



# Differentiated education for poverty reduction: microeconomic data analysis in Benin

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**Abstract:** The poverty analysis and the education's effects on poverty is the subject of numerous studies in the literature, but in general, the literature remains less extensive on the education effects on particular aspects such as depth and severity of poverty. The objective of this paper is to analyze the effect of the household head's education's level on the depth and severity of household poverty in Benin. To this end, basing on data from the 2018-2019 'Harmonized Survey on Living Conditions of Households in Benin', using education level as interest's variable, a poverty depth model is estimated respectively on poor households, on the poorest households and on the least poor households, controlling for selection bias. Similarly, a poverty severity model is estimated on all poor households, with control for selection bias. The results show that, beyond the positive effect of education on the poverty gap of households in general, the need for education to reduce the distance of the poor from the poverty line differs according to poverty class. Similarly, access to upper secondary education for the poorest of the poor is necessary to break pockets of extreme poverty.

**Keywords** poverty; education; welfare; selection; depth; severity.

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## 1. Introduction

Launched by the World Bank in the mid-80s, the debate on poverty has kept on mobilizing the scientific community right up to the present day. Poverty, a subject at the core of economic and social debate, has become such an important issue, as evidenced by the ever-increasing number of publications on this issue by both international institutions and researchers. Understanding poverty is a necessity if we are to succeed in the challenge of eradicating it in all its forms, in line with sustainable development goal no. 1 (SDG)

Poverty's determinants analysis has widely been a focus of investigation in the literature; and then, using the level of household well-being, some studies have been interested in analyzing the factors favoring the situation of households below the poverty line determined by the cost of a set of goods deemed sufficient to satisfy fundamental needs (Attanasso, 2004). Other studies have focused their analyses on the household living standards' determinants (Lachaud, 2000; Yambare & Ossouna, 2020; Ndiaye, 2023; Bassier, 2023) and the definition and clarification of middle class poverty (Schotte et al ;, 2018)

.What these studies have in common is that they seek to explain either the poverty situation or the level of household well-being; in a whole, they are less interested (or not at all) in the factors that explain the distance of poor households from the poverty line, as measured by the depth of poverty according to FGT indicators. They are even less interested in the determinants of the degree of concentration of the poor in the different quintiles, a degree of concentration measured by the severity of poverty. And yet, the effectiveness of actions on the determinants of poverty depends not only on the relative distance of the poor from the poverty line, but also on the degree of concentration of the poorest in the lowest welfare quintiles. A knowledge of the determinants of this distance and concentration is therefore vital for better targeting anti-poverty policies. What we know about depth and severity is generally its overall level, or disaggregated according to environment, socio-professional category and so on. But when it comes to the determinants of this depth or severity, the literature on the subject is even less extensive. The theories of human capital (Becker, 1962; Schultz, 1961) and endogenous growth (Lucas, 1988; Romer, 1986) provide larger proof that education is a factor of growth and of the fight against all forms of poverty; thus, an improvement in the level of education is likely to reduce the poverty rate at the macroeconomic level. But the reduction in the poverty rate at the macroeconomic level is not necessarily synonymous with a reduction in the depth or severity of poverty; indeed, when the individuals lifted out of poverty as a result of improved education are predominantly those located close to the poverty line, there may be a reduction in the incidence of poverty while the depth and severity of poverty do not improve. It is therefore necessary, when looking at the effects of education on poverty, to consider the consequences of the level of education not only on the depth but also on the severity of poverty. In Benin, where 52% of the population is uneducated, with disparities depending on the environment (42.9% in urban areas and 59.3% in rural areas according to the EHVC report (2018-2019), what then is the effect of the level of education on the depth and severity of poverty? The objective of the present survey is to analyze the effect of the household head's level of education on the depth and severity of household poverty in Benin.

This research summarizes the methodological review of the relationship between education and poverty in a section (2); in the light of this review, the section (3) proposes a methodological approach describing the data, the model analysis and the variables; the section (4) presents and discusses the results obtained, and the section (5) concludes the paper by formulating policy implications.

## **2. Education and poverty: a diversity of methodological approaches**

Education's effect on poverty analysis is the subject to abundant literature with diverse methodological approaches, although most work focuses on the incidence of poverty and its dynamics. At the heart of the literature, the logical framework through which education acts on poverty is particularly important for understanding the effects of education. Similarly, the methodological approaches used deserve to be well understood, so as to better assess the effect of education and generating of reliable indicators useful for formulating policy implications.

### **2.1 How can education help to act on poverty?**

According to UNESCO (2014), if every community of students in low-income countries acquired basic reading skills by the time they left school, 171 million people could be lifted out of poverty. It is about the illustration of the role of education in the fight against poverty. But the mechanism of education action on poverty is not the same according to the different levels of education.

At primary level, education contributes to productivity improvements in the primary sector of the economy. At the secondary level, education contributes mainly to productivity improvements in the primary and secondary sectors, and to a lesser extent in the tertiary sector. The consequences of productivity improvements at these levels of education are then revealed in terms of gross domestic

product (GDP) and private and public financial resources for the provision of basic services usable by households, which in turn improves the level of household consumption of food and non-food goods. Thus, improved consumption of goods contributes to well-being and the gradual emergence from poverty (Pritchett, 2001; Temple, 2001; Hugon, 2005). At a higher level, the effects of education manifest themselves in terms of research and development, technological innovation and technology imitation, all of which affect overall productivity in all sectors of economy, with positive externalities on other education sectors (Pritchett, 2001).

Generally speaking, both theoretical and empirical evidence of the poverty-reducing effect attributed to education points to the fact that education contributes to improving productivity and ensuring the availability of a workforce with the requisite skills and levels of qualification; it also confers on individuals the capacity for creativity, entrepreneurship and the quest for progress, all of which reinforce the thesis that education is an excellent means of combating poverty. If education has positive effects on poverty reduction, how does the literature analyze these effects?

## **2.2 Varied methodological approaches for different objectives**

The relevance and political implications of education's effects on poverty depend on a large extent to the methodology used to obtain these effects. In general, and at microeconomic level (since this is what interests us in the present study), the literature has mobilized econometric approaches that vary according to the objectives pursued. Broadly speaking, we can retain three main families of analysis depending on the variable used to measure poverty: analysis in terms of poor and non-poor individuals (Attanasso, 2004), analysis in terms of level of well-being considered as a quantitative variable (Lachaud, 2000; Ndiaye, 2023) and analysis based on a multidimensional poverty index (Ndiaye, 2023). Firstly, in the analysis in terms of poor/non-poor individuals, binary logistic modeling is generally mobilized to determine the effect of different explanatory variables on the probability of being poor. Then, in the quantitative analysis of well-being, two approaches are used: the consideration of well-being as a continuous quantitative variable, which mobilizes least-squares modeling (Lachad, 2000), and the use of well-being classes, which mobilizes ordered multinomial logistic regression (Lachad, 2000). Finally, there is the analysis using fuzzy set theory with quantile regression on a multidimensional poverty index (Ndiagne, 2023).

It should be noted that all these methods of analysis have in common that they are approaching the effect of explanatory variables on the individual's situation; within this framework, no place is given to the distance at which the individual is oriented from the poverty line; yet two poor individuals can differ by the gap which separates their level of well-being from the poverty line accepted in the population. As a result, while been able to provide information on the factors that explain the individual's situation, the lack of capacity to highlight the effort required within the framework of anti-poverty policies to bring individuals at least up to the threshold required to be non-poor. Similarly, these results are silent on the ability of policies to target the poorest strata. Consequently, on the basis of these results, we can put in place anti-poverty policies that will improve overall household welfare without significantly reducing poverty rates; we can also put in place policies that will improve the welfare of households closer to the poverty line, and lift them out of poverty, thus reducing poverty rates while keeping pockets of extreme poverty in poverty.

This article's contribution is twofold: on the one hand, from a methodological point of view, the article takes a different approach to the indicator on which we apprehend the effects of poverty's determinants; indeed, the approach used here goes beyond the incidence of poverty or the level of household well-being by using the depth and severity of poverty; we thus manage not only to capture the effect of the determinants identified on the distance separating households from the poverty line, but also to appreciate the extent of the influence of these determinants on extreme pockets of poverty. On the other

hand, and this is a consequence of the first contribution, the results offer a better operationalization of policy implications in the fight against poverty.

### 3. Empirical analysis of the education's effect on poverty's depth and severity in Bénin Republic

#### 3.1 Data sources and analysis model

This study uses data from the 2018-2019 'Harmonized Survey of Household Living Conditions in Benin', carried out by the Institut National de la Statistique et de l'Analyse Economique (INSAE), which institution is called today "Institut National de la Statistique et de la Démographie (INStaD)". The main aim of the survey is to produce data for the monitoring/evaluation of poverty and household living conditions in Benin, and covers a sample of 8012 households, including 3940 households in urban areas and 4072 households in rural areas. In the first wave, survey teams interviewed 3997 households (1940 in urban areas and 2057 in rural areas). 2013 Population Census and Housing (RGPH) is the sampling frame, containing 10032 enumeration areas, nationally representative and covers all regions with urban and rural areas surveyed in all regions except Littoral, a purely urban region. The sample plan uses the poverty rate - from the 2011 Integrated Modular Survey of Household Living Conditions - as the variable of interest. The sample plan then allocated the sample to regions (departments), taking into account the number of households in the regions while minimizing the relative error. Finally, the sample plan defined the areas as rural, urban and countryside, as well as each of the 12 regions.

Based on these criteria, 23 explicit sampling strata were selected. Once the sample size and distribution had been decided, a two-stage sampling methodology was implemented. In the first stage, 670 enumeration areas (EAs) were selected with probability proportional to size (PPS) using the 2013 RGPH and the number of households as the size measure. In the second stage, 12 households were randomly selected from each enumeration zone. The estimated total survey sample size was initially 8,040 households - 3,960 from urban areas and 4,080 from rural areas -. After randomly dividing each enumeration area into two equal groups, the survey was carried out in two waves.

The choice of analysis model depends on the nature of the poverty variable selected. For this survey, two indicators have been chosen: firstly, the poverty's depth, (the average of the poverty gaps which is the difference between the household's welfare level and the poverty line), and secondly, the severity of poverty, (the average of the squares of the poverty gaps). It is therefore necessary to determine the poverty gap and its square for each household. Let  $w_i$  be the well-being of household  $i$ , and  $w_s$  the poverty line for the study population.

let  $y^* = \frac{w_s - w_i}{w_s}$  denote the distance (in %) of the household from the poverty line. For poor households, it is obvious that  $y^* > 0$ , since their well-being is below the poverty line. On the other hand, for non-poor households,  $y^* \leq 0$ , since their well-being is at least above the poverty line. The idea here is to estimate two regression models, one to understand the poverty depth's determinants, the other the poverty severity's determinants, the interest's variable in the two models being the education level's variable. The development of the two models and the variables' description are presented in appendix 1.

#### 3.2 Analysis variables

##### 3.2.1 Approach variables for the depth and severity of poverty

According to the EHCVM 2019, the global annual poverty line is estimated at 246542 FCFA, equivalent to 406USD. This threshold includes a food component (146,793 FCFA equivalent to 242USD) and a non-food component (99,749 FCFA equivalent to 164USD); the depth and severity of poverty are calculated from the poverty gap for poor households (below the poverty line), using FGT indicators as presented in appendix 1.

### 3.2.2 Explanatory variables for depth and severity of poverty

Two categories of variables are used in the analysis: variables of interest, such as the education's level of the head of household, and control variables.

About the head of household's education variables, there is no unanimity on the measurement of education, as shown by (Béduwé, 2015), but in general, the measure adopted in the literature is function to the structure of existing data. In view of the structure of the EHVCN (2018-2019) data, the choice here is based on the level of education attained by the head of household. As the explained variables are considered only for poor households, it is necessary to take into account the education levels of household heads in the poor subgroup for a better definition of education levels.

A summary analysis of the database shows that only 3.11% of heads of poor households have more than upper secondary education. We can therefore group education levels into four (04) categories, thus obtaining four (04) education level variables, and use the education variable that we name "h\_studies", which have four modalities: "No\_study" when the individual has never attended school, "primary" if the individual has reached at most primary level; "secondary\_1" if the individual has completed at most lower secondary education; and Post\_second\_1: if the individual has completed more than lower secondary education.

Choosing the "no\_study" category as a reference, each of the other categories should negatively influence the relative gap and its square for individuals.

Nevertheless, disaggregation to all levels of education (without grouping) is used at statistical analysis levels for precision purposes.

Apart from the education variables, the following variables, generally used in poverty analyses, are used to refine the estimates: the head of household's age, the adult equivalent of household size, the head of household's gender, the socio-professional category, the presence of a major handicap in the head of household, and the residence place of the household which can be urban or rural.

## 4. Results, analysis et discussions

### 4.1 Poverty profil in Benin

#### 4.1.1 Poverty, a phenomenon affecting the least educated in Benin

Calculation of the FGT poverty indicators shows that poverty is present in the categories of households headed by people with the lowest levels of education (table 1).

**Table 1.** FGT poverty indicators by education level.

Education levels	Poverty Incidence (P <sub>0</sub> )		Index of the depth of the poverty (P <sub>1</sub> )		Poverty severity index (P <sub>2</sub> )	
	Estimation	Standard deviation	Estimation	Standard deviation	estimation	Standard deviation
No level	0,4843	0,009	0,144	0,003	0,059	0,002
Primary	0,337	0,014	0,083	0,005	0,031	0,002
General secondary first level	0,256	0,017	0,053	0,004	0,017	0,002
Technical secondary first level	0,209	0,135	0,055	0,040	0,024	0,021
General secondary second level	0,162	0,021	0,032	0,005	0,009	0,002
Technical secondary second level	0,142	0,071	0,024	0,014	0,005	0,003
Post-secondary	0,0181	0,018	0,005	0,005	0,001	0,001
Higher education	0,0402	0,015	0,007	0,004	0,002	0,001
<b>Set</b>	<b>0,384</b>	<b>0,006</b>	<b>0,107</b>	<b>0,002</b>	<b>0,043</b>	<b>0,001</b>

Source : based on estimates, weighted

Firstly, with regard to the incidence of poverty, 48.43% of households headed by individuals with no level of education live below the poverty line; this rate is 33.70% for households headed by individuals with primary education or less, and falls as we move towards households headed by individuals with increasingly higher levels of education. Overall, after the secondary level of education, it falls below the 5% mark, which testifies to the strong presence of poor people among households headed by less-educated individuals. This finding is justified by the monetary dimension of the poverty analyzed: indeed, the indicator of well-being used is the consumption of goods (both food and non-food); and the consumption of these goods is facilitated by the possession of an income, which according to Mincer (1997) increases with the level of education of individuals; we thus understand that low levels of education go hand in hand with low levels of income, limiting access to goods and thus reducing household well-being, pushing it below the poverty line.

Secondly, poverty is deeper in households headed by individuals with a low level of education; if we take households headed by individuals with no level of education at all, they are at around 14.4% of the poverty line, which means that they need to be allocated an average of 14.4% of the global annual poverty line estimated at 246,542 fcfa (equivalent to 406USD), or around 35502 fcfa, (equivalent to 58 USD) to bring them up to the poverty line. And as one moves towards higher levels of education, the poverty depth index decreases to below 0.5% for the group of households headed by an individual with post-secondary education.

Finally, in terms of the poverty severity index, the poorest of the poor households are found among those headed by an individual with no level of education, with the concentration of poor households in the lower living standards decreasing as the education level of the household head increases.

Table 2 shows the distribution of households by poverty quintile and education's level of the head of household. In that table, fifth quintile refers to the 20% of poor people closest to the poverty line. First quintile poverty refers to the 20% of poor people furthest from the poverty line).

**Table 2: distribution of households by poverty quintile and level of education of the head of household.**

Poverty quintiles	Level of education of head of household			
	None	Primary	Secondary	Post secondary
Fifth quintile	0,111	0,041	0,024	0,009
Fourth quintile	0,128	0,035	0,019	0,009
Third quintile	0,143	0,031	0,014	0,006
Second quintile	0,154	0,035	0,015	0,005
First quintile	0,184	0,002	0,009	0,002
<b>Set</b>	<b>0,721</b>	<b>0,030</b>	<b>0,081</b>	<b>0,030</b>
Numbers of observation : 2473				
Population size:	4503883			
Chi2 uncorrected:	80,361			
Fisher (11,80, 29175,60) :	4,880			

**Source : From EHCVM 2018-2019 database, after weighting.**

Overall, the data in this table help to notice a strong presence of households headed by an individual with no level of education in the different poverty levels. The data in this table reinforce the finding that heads of poor households have a low level of education, whatever the poverty quintile in which the household is located.

#### **4.1.2 Absence versus presence of selection bias in gap and severity models**

The estimating equations results of the poverty's depth and the poverty's severity basing on a naive regression (which ignores the presence of selection bias) are presented in table 2.1. in appendix 2. The poverty's depth is estimated first for all poor households, then respectively for the last two grouped quintiles (the 40% least poor households) and the first two grouped quintiles (the 40% poorest households); the poverty's severity is estimated for all poor households. The aim is to capture the level of education that best impacts the depth of poverty according to household poverty level.

In a second step, we run regressions that account for the presence of selection bias. Table 2.2. in appendix 2 presents the results of these regressions.

In the poverty's depth model, as in the severity model, the idea is to determine the factors influencing a poor household's distance from the poverty line, and those influencing the concentration of poor households in low levels of well-being. As this distance and concentration are only analyzed for poor households (non-poor households have a zero gap), it cannot be ruled out that, on the one hand, distance from the poverty line and household poverty are simultaneously explained, and on the other hand, the concentration of poor people in low levels of well-being and household poverty are also simultaneously explained. If this were the case, the process of identifying the determinants of the welfare gap of the poor on the one hand, and of the degree of concentration of the poor in low levels of welfare on the other, independently of the poverty status equation, could run up against a selection bias when the estimates are carried out only on poor households. Using Heckman's (1978) estimation method, we are able to determine the existence of this selection bias.

A comparison of the naive regressions's results (without selection, in Table 3) with those of the regressions with selection (Table 2.2. appendix 2) shows that the estimated coefficients of the education variables in the naive regressions are in absolute terms higher than those obtained in the regressions with selection; this highlights an overestimation of the education's variables effect in the absence of taking into account the selection bias. However, the estimation results in Table 2.1. appendix 2 show, in terms of the Mills ratio coefficient significativity, that there is indeed a selection bias, which is corrected by using the method of Heckman (1978).

### **4.2 Analysis and discussions**

#### **4.2.1 Access to education for the poor: a necessity for reducing the depth of poverty**

The role of education in household well-being, and in households' chances of getting out of poverty, is widely established in the literature; but when it comes to the poor's position in the poverty situation, our results tell us more: in terms of the results in Table 2.2.( appendix 2), compared to households with no education at all, households with primary, lower secondary and upper secondary levels of education have a smaller poverty gap (distance between the household's level of well-being and the poverty line). This result, which does not contradict the risk-reducing effect of exposure to poverty (Attanasso, 2004, Lachaud, 2000, Yambare & Ossouna, 2020), is a strong indication of the need to promote access to education for individuals if we hope to increase the well-being of poor households. Education thus appears to be an investment that yields significant social and private gains, in line with the teachings of human capital theory (Becker, 1962; Schultz, 1961). According to the same results (table 2.2., appendix 2), poor households headed by women are also farther from the poverty line than those headed by men. If we link this result to the one concerning the effect of education levels, we can deduce that promoting women's education in particular has gains in terms of reducing the depth of poverty.

Poor people's lack of education pushes them further away from the poverty line for several reasons: firstly, according to the literature (Decreuse and Granier, 2004; Mincer, 1997), lack of education reduces the chances of participation in the labor market, and non-participation in the labor market implies low individual and household income, which deprives the household of the consumption of both food and

non-food goods. According to table 3 below, 72% of poor households are headed by people who have never been to school, and among them there is generally a high proportion of people in precarious employment (78.8% of laborers and household helpers, and 79.5% of family workers contributing to a family business are found among heads of households who have never attended school). Secondly, since education also plays a role in ensuring the social transformation of individuals (Poirot, 2005; Temple, 2001), the absence of education among heads of household, by reducing the capacity of households to undergo social change, can deprive these households of access to non-food goods, access to which improves the level of well-being.

**Table 3: Distribution of poor households by education status and socio-professional category of household head**

CSP of the CM	No level		At least the primary		Set	
	%	Confidence interval	%	Confidence interval	%	Size
Superior frame	0.0		100.0		100.0	510
Middle management/supervisor	0.0		100.0		100.0	2,753
Skilled worker or employee	15.3	[7.2, 29.6]	84.7	[70.4, 92.8]	100.0	14,858
Unskilled worker or employee	44.8	[34.8, 55.4]	55.2	[44.6, 65.2]	100.0	32,742
Labourer, housekeeper	78.8	[49.8, 93.3]	21.2	[6.7, 50.2]	100.0	3,655
Trainee or paid apprentice	18.5	[4.3, 53.3]	81.5	[46.7, 95.7]	100.0	2,768
Trainee or non paid apprentice	13.7	[1.7, 59.3]	86.3	[40.7, 98.3]	100.0	1,332
Family worker contributing to a family business	79.5	[57.9, 91.6]	20.5	[8.4, 42.1]	100.0	6,146
Own-account worker	75.5	[73.3, 77.5]	24.5	[22.5, 26.7]	100.0	594,008
Boss	51.6	[27.1, 75.4]	48.4	[24.6, 72.9]	100.0	5,609
Total	72.0	[69.8, 74.0]	28.0	[26.0, 30.2]	100.0	664,379
Pearson: chi2(9) non adjusted = 644.3456						
F(7.90, 62551.51) = 20.0277 Pr = 0.000						

Source: based on estimates from the EHCVM 2018-2019 database, after weighting.

#### 4.2.2 The need for education to reduce the depth of poverty differs according to poverty class

While it has been established above that education is a necessity for reducing the depth of poverty, the fact remains that the educational requirements for reducing the depth of poverty are not the same for the different poverty classes. Indeed, the estimates (Table 2.2., appendix 2) show that, at the 95% confidence level, the poorest 40% of households simply need level 1 secondary education to get closer to the poverty line (model 2.1 in Table 2.2., appendix 2), whereas the poorest 40% of households need primary education, even if the other levels of education also reduce their poverty gap (model 3.1 in Table 2.2., appendix 2).

The need for primary education as a priority for the poorest of the poor is in line with the structure of the Beninese economy, given the findings of the literature. Indeed, as primary education contributes to improving productivity in the primary sector of the economy, with its effects on consumption and well-being (Pritchett, 2001 ; Temple, 2001 ; Hugon, 2005), providing access to primary education for the poorest of the poor will help to reduce the household poverty gap; it should be remembered that 52% of Benin's population is uneducated, with a high concentration (59.3%) in rural areas; it follows that primary education will enable poorer households to acquire basic life skills and the rational exercise of production activities in the primary sector, thereby improving their well-being.

As for the poorest of the poor households, their priority need for secondary education to move away from extreme poverty is in line with the objectives of secondary education according to the literature ((Pritchett, 2001; Temple, 2001; Hugon, 2005); indeed, secondary education mainly brings an improvement in productivity in the primary and secondary sectors, and to a lesser extent in the tertiary sector. As poverty decreases with the level of education (Becker, 1962; Schultz, 1961, Attanasso, 2004;



Lachaud, 2000 and Ndiagne, 2023), the least poor households implicitly have, on average, a higher level of education than the poorest households, and their need for education is therefore greater than that of the poorest households.

But beyond the differentiated educational needs for poverty reduction, it is equally necessary to be able to break the pockets of extreme poverty; and this requires education of a specific level.

#### **4.2.3 Access to upper secondary education for the poorest is necessary to break out of pockets of extreme poverty**

Extreme poverty is one of the facets of poverty which has the most dramatic consequences for households; in fact, if poor households are concentrated in the lowest poverty quintiles, the difficulties of survival become greater, and the cost of poverty reduction becomes enormous. Finding ways to break pockets of extreme poverty becomes a prerequisite for the effectiveness of poverty reduction measures. According to table 1, the highest poverty severity index in Benin (0.059) is in the category of households with no level of education; compared to households with other levels of education, this means that there is a higher concentration of poor people in the lowest living standards in the category of households with no level of education compared to other household categories. And according to model 4.1 in table 2.2., appendix 2, primary, secondary 1 and secondary 2 education significantly reduces the squared poverty gap for households; this means that access to these levels of education will lower the poverty severity index on average, helping households to escape extreme poverty. This justifies the choices made by Benin in terms of education policy, notably the option of compulsory schooling up to the first cycle of primary education, with free education up to the end of primary school for all, and just as importantly, the need to ensure that all children have access to primary education.

### **5. Conclusion and policy implication**

Reflection on the effects of education on the depth and severity of poverty in Benin has produced a number of findings with more specific implications for anti-poverty policy, which has multiple consequences for the economy and society. Four main conclusions emerge from the analyses.

Firstly, households headed by individuals with a low level of education are more exposed to the risk of poverty, and reducing the depth of poverty requires an improvement in people's level of education; indeed, in view of the teachings of human capital theory, particularly in terms of the fundamental role played by education in improving labor productivity, and on the other hand the empirical evidence derived from the data used, household access to different levels of education leads to a reduction in the depth of poverty.

Secondly, while there is now unanimous agreement on the role of education in general in the fight against poverty, the educational needs of poor households to reduce poverty gaps are heterogeneous: while the least poor of the poor need lower secondary education to get closer to the poverty line, the poorest of the poor need primary education as a priority to escape extreme poverty. Investing in education in a way that takes into account the specific needs of the poorest of the poor will improve the effectiveness of anti-poverty policies.

Thirdly, and as a complement to the first two conclusions, reducing pockets of extreme poverty requires that people have access to upper secondary education. Indeed, with the evolution of technology and changes in the labor market, primary and secondary level 1 education are less and less likely to promote access to the labor market for populations, and consequently the acquisition of subsequent income to satisfy basic needs; jobs, whether monthly paid or unpaid, increasingly require skills that primary and secondary level 1 education alone can no longer offer young people, which justifies the need for a paradigm shift in education policy.

These various conclusions have policy implications. The implications are as much in terms of general anti-poverty policy as in terms of education policy in particular. On the one hand, from the point of view of general anti-poverty policy, it is clear that policies need to be more targeted according to the specific needs of different categories of poor people; this implies that poverty needs to be well segmented in order to provide each class of poor people with the services that correspond to their needs. On the other hand, from the point of view of education policy, the objective of access to upper secondary education for all is a necessity in general, and state support for this objective in rural areas where poverty has a greater incidence is more necessary than ever; achieving this objective is of major importance if we are to break the pockets of extreme poverty that generally inhibit efforts to combat poverty in the world in general and in developing countries in particular.

Thus, the present paper suggests that special attention to the question of education is indispensable for the success of anti-poverty policies in general and the reduction of its depth in particular; however, there is a need to question the type of training compatible with these objectives. Further investigations, particularly into the contribution of the professionalization of teaching to the effectiveness of anti-poverty policies, are needed, the results of which will be of major importance in refining and completing the conclusions reached in this paper.

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## Appendix 1

Assuming that  $y^*$  depends linearly on a set of explanatory variables  $x$ , we can write: :

$$y_i^* = x_i\theta + \varepsilon_i \quad (1)$$

$\theta$  is a vector of parameters, and  $\varepsilon$  is an error term assuming a normal distribution  $N(0; \sigma^2 I_n)$

As the depth and severity of poverty are only observed in the sub-group of poor households,  $y_i^*$  n' is only considered for households where  $y_i^* > 0$ .

### 1. Analysis model

Let  $w_i$  be the well-being of household  $i$ , and  $w_s$  the poverty line for the study population.

let  $y^* = \frac{w_s - w_i}{w_s}$  denote the distance (en %) of the household from the poverty line. For poor households, it is obvious that  $y^* > 0$ , since their well-being is below the poverty line. On the other hand, for non-poor households,  $y^* \leq 0$ , since their well-being is at least above the poverty line.

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$$y_i^* = x_i\theta + \varepsilon_i \quad (1)$$

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As the depth and severity of poverty are only observed in the sub-group of poor households,  $y_i^*$  n' is only considered for households where  $y_i^* > 0$ .

However, estimating model (1) solely on poor households is potentially a source of selection bias; in fact, to do so is to ignore the role of factors explaining the household's poverty situation, and therefore the random nature of the sample. This selection bias is then detected and corrected using Heckman's (1978) two-step approach, by correcting the estimate of the mathematical expectation of  $y$  and  $y^2$  by the inverse of the Mills ratio. Technically, the estimation procedure is as follows:

$$\text{Depth model: } \begin{cases} Pov_i = 1[z_i\gamma + u_i \geq 0] \\ y_i^* = x_i\delta + \varepsilon_i \end{cases} \quad (2)$$

$$\text{Severity model: } \begin{cases} Pov_i = 1[z_i\gamma + u_i \geq 0] \\ y_i^{*2} = x_i\delta + \varepsilon_i \end{cases} \quad (3)$$

In equations (2) and (3), the parameters to be estimated are  $\gamma$  and  $\delta$  while  $z_i$  and  $x_i$  are vectors of explanatory variables, composed of possibly common variables. Moreover,  $u_i$  and  $\varepsilon_i$  are each time unobserved error terms, independent in  $i$ , and it is assumed that their perturbation law does not depend on  $z_i$  and  $x_i$ .

Estimation of models (2) and (3) using Heckman's (1978) two-step method assumes only the normality of the disturbance  $\varepsilon$  and the fact that, conditional on the explanatory variables, the regression of  $\varepsilon$  and the fact that, conditional on the explanatory variables, the regression of  $\varepsilon_i$  on  $u_i$  is linear :

$$\varepsilon_i = \rho u_i + \vartheta_i \quad (4)$$

$$\text{With } E(\vartheta_i/x_i, z_i, pov_i) = 0 \text{ and } V(\vartheta_i/x_i, z_i, pov_i) = \sigma_1^2(1 - \rho^2) \quad (5)$$

Under these assumptions, we show that

$$E(y_i/x_i, z_i, pov_i = 1) = x_i\delta + \rho\sigma_1\lambda_i \quad (6)$$

With  $\lambda_i = \frac{\varphi(z_i\gamma)}{\phi(z_i\gamma)}$  the inverse of Mill's ratio.

Finally, we can easily estimate the selection equations according to the probit model and obtain a convergent estimator  $\hat{\gamma}$  and  $\gamma$ , which is used to calculate  $\hat{\lambda}_i = \frac{\varphi(z_i\hat{\gamma})}{\phi(z_i\hat{\gamma})}$  which will in turn be used to estimate depth and severity models.

2. Variables' description

The depth and severity of poverty are calculated from the poverty gap for poor households (below the poverty line), using FGT indicators. According to (Foster et al., 1984), the poverty depth index ( $P_1$ ) and the severity index ( $P_2$ ) are given respectively by the formulas:

$$P_1 = \frac{1}{N} \sum_{i=1}^N \frac{G_i}{z} \tag{7}$$

$$P_2 = \frac{1}{N} \sum_{i=1}^N \left(\frac{G_i}{z}\right)^2 \tag{8}$$

With  $\frac{G_i}{z} = \frac{(y_i - z)I(y_i < z)}{z}$  the difference between the value of the well-being indicator and the poverty line for a poor individual.

We therefore calculate the relative gap for each poor household  $var\_profond = \frac{G_i}{z} = \frac{(y_i - z)}{z}$  and its square  $var\_severe = \left(\frac{G_i}{z}\right)^2$ , which will be used as explained variables.

**Appendix 2: estimations results**

Table 2.1.: Regression coefficients for depth and severity of poverty models (without selection)

VARIABLES	(1) poor_depth	(2) poorer_depth	(3) less poor depth	(4) severity_poor
H_studies(ref : none_study)				
primary	-0.083*** (0.018)	-0.005 (0.008)	-1.106*** (0.086)	-0.053*** (0.010)
secondary	-0.039*** (0.009)	-0.007 (0.005)	-0.185*** (0.041)	-0.024*** (0.006)
	-0.077*** (0.012)	-0.013** (0.006)	-0.399*** (0.057)	-0.045*** (0.007)
Residence (ref=urban)				
rural	-0.002 (0.007)	0.002 (0.004)	-0.277*** (0.036)	-0.001 (0.005)
eqadu1	0.003 (0.005)	-0.002 (0.003)	0.518*** (0.033)	0.002 (0.003)
eqadu_sqrt	0.002 (0.001)	0.000 (0.001)	-0.069*** (0.006)	0.001* (0.001)
Genders (ref=male)				
female	-0.004 (0.010)	0.013*** (0.005)	-0.097 (0.062)	-0.006 (0.007)
Csprof(ref=man_overs)				
Ouv_employ	0.059* (0.034)	0.032** (0.013)	0.742*** (0.191)	0.031 (0.019)
Cadre_maitrise	0.053* (0.032)	0.032*** (0.012)	0.890*** (0.178)	0.028 (0.018)
Own_cpte	0.054* (0.030)	0.031*** (0.011)	0.932*** (0.166)	0.025 (0.017)
Constant	0.197*** (0.033)	0.058*** (0.013)	-2.597*** (0.211)	0.070*** (0.019)
Observations	2,473	990	6,528	2,473
R-squared	0.049	0.019	0.200	0.045

Standard deviation in brackets

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Source: based on estimates from the EHCVM 2018-2019 database, after weighting.

Table 2.2.: Regression coefficients for depth and severity of poverty models (with selection)

VARIABLES	(1.1)	(1.2)	(2.1)	(2.2)	(3.1)	(3.1)	(4.1)	(4.2)
	Depth selection model (poors' set)		Depth selection model (40% less poor ones)		Depth selection model (40% poorest ones)		Severity selection model (set of poors)	
	gap	Selection equation	gap	Selection equation	Gap	Selection equation	gap_sqrt	Selection equation
hage		-0.009***		-0.005***		-0.007***		-0.009***
H_studies(ref : none_study)		(0.001)		(0.001)		(0.002)		(0.001)
primary	-0.018 (0.038)	-1.019*** (0.070)	-0.016 (0.016)	-0.544*** (0.082)	-0.017 (0.036)	-0.593*** (0.171)	-0.008 (0.025)	-1.019*** (0.070)
secondary	-0.020 (0.013)	-0.322*** (0.041)	-0.008* (0.005)	-0.066 (0.048)	-0.017 (0.012)	-0.162** (0.070)	-0.011 (0.009)	-0.322*** (0.041)
Post_second_1	-0.048** (0.019)	-0.509*** (0.051)	-0.014** (0.006)	-0.097 (0.059)	-0.019 (0.023)	-0.458*** (0.100)	-0.025** (0.013)	-0.509*** (0.051)
eqadu1	-0.015 (0.010)	0.302*** (0.023)	0.002 (0.006)	0.200*** (0.027)	-0.000 (0.005)	0.028 (0.039)	-0.010 (0.007)	0.302*** (0.023)
eqadu_sqrt	0.003** (0.001)	-0.030*** (0.004)	-0.000 (0.001)	-0.028*** (0.006)	0.000 (0.001)	0.010 (0.007)	0.002*** (0.001)	-0.030*** (0.004)
Genders (ref=male)								
female	0.001 (0.010)	-0.128*** (0.041)	0.013** (0.005)	-0.061 (0.049)	-0.007 (0.010)	-0.052 (0.069)	-0.002 (0.007)	-0.128*** (0.041)
Csprof(ref=man_overs)								
Ouv_employ	0.030 (0.037)	0.537*** (0.116)	0.038** (0.017)	0.306** (0.135)	0.060 (0.041)	0.062 (0.260)	0.011 (0.025)	0.537*** (0.116)
Cadre_maitrise	0.017 (0.038)	0.504*** (0.112)	0.040** (0.017)	0.317** (0.129)	0.057 (0.041)	0.001 (0.254)	0.003 (0.025)	0.504*** (0.112)
Own_cpte	0.014 (0.037)	0.594*** (0.102)	0.040** (0.017)	0.360*** (0.118)	0.017 (0.039)	0.182 (0.235)	-0.003 (0.024)	0.594*** (0.102)
Residence (ref=urban)								
rural	0.008 (0.009)	-0.152*** (0.032)	0.000 (0.004)	-0.087** (0.038)	-0.001 (0.008)	0.003 (0.054)	0.006 (0.006)	-0.152*** (0.032)
Handic (ref=none)								
yes		0.020 (0.064)		-0.104 (0.080)		0.269** (0.110)		0.020 (0.064)
Constant	0.370*** (0.090)	-1.151*** (0.128)	-0.006 (0.073)	-1.608*** (0.150)	0.530*** (0.080)	-0.280 (0.272)	0.191*** (0.059)	-1.151*** (0.128)
		-0.0931** (0.0442)		0.029 (0.032)		-0.092 (0.059)		-0.065** (0.029)
Observations	8,012	8,012	8,012	8,012			2,473	2,473

Standard deviation in brackets

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

Source: based on estimates from EHCVM database 2018-2019