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ANALYSIS OF THE IMPACT OF EDUCATION ON POVERTY IN CAMEROON: AN APPLICATION OF THE NESTED LOGIT MODEL

*Strictly as per the compliance and regulations of:*



# Analysis of the Impact of Education on Poverty in Cameroon: An Application of the Nested Logit Model

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## 1. INTRODUCTION

The aim of this paper is to contribute to the literature given the role played by human capital in the well-being of households. The point is about demonstrating that education has a meaningful impact on poverty alleviation. Findings thus show that education determines the poverty level of people in Cameroon and that it has far more impact alleviating poverty on those close to the poverty line.

According to Davis and Sanchez-Martinez (2015), the definitions of poverty adopted over time have reflected a shift in thinking, from a focus on monetary aspects to wider issues such as political participation and social exclusion. Especially, the analysis of the determinants of poverty has been intensively studied after the seminal researches that have been done within the classical and neoclassical economics perspectives by Smith (1776), Ravallion and Chen (2008), and Becker (1995). The latter suggests that there is a very close relationship between investment in human capital and poverty reduction. Subsequently, the primary determinant of a country's standard of living is how well it succeeds in developing and utilizing the skills, knowledge, health, and habits of its population. As a matter of fact, well-being/ poverty tends to be positively impacted by many determining factors prominent among which are the main sources of human capital namely education and health or, these determining

factors associated with others for instance access to loan, social security, etc., have an impact on people's well-being.

However, a deep analysis of the existing relationship between human capital and poverty has been made using other theoretical approaches that are either extension, or questioning of the neoclassical traditional theoretical approach. For example, the Keynesian/neo-liberal schools according to which poverty is considered largely involuntary and caused mainly by unemployment.

These theoretical foundations do not always agree on the meaning that should be given to the relationship between human capital and poverty. Factually, albeit not a general rule, human capital acquisition improves households' economic well-being. To drive home this point, education is often sacrificed on the altar of child labour especially in poor households whereas children from better-off households do not work. As a result, Baland and Robinson (2000) brings out the contrast between poverty reduction goals and children education at least for poor households. By contrast, other kinds of evidence support inference that human capital greatly fosters economic well-being and reduces poverty.

According to Becker (1975) expenses on inter alia education, training, medical care are investments in human capital. They are referred to as human capital because no one can ever be unyoked from their knowledge, skills, health, or values as it may be the case with their financial assets and property. Education is one of the most important investment in human capital. Poverty has customarily been related to income. People are therefore said to be living in poverty when they have no income and other resources necessary for better living conditions (an adequate diet, property, facilities, goods and services) that enable them to play their parts, perform their duties and get involve in their society (Townsend, 2006).

As a matter of fact, poverty leads to dearth and exclusions. Many countries around the world particularly Sub-Saharan African countries (SSA) are faced with the huge challenge of maintaining or improving people's well-being and therefore promote comprehensive public policies especially those pertaining to the generation of human capital, and thus education.

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In fact, according to Nga Ndjobo and Abessolo (2017), human capital investors motivations are essentially of three kinds: first and foremost, when the State earmarks budget to upgrade education in a bid to enhance development; secondly, when employers take on responsibilities for the training of their employees and expect growth in productivity; and lastly, when people are willing to devote time and money to education and training to increase their wage on the job market.

However, since most developing countries are often have fatal flaws in their labour market (expressed by inadequate wages, high unemployment rates as well as the downgrading of graduates), it is sometimes noticed that education acquisition does not systematically lead to poverty alleviation.

However, it can be assumed that if education acquisition means poverty reduction for some, it is not always the case for others. In fact, it has been shown that the standard of living of households has a positive and meaningful impact on the acquisition and the returns of the education (Psacharopoulos and Patrinos, 2018). Thus, the less someone is poor, the more they acquire education in quality and quantity; better still, they are able to enter the labour market. Meanwhile, the poor are not expected to value that much the quality of education but to the quantity. So, hypothetically, it can be assumed that this type of education does not always allow the poor to get out of their state of poverty.

The contribution of education for the betterment of households' well-being and reduction of poverty seems to be mitigated, not to say differentiated. In such a context it is possible that people who spent the same number of years receiving education end up having different results in terms of getting out of the trap of poverty. Hence the question on whether the acquisition of education leads to poverty reduction in a uniform manner regardless of the person's level of poverty.

Given all the aforementioned, this paper aims to review the relationship between human capital and economic well-being (as well as poverty) in a bid to highlight the place of education in the continuous efforts made to stamp out poverty. We tapped in ECAM III (CNIS, 2007) database to reach two main objectives. Firstly, we assessed the role played by education in poverty in Cameroon based on whether the person is close or far below the poverty line and secondly, we assessed the share of education in poverty reduction based on how close or how far below people are from the poverty line.

Our analysis provides new avenues for understanding the phenomenon of poverty, and therefore contribute to the literature on economic well-being. Our results show that education plays multiple roles in poverty. It determines people's poverty level, it also contributes in reducing the poverty level of those close to the poverty line and when it comes to people far below the poverty line, education tends to have a

significantly negative effect on poverty reduction in Cameroon.

These results show how indispensable it is for the government to provide financial assistance in the field of education targeting those who fall far below the poverty line and by so doing, their education expenses could be spared and earmarked for meeting other basic needs. What's more, the said financial assistance should enable them to receive high standard education in order to give them the opportunity to enter the labour market and get out of poverty. Other factors like income play a key role in poverty alleviation. Our findings end up showing that, it is detrimental when a given level of education is not reached, for, the less people spend years receiving education the more negative impacts it has on poverty reduction. Conversely, the more they spend years receiving education, the greater the positive, significant and meaningful impact it has on poverty reduction.

The rest of the paper is organized as follows. Section 2 presents and describes data used and shows the empirical model and the estimation method, in section 3 results are discussed. Finally section 4 concludes.

## II. METHODOLOGY OF THE STUDY

### a) *Data and Variables*

#### i. *Data*

Data used in this study are primary data from the ECAM III database (Third Cameroon Household Survey)<sup>1</sup>. This survey was carried out over the period May - July 2007. The ECAM III which covered the national territory of Cameroon is a survey carried out by the Government, through the National Institute of Statistics (CNIS). The main objective of ECAM III is to update the poverty profile and the different indicators of households' living conditions established in 2001 and to evaluate the impact of the main programs and policies implemented within the framework of the fight against poverty (CNIS, 2008). That said, the statistical unit of ECAM III is the private household<sup>2</sup> and its observation units are both household<sup>3</sup> and individuals<sup>4</sup>. Finally, ECAM III targeted a sample of 12,000 households, of which 11,391 were actually visited (CINS, 2008).

#### ii. *Definition of variables*

For the purpose of this study, poverty refers to people living below the poverty line. The model thus developed here required the use of dependent variables and two types of explanatory variables:

<sup>1</sup> The first and second ECAM (Cameroon Household Survey) were realized respectively in 1996 (ECAM I) and in 2001 (ECAM II).

<sup>2</sup> By opposition to the collective households: boarding schools, barracks, hospitals, convents, etc.

<sup>3</sup> Accommodation, housing, inseparable spending of the household, etc.

<sup>4</sup> Demographic characteristics, individual spending, etc.

- A "type" variable, dependent on the equation of the first level of choice or top level. It identifies the alternatives for this level of choice, that is the possibility somebody has to choose between poverty and non-poverty
- A dependent variable "poverty line", of the equation of the second level of choice or bottom-level. A "state of poverty" variable that identifies the various alternatives people have, once they are identified as poor.
  - Variables pertaining to people's position regarding poverty*

The explanatory variables of the alternatives to poverty or non-poverty (first level of choice or top level). These variables are basically related to demography and people's social and family context. These are variables specific to people as individuals which are individual-specific variables.

Within the framework of this study, individual-specific variables include: The age that corresponds to the number of completed years of the person ranging from 15 to 64, the square age (divided by 100)<sup>5</sup>, the gender, the marital status, the area of residence and the size of the household in which they dwell.

- Variables pertaining to the various states of poverty*

Explanatory variables of the different states of poverty (second level of choice or bottom-level). These variables mainly deal with characteristics (taken separately) of the state of poverty to which the person belongs. They occur after people have been identified as poor or non-poor. They will maximize their utility. These variables are specific to different states of poverty. They refer to the number of years somebody spent receiving education (they represent successful years of schooling), the person's number of years of education squared (divided by 100)<sup>6</sup>, the average number of hours of work for the people of each state of poverty and per region and lastly to the imputed income. The latter refers to the income that people may expect from their participation in different segments of the labour market. Here, it corresponds to the average income level<sup>7</sup> as applied in the different segments of the labour market and by region.

#### *b) Empirical Specification and Estimation Approach*

The use of the econometric approach chosen in this study is in agreement with the classical economic traditions according to which individuals are largely responsible for their own destiny,

choosing in effect to become poor (Davis and Sanchez-Martinez, 2015). Indeed, this econometric approach implies that somebody irrespective of their age is faced with a problem of "choice" regarding the two-level poverty line. They can be either above the poverty line (non-poor) or below (poor). In the latter case, two main alternatives can also be identified, either the person is poor but close to the poverty line, or is poor and far below the poverty line. This hierarchical structure of the model<sup>8</sup> can be better understood in the form of a decision tree (see Figure 1 in Appendix). In this latter structure, poverty and non-poverty are dealt with differently for people's reactions to poverty are not the same.

#### *i. Identification Strategy and Model Selection*

The nested logit model is a combination of standard logit models that differs from the latter by the fact that the components of the alternative choice error do not necessarily need the same distribution. Moreover, the nested logit model admits more general substitution frameworks. The idea of this model lies with a grouping of similar alternatives within subsets or subgroups, in order to create a hierarchical structure of alternatives (Ben-Akiva and Lerman, 1985; Train, 2003). Alternative errors terms are correlated to each other within (the same) subset, while those of alternatives in different subsets are not correlated. Thus, the IIA assumption is maintained within each subset, but the variance may differ between the different subsets. The nested logit model process thus accommodates a partial violation or release of the IIA property (Kamgnia, 2007; Silberhorn et al., 2006).

Besides, the rationale for its use is based on the likelihood-ratio test<sup>9</sup> and the Hausman-McFadden (1984) test that we do. Parameter *IV* (Inclusive Value) can be used to test the IIA hypothesis. Indeed, a test of the null hypothesis  $IV = 1$  is an effective test of the relevance of the latter in the multinomial logit model.

#### *ii. Position to the poverty line model*

People's position to the poverty line is represented by a Random Utility Model (RUM) estimated by the conditional logit technique initiated by McFadden (1973). The Random Utility Theory (RUT) is consistent with this model. In fact, the RUM approach assumes that somebody "selects" one option from several alternatives. We assume that the person "chooses" the alternative that gives him the highest utility.

<sup>5</sup> The division by one hundred allows to avoid certain inconveniences bound to the size effects.

<sup>6</sup> The division by one hundred allows to avoid certain inconveniences bound to the size effects.

<sup>7</sup> In this study, the income is approximated by per capita expenditures.

<sup>8</sup> The situation which we define here is obvious. However, when it is not the case, it is possible to tidy up the alternatives in subgroups. So, when the hypothesis of IIA holds between two alternatives, these can be tidied up in the same subset or the subgroup.

<sup>9</sup> This test is proposed by McFadden, Train and Tye (1977).

Thus, one of the subgroups in the nested logit model is the model for deciding or identifying a case of poverty or non-poverty. In this case, we assume that

$$U_i(\text{poverty}) = \gamma^P X_i + \vartheta_i^P$$

$$U_i(\text{non - poverty}) = \gamma^{NP} X_i + \vartheta_i^{NP}$$

In the model of decision or identification of poverty, the vector  $X$  contains the characteristics of the

the utility levels associated with the choice or identification of poverty or non-poverty are respectively:

person. The probability of identification of the person  $i$  with respect to the poverty line is thus:

$$\text{Prob}(i \text{ poverty}) = \frac{\exp(\gamma^P X_i)}{(1 + \exp(\gamma^P X_i) + \exp(\gamma^{NP} X_i))} \quad (1)$$

The same therefore goes for non-poverty. It is a standard multinomial logit equation.

### iii. Various states of poverty Model

The other subgroup in the nested logit model is the model of "choice" or identification of people's states of poverty. Explicitly, tapping from Greene (1997)

formulation, the model assumes that if the person  $i$  chooses to live in a state of poverty or is identified in a state of poverty, or else decides to be a poor or is identified as being a poor, they will be classified among  $j$  poverty alternatives. The utility of this person can be expressed as:

$$U_i^P(\text{state of poverty } j) = \beta^P Z_{ij} + \varepsilon_{ij}^P, \quad j = 1, \dots, J \quad (2)$$

Where  $Z$  is the state of poverty characteristics vector. If we observe that the person  $i$  chooses a state of poverty or is identified in a state of poverty  $k$ , it will imply that  $U_i^P(\text{states of poverty } k) > U_i^P(\text{states of poverty } j) \quad \forall j \neq k$ .

More so, it is assumed that individual-specific error terms  $\varepsilon_{i1}^P, \varepsilon_{i2}^P, \dots, \varepsilon_{iK}^P$  are random and have, in the stochastic utility function, independent GEV (Generalized Extreme-Value)<sup>10</sup> distributions. McFadden

(1973) shows that under these conditions, the probability that the person  $i$  chooses the state of poverty or be identified in the state of poverty  $j$  is given by:

$$\text{Prob}(i \text{ chooses or is identified in the state of poverty } j) = \frac{\exp(\beta^P Z_{ij})}{\sum_{j=1}^J \exp(\beta^P Z_{ij})} \quad (3)$$

The estimate of equation (3) produces a single vector of parameters  $\beta^P$ , which shows that the effect of the characteristics of the state of poverty  $Z$  on the probability that the person who has already been identified as poor, lies in the state of poverty  $j$ . It should be noted that there is a similar equation for a state of non-poverty. In addition, the variable "education" is included in the "identified as poor" sub-group because it

varies from one state of poverty to another, and also from one person to another.

### iv. Combining decision or identification of position to the poverty line and the various states of poverty

To jointly estimate the models of situation with respect to the poverty line and people various states of poverty, the nested logit model combines (1) and (3) as shown below. The unconditional probability that the person  $i$  "chooses" or is in the state of poverty  $j$  is:

$$\text{Prob}(\text{choosing a state of poverty } j) = \text{Prob}(i \text{ chooses } j \mid i \text{ poor}) * \text{Prob}(i \text{ poor})$$

Or by using equations (1) and (3)

$$\text{Prob}(i \text{ chooses } j \text{ poverty}) = \left[ \frac{\exp(\beta^P Z_{ij})}{\sum_{j=1}^J \exp(\beta^P Z_{ij})} \right] \left[ \frac{\exp(\gamma^P X_i + \sigma^P I_i^P)}{(1 + \exp(\gamma^P X_i + \sigma^P I_i^P) + \exp(\gamma^{NP} X_i + \sigma^P I_i^P))} \right] \quad (4)$$

Equation (4) is the multiple of equations (1) and (3), except for the appearance of the parameter  $\sigma^P$  and the variable  $I^P$ , called inclusive value and defined as:

<sup>10</sup> Gumbel distribution, for example.



$$I_i^P = \log \left( \sum_{j=1}^J \exp(\beta^P Z_{ij}) \right) \quad (5)$$

Inclusive value represents the utility associated with choosing states of poverty. If the coefficient of the inclusive value,  $\sigma^P$  is zero, equation (4) then turns to be the probability of choosing the state of poverty  $j$  multiplied by the probability of being identified as poor. In other words, if  $\sigma^P$  is equal to zero, there is no classification of alternatives by subgroups. In this case, the identification as poor or non-poor is independent of the value of the utility of the options in the subgroup of poverty alternatives, and there is no need estimating decisions jointly.

Thus, the coefficient  $\sigma^P$  provides a relevant statistical test for the opportunity of classifying decisions by subgroups<sup>11</sup>.

Having specified the probabilities of choices or identifications observed in equation (4), and in the corresponding equation for non-poverty, we can establish a likelihood function as we usually do.

The parameters  $\beta^P, \beta^{NP}, \gamma^P, \gamma^{NP}, \sigma^P$  and  $\sigma^{NP}$  are then estimated by the usual techniques of maximum likelihood<sup>12</sup>.

### III. RESULTS AND DISCUSSIONS

The results of our different estimates are shown in Table 1 in the Appendix. The following are crucial information unveiled by the results:

1. Education determines the level of poor people;
2. Among the poor, education contributes to further reduce poverty of those of them who are close to the poverty line;
3. When poor people are far below the poverty line, education tends to have a negative and weighty impact on poverty reduction in Cameroon.

As a result, poverty is widely spread. Our results come from the estimate of the nested logit model for people of working age, through which equations of poverty and choice or identification of states of poverty are estimated simultaneously. The likelihood ratio test for IIA hypothesis (LR test for IIA) clearly rejects the null hypothesis of parameter IV (inclusive value) equal to the unit. Similarly, the dissimilarity parameter of "poverty" is included in the unit interval. This corresponds to a correlation of the error terms of about 0.1918, implying that the unobserved factors that lead people to poverty also affect the choice or identification of their state of poverty.

These main results found ultimately show that when the number of years spent receiving education is below a certain threshold of quantity and quality, education has a negative impact on poverty reduction. In this case, the acquisition of education is simply the result of the absorption of the scarce resources available to the poorest. The latter can only receive little education given the limited resources available to them. On the other hand, the more the number of years spent receiving education, the greater the role of education in reducing poverty. In this case, education plays a significant, positive and meaningful role.

In fact, the non-poor or the not-so-poor are able to disburse considerable amounts of money for the purpose of education, without however sacrificing their well-being. The accumulation of human capital represents for them a privileged source of spending. These results are consistent with those in the literature which suggest that acquiring human capital in general and education in particular, helps to improve the well-being of people and can be considered as a reducing risk element of high poverty (Mihai et al., 2015). Similarly, this acquisition and accumulation which follows to be profitable it must be widespread among the poorest. For that purpose, Zhang (2014) shows that educational costs cause poverty and deprivation for low- and middle-income families.

Poverty is characterised by a lack of or insufficient resources of all sorts for alternative use. Given that poor people, like anybody else, have unlimited needs they often consider that the opportunity cost associated with the time spent receiving education is really substantial not to say unbearable and must therefore be substituted by the profit guaranteed by a paid activity that requires few qualifications. The issue of (direct and indirect) cost of education should thus be the gist of the analysis and the crux of the matter of economic policies relating to poverty in countries severely affected by this phenomenon such as Cameroon, insofar as education allows to improve the well-being of people but unfortunately, is very difficult to access.

Our findings consequently, show how indispensable it is for the government to provide financial assistance in the field of education targeting the poorest so that their education expenses could be spared and used for other purposes on the one hand and on the other, the said financial assistance should enable them to receive high standard education in order to give them the opportunity to enter the labour market and get out of poverty. Other factors like income play a key role in poverty alleviation.

<sup>11</sup> When the IIA hypothesis (independence of irrelevant alternatives) holds (or is well applied) within two alternatives, they can be classified in the same sub-set or sub-group.

<sup>12</sup> The full information maximum likelihood.

#### IV. CONCLUSION

This paper dwells on human capital and household well-being in Cameroon. Results from nested logit model estimates indicate that education have a significant impact on poverty alleviation. Moreover, our findings show that education determines the poverty level of people in Cameroon, and that education contributes to poverty reduction and this is particularly true for those who are close to the line of poverty.

The findings of this study ultimately suggest that when the number of years spent receiving education is below a certain threshold of quantity and quality, education has a negative impact on poverty reduction. Meanwhile, the more the number of years spent receiving education, the greater the role of education in reducing poverty for it is significant, positive and meaningful.

This paper has some relevant policy implications. It is crucial for the poorest to receive financial support from the government to cover education expenses so they may strive to meet other needs (housing, clothing, etc.). The said financial assistance should equally enable them to receive high standard education in order to give them the opportunity to enter the labour market of the society to which they belong, get out of poverty and definitely put an end to this vicious circle.

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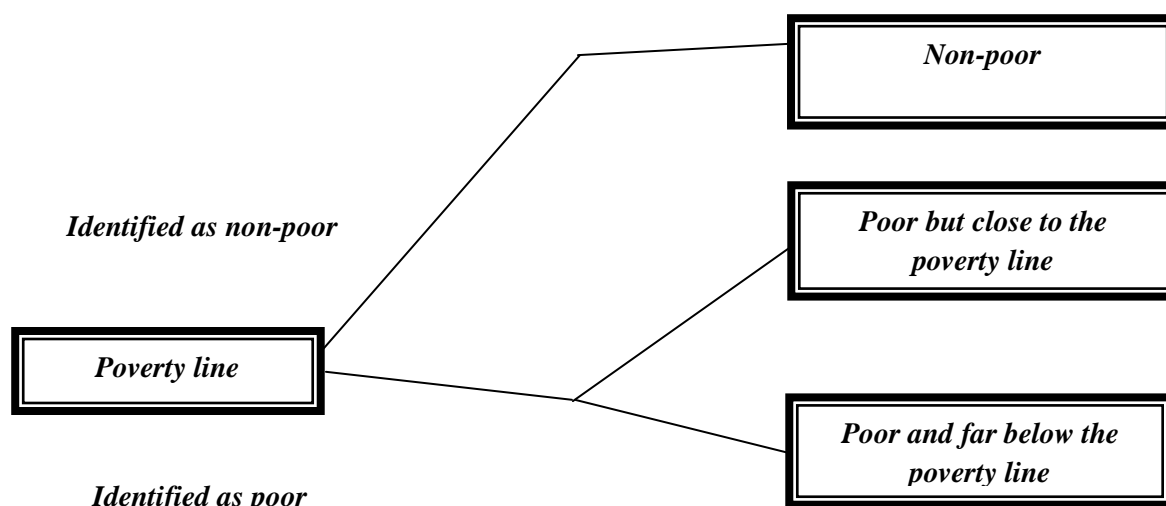
**Table 1:** Estimators from the estimates of the nested LOGIT model of poverty in Cameroon

VARIABLES	
<i>Dependent variables of the equation of the second level of choice or bottom-level</i>	
Poverty Line State of poverty	
<i>Independents Variables</i>	
Average of successful years of education	-0.438*** (0.032)
Square average of successful years of education (divided by 100)	4.099*** (0.236)
Log of the average imputed income	0.783*** (0.083)
Log of the average worked hours	-1.526*** (0.211)
<i>Dependent Variable of the equation of the first level of choice or top level</i>	
Type	
<i>Independent Variables</i>	
Potential age	0.006 <sup>ns</sup> (0.004)
Potential age squared (divided by 100)	-0.014 *** (0.005)
Gender (Male = 1 or else 0)	0.577 *** (0.063)
Household size	-0.311*** (0.010)
Marital status (married or living in a de facto union = 1 or else 0)	-0.362 *** (0.066)
Area of residence (urban = 1 or else 0)	1.592*** (0.050)
<i>Control Variable</i>	
Type	
$\lambda_{non\_poor} = 1$	1 (constraint)
$\lambda_{poor}$	0.1918 (0.0253)
Number of observations = 32412 Number of cases = 10804 Alternatives per case: Minimum = 3      Average = 3.0      Maximum = 3 Wald chi2(10) = 2540.69 Log likelihood = -6373.3667 Prob > chi2 = 0.0000 Test LR for IIA (tau = 1):      chi2(1) = 261.62      Prob > chi2 = 0,0000	

Notes: standard errors are in parentheses, \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

Source: author based on ECAM III database (CNIS, 2007).





Step 1 of the decision-making process: Step 2 of the decision-making process:

Non-poor or poor  $i = 1, 2$

State of poverty close to or far below the  
poverty line  $j = 1, 2$

Source: Author.

*Figure 1:* Structure of the decision-making model