptual issues of the three vectors used in the paper. The proposed Aggregate Education Inequality (AEI) index would explain the cumulative inequality that arises in distributing household children's education.

First, according to Barro and Lee (2010), educational attainment was categorised into seven levels as indicated in Table II.

Table II: Educational Attainment Factor for AEI Index

Description of level	Weight
No education	0
Incomplete primary	1
Complete primary	2
Incomplete secondary	3
complete secondary	4
Incomplete tertiary	5
Complete tertiary	6

Source: Barro and Lee (2010) Educational Attainment Levels

Here, we employed this method with adjustment to the weight assigned in constructing the AEI index. Barro and Lee (2010) assumed zero (0) for the group with 'no education due to statistical assumption. Although a household did not attend formal schooling, it does not imply that such a household has 'zero knowledge'. For example, 'a no formal education household' that argued his case in the court of law constructively and won the suit should not be considered having 'zero knowledge' of the law and principles guiding the society. Likewise, a woman of 'no formal education who buys and sells in the market (i.e. trader), makes a profit and protect the business throughout the business lifespan, should not be considered as having 'zero knowledge' in business education. Simply, the Thomas et al. (2000) argument is about academic exercise which this study respects and adopts (Further explanation is placed in Appendix I, Notes 1 section).

Second, according to Nigerian educational culture, there are four expected points of enrolment – primary, junior secondary, senior secondary and post-secondary admissions (i.e. admission for Polytechnic, Colleges of Education and Universities). However, at each point of enrolment, the distribution (enrolment/admission) could be skewed negatively due to quota criteria and difficulty level of the entrance examination conducted by UTME (Joshua, et al., 2014). Instead of using the Maas and Cruel (1982) methodology, i.e. standard deviation and Lorenz curve, the study considered each point of enrolment as crucial to determining the state of inequality peculiar to Nigeria, as presented in

Table III. Enrolment Factor for AEI Index

Description of level	Weight
No primary enrolment	0
Primary enrolment	1
No junior secondary admission	2
Junior secondary admission	3
No senior secondary admission	4
Senior secondary admission	5
No post-secondary admission (Tertiary)	6
Post-secondary admission (Tertiary)	7

Source: *Author*

Note: Post-secondary admission could be Colleges of education, Polytechnic or University.

Table III explains eight (8) levels of enrolment variable across households. With this, it makes statistical sense to adopt the existing EIG methodology (see Thomas et al., 2000; Agrawal, 2014) (See Appendix I, Note 2 section for further details of the model)

Third, the literacy vector of the index explains deprivation and inequality. Illiteracy is categorized as a factor that deprives an individual of achieving the desire of being (Sen, 1999). Although literacy is an education indicator, it differs from educational attainment. Many attempted schoolings up to secondary level but might find reading a challenge. In DHS categorization, there are five levels, namely: cannot read at all = 0; able to read-only parts of sentence = 1; able to read whole sentence = 2; no card with the required language = 3 and blind/visually impaired = 4. This categorization was expanded to 8 levels in this study. Hence, the proposed levels are presented in Table IV.

Table IV: Literacy Levels AEI Measurement

Description of level	Weight
Cannot read at least one mother language at all	1
Able to read only parts of sentence in at least one mother language	2
Able to read whole sentence at least one mother language	3
Cannot read English at all	4
Able to read only parts of sentence in English	5
Able to read whole sentence of English	6
Cannot read either English or at least one mother language at all due to blindness/visually impaired	7
Able to read whole sentence in both English and at least one mother language	8

Source: *Author*.
Note: *The Table was expanded beyond the DHS literacy categorization.*

Normally, a household that could not read at all still counts and calculate numerals especially when it comes to money. In defining literacy by Matsuura (2006) in UNESCO publication, it does not refer to it as reading and writing alone. It is an ability to have broader learning and mastery of information. An illiterate person may have a small proportion of knowledge and limited mastery of information. Simply, a household is not ignorant of learning and information. In consequence, the study chose to assign weight that begins with at least 1 to account for the little part of knowledge acquired from the environment (Gee, 2013). Thus, it will be appropriate to use the concentration method of analysis (i.e. market share) to identify the literacy share across literacy categorizations highlighted in Table IV (See Appendix I, Note 3 section for further details of the Herfindahl Hirschman Index (HHI))

IV. THE AGGREGATE EDUCATION INEQUALITY (AEI) INDEX

After understanding the Notes in Appendix I on how the three indicators of inequality were developed, this section concentrates on deriving a new measurement named as Aggregate Education Inequality (AEI) index. The indicators of the AEI comprise educational attainment, enrolment and literacy. Thus, the proposed AEI index defines the degree of inequality or the aggregation of inequality existing in education distribution to which logarithm function is introduced. Conventionally, the geometric mean is expressed as $GM(\alpha_1, \dots \alpha_n) = \sqrt[n]{\alpha_1} \dots \dots \alpha_n$ (Miller, 2003). In Appendix II, the dimensions of the inequality have been expressed in natural logarithm (See Appendix II, Note 4 – 6). In the case of the natural log, the AEI index is expressed as the geometric mean of the logarithm inequality (GMLI) for all vectors in the distribution (see Bhatia, 2008, Sandor, 2015 for the proof). Since we integrated the natural log into all the vectors of the index, then the AEI index is statistically expressed in equation (i) as:

$$AEI = \left(\prod_{i=1}^{n} id_i \right)^{1/n} \quad \text{(i)}$$

Where AEI represents the aggregate education inequality index; id is the natural log of inequality dimensions, in education distribution, where dimensions, is the total number of dimensions of the inequality. Thus;

$$AEI = \sqrt[n]{id_i * id_2 * \dots id_n} \quad (ii)$$

In a simplified manner, equation (ii) produces the aggregate education inequality. The nth id_i of the dimensions is in equation (ii) is represented in equation (iii) to reflect the three indicators as:

$$AEI = \sqrt[3]{LF_{GEAT} * LF_{GERl} * LF_{\lambda}} \; = \; \frac{LF_{GATT} * LF_{GERRl} * LF_{\lambda}}{3} \quad (iii)$$

Where LF = Logarithm function; GEAT = Value of Gini of Educational attainment; GERl = Value of the Gini of Enrolment and λ = Value of the literacy share

V. CONCLUSION

This paper argued that analyzing inequality in education with independent indicators (e.g. educational attainment or enrolment as found in Thomas et al. (2001) and Maas and Criel (1982)) is insufficient to observe the magnitude of inequality in education distribution that usually affects wages and employment. In consequence, the study developed an aggregate index for analyzing the total educational inequality across households. Although the index retains the conventional education inequality Gini using the educational attainment dimension (Thomas et al., 2001), the study added other two variables that explain the aggregate inequality in education distribution. These include enrolment and literacy dimensions. Each of the dimensions is transformed into a natural log indicating changes in each dimension. In other words, this gives the rate of change in aggregate inequality occurring in education distribution to conform to data of the logarithm function. As such, the geometric mean of the logarithm inequality (GMLI) aggregately integrates all the three dimensions to explain both major and eccentric features of inequalities and or deprivation in education distribution (See Sandor, 2015).

Thus, five independent development issues arose from the proposed AEI index methodology in examining aggregate educational inequality.

i. An aggregate index that explained aggregate inequality in education distribution (i.e. AEI index) was developed from educational attainment and enrolment using educational inequality Gini methodology (Agrawal, 2014) and literacy using Herfindahl Hirschman Index (HHI) that determines the concentration of literacy among the group cohorts.

ii. Although the paper did not examine the index empirically, to achieve quality education for national development, government needs to rationally understand the total volume of inequality in education distribution using the proposed index.

iii. Empirical investigation of the AEI index on a country basis will bring about sustainable educational policy for development.

iv. Enrolment variable could be used to establish inequality if each enrolment point is considered for enrolment cohorts.

v. The novel of the study lies on the addition of enrolment and literacy as variables that produce aggregate index proposed.

Finally, although the study did not carry out empirical investigation from an economics of education perspective, it is suggested that the proposed AEI index should be tested against real education and economic data to assess the prediction capability, accuracy and determine its suitability for education and economic policies to stimulate welfare and development.

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APPENDIX I: Notes on the Methodology for Developing the AEI Index

We begin to develop the aggregate education inequality (AEI) index using the three dimensions – educational attainment, enrolment and literacy.

Note 1: *Educational Attainment Dimension*

In this section, the paper adopts education inequality Gini using educational attainment.

Educational Attainment Gini

Agrawal (2014) methodology of education inequality Gini (EIG) is adopted for the educational attainment dimension. It should be noted that both the seven levels of Barro and Lee (2010) and the six levels of the DHS as earlier explained could be applied in the analysis, depending on the source of data.). Hence, The Gini of education inequality is stated in equation (1) while the mean years of schooling (MYS) is explained in equation (2).

$$GEAT = \frac{1}{2\mu}\sum_{i=1}^{n}\sum_{j=1}^{n} pr_i \left| ys_i - ys_j \right| pr_j \quad (1)$$

Where $GEAT$ represents Gini of educational inequality derived from educational attainment and the model for μ is stated in equation (2).

$$\mu = \sum_{i=1}^{n} pr_i * ys_i = MYS \quad (2)$$

The subscript ys_i and ys_j in equations (1) and (2) denotes years of schooling for educational levels attained by individuals, pr_i and pr_j represent the population proportions. The model measures the ratio to the mean years of schooling (MYS) of half of the deviations from average schooling between all possible pairs of households (Obasuyi & Rasiah 2019; Agrawal, 2014). Thus, GEAT = 0 <=1.

Note 2: Enrolment Dimension

The study introduced Gini methodology to estimate the inequality in enrolment using Agrawal (2014) methodology because the levels of enrolment are ranked into eight (8) levels (see Table III). Hence, the Gini of enrolment ($GERl$) is expressed in equation (3). Also, the μ representing the mean years of accessibility (MYA) to formal educationis determined in equation (4).

$$GERl = \frac{1}{2\mu}\sum_{i=1}^{n}\sum_{j=1}^{n} pr_i \left| ye_i - ye_j \right| pr_j \quad (3)$$

Where $$\mu = \sum_{i=1}^{n} pr_i * ye_i = MYA \quad (4)$$

The subscript ye_i and ye_j denotes years of enrolment for educational levels expected to be enrolled by individuals, pr_i and pr_j represent the population proportions. The μ denotes the mean years of accessibility (MYA). Like in $GEAT$, the model measures the ratio to the mean years of accessibility (MYA) of half of the deviations from average enrolment between all possible pairs of households (Agrawal, 2014). Here, the Agrawal (2014) and Thomas et al. (2001) EIG methods are considered because of the similar weighting system which allows for all the possible pairs of enrolment across households. The MYA explains the country's stock of accessibility to education over time.

Note 3: Literacy Inequality Determination

The use of Herfindahl Hirschman Index (HHI) caught across various disciplines including marketing, banking and finance, agricultural science and communication (Fuchs, 2017; Deconinck, 2019; Avila et al., 2013; Lauraéus et al., 2021) because it measures concentration or inequality among competing groups in the distribution (Rhoades, 1995). In the literature, Rhoades (1995) argued that concentration is used interchangeably with inequality. In so doing, this study attempts to adopt HHI as the appropriate measure of inequality for literacy studies, in other words, the concentration of literacy across households. The HHI focuses size or quantity of the share in the competition or distribution. For example, "HHI, is a measure of the size of firms in relation to the industry and an indicator of the amount of competition among them" (Lauraéus et al. 2021, p.72; see also Adams 2017; Hirschman 1964; Herfindahl 1950). The literacy groups are contained in Table IV which shows eight group cohorts. Let HHI = λ. So, the literacy inequality for a group of individuals using the eight group levels would be as stated in equation (5).

$$\lambda = \sum_{i=1}^{n} X_i^2 = X_1^2 + X_2^2 .... X_n^2 \quad (5)$$

The λ represents the literacy inequality concentration in the group; $X_1^2 + X_2^2 ..... X_n^2$, explainthe square of household literacy share in the literacy distribution from group 1 to the nth group in the distribution. The theoretical range of λ is that the λ is having a value close to 0 and the maximum value is 10,000. Thus, if the estimated value is less than 0.1 (i.e. $\lambda < 0.1$), then there is low literacy concentration. If the estimated value is greater than 0.18 (i.e. $\lambda > 0.18$), then there is high literacy concentration. However, suppose we have only a household that has the entire X, then the λ concentration would be 100. Since we have eight groups in the

literacy distribution (See Table IV), different results could emerge between 0.1 and 0.18. Thus, the results are expected to be interpreted as:
Suppose:

1. 1. λ < 100, the literacy share of the distribution is having low concentration
2. λ value is between 100 and 1000, there is fair literacy share in the distribution
3. λ value of literacy share is lying between 1000 and 1800, literacy share is moderately concentrated
4. λ > 1800, literacy share is highly concentrated (Adams, 2017)

At point 4, the estimated value indicates that literacy dominates the society indicating no inequality and assumed to influence household welfare positively. In the event when the eight groups have equal literacy share in the distribution, the reciprocal of the λ will be equal to the number of the groups in the distribution (Adams, 2017).

Appendix II: Natural Logarithm Function of the Dimensions

After obtaining the values of equations (1), (2) and 3 in Appendix I, we find the natural logarithm function (NLF) for each dimensions. These are presented in equations (6), (7) and (8).

$$NLF_{GEAT} = \ln(GEAT) \qquad (6)$$

Where NLF_{GEAT} is the logarithm function of the GEAT, estimable from the differences in educational attainment indicator. The ln is the natural log.

$$NLF_{GERL} = \ln(GERl) \qquad (7)$$

Where NLF_{GERl} represents the logarithm function of the$GERl$ associated with differences in educational enrolments during the years of enrolment for the component $i, GERl$, while ln is the natural log.

$$NLF_{\lambda} = \ln(\lambda) \qquad (8)$$

Where NLF_{λ} represents the logarithm function of the literacy share among the literacy group defining the inequality across households for component i, λ .

Hence, the NLF for the three parameters is used to construct the AEI index (See equation (i).