The Impact of Education on the Behaviour of Labor Supply in Cameroon: an Analysis using the Nested Multinomial Logit Model

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ABSTRACT

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This article renders an analysis of the impact of education on labour supply behaviour, particularly in terms of participation decision and the level of employment and unemployment of the active population in the labour market in Cameroon, through the nested logit model. Using data obtained from the database of ECAM III carried out in 2007, we find that individuals who constitute the labour supply being faced with four alternatives (domestic activities, the informal, the public and the private formal sectors) choose to work in the sectors which best values their education. Thus, for these individuals, it is more likely to choose to practice in the sectors associated with lower levels of education than other sectors. Also, these individuals have the tendency of orientating their choices primarily to sectors in which the average level of education is at most equivalent to theirs. Therefore, signals sent by job-seekers to employers, requesting access demand to certain sectors instead of others are obviously determine by their various levels of education. Moreover, participation in a sector of the job market in Cameroon is a decreasing function of average charged income and average worked hours that are established.

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1. Introduction

Education plays a very important role in most countries of the world. The individual and collective desire for education is motivated by the private and social results produced by its accumulation. But then, does the fact that individuals obtain education always permit them to offer their labour force in the market?

Individuals who acquire education (like the others) are faced with choices. These ones can be represented either through the form of participation in the labour market, or non-participation in this market. Thus, when an individual decides to participate in the labour market, he/she often searches for information about potential job opportunities existing in this market. He/she emits signals to potential employers who may be interested in the profile that the individual presents.

The decision to participate in the labour market is generally underlined by the amount of paid work that a person wishes to offer in a given period of time (a day, a week, a month, a year or lifetime) based on his/her tastes and economic and social environment (Cahuc and Zylberberg, 2003). The explanation of this decision is usually given by the theory of labour supply. However, the decision to participate in the labour market does not guarantee a job, given that it is not always available.

In addition, individuals wishing to provide a given amount of paid work do not always have accurate information about job opportunities that exist in the market. In order to get employed and obtain revenue, the mere desire to participate in the labour market is not enough; the jobs must be searched in the labour market. That is the subject of the theory of employment prospection. However, the latter is not opposed to that of labour supply, insofar as the inaccuracy of information is put at the center of its approach, adding the category of "unemployed" to those of the "employed "and the "inactive" to which the theory of labour supply is limited (Cahuc and Zylberberg, 2003).

Several other economic theories have attempted to explain the role of education on the behaviour of individuals who offer their labour in a market. For example, according to the theory of human capital, if a rational agent decides to further his studies, it is simply because from a financial perspective, he estimates that the expected increase in his revenue throughout his active life shall cover the cost that he must initially bear for the

education. According to this theory therefore, individuals acquire education with the main objective of obtaining a job which would give them revenue that is an increasing function of the educational level they attained (Becker, 1964; Mincer, 1974).

However despite the education acquired, some individuals may choose not to offer their labour in the market, especially if the wages are below a certain standard value. As per the theory of labour supply, this standard wage value that leads an individual to choose inactivity is the reserve salary. Meanwhile as per the theory of employment search (or job prospecting), when a job-seeker refuses a job on the basis of this standard wage value, it indicates the reservation wage (Cahuc and Zylberberg, 2003).

Objectives of the study

The main objective of this article is to analyze the effects of education on the labour supply behaviour in Cameroon. It precisely includes the following points:

1. determine the effect of individuals' education on their decision to participate in the labour market;
2. determine the effect of education on the levels of employment and unemployment of the active population in the labour market of Cameroon.

Education is the main factor affecting human capital. The theory underlying the concept of human capital has given an explanation for the relation that exists between education and the labour market. We shall first of all carry out a theoretical analysis of the relation that exists between education and labour supply. Then this relation shall be particularly analyzed in Cameroon through the specification and appraisal of an analytical model of labour supply, the Nested Logit Model (NLM).

2. Relation between education and the labour market in Cameroon

The provision of education in Cameroon operates through an educational system which is the result of the dual English and French domination experienced in the country before its independence. Thus, the duality of the languages and their various teaching modalities[1] are

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[1] English in the North West and South West Regions, and French in the eight other Regions of the country.

coupled to diverse educational curricula. On one hand therefore, there is the public order of education, and on the other hand, there is the private order which comprises of the secular private, the Catholic private, the Protestant private and the Muslim private (Education Strategy Paper, Cameroon 2006).

Despite this diversity, the educational system of Cameroon is well structured and definite at the central level of the State. Indeed, the State appears as the leading organizer of the educational system in Cameroon. The state influences demand and supply of education more than any other agent or institution by its orientations and decisions (Education Strategy Paper, Cameroon 2006).

The education system of Cameroon enables graduates to acquire a variety of educational levels[2] and diplomas[3]. These individuals either decide to focus on non remunerating domestic activities or to seek employment in the market. They thus offer their labour to those who likely need it in exchange for payment. Labour demand in Cameroon essentially consists of entities from two main juxtaposed segments: a structured or formal modern sector and a non structured sector known as the informal sector.

This modern-informal dichotomy in the appraisal of mechanisms of the labour market in terms of changes in employment and wage determination, often highly considered in developing countries, may seem to be "simplistic" and consequently limited in the case of Cameroon due to the evolution of educational and socio-economic structures (Abessolo, 1997). However, this segmentation of the labour market increased due to the economic crisis in Cameroon in the mid-1980s. Since then the market has been characterized by a growing gap between supply and demand for labour.

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[2] In addition to higher education which is same, every sub-system (Anglophone and francophone) comprises of five educational levels: pre-school, primary, post primary, secondary and training.

[3] The primary cycle is concluded by the First School Leaving Certificate (FSLC); the first secondary cycle of the francophone general education is completed with the Brevet d'Etudes de Premier Cycle (BEPC) while that of the anglophone is completed by the General Certificate of Education Ordinary Level (GCE O/L). The second cycle is completed with the Baccalauréat in the francophone sub-system and the General Certificate of Education Advanced Level (GCE A/L) in the anglophone sub-system. Individuals who have obtained a pass in the Baccalauréat or GCE A/L can gain access to higher education, but entry to professional schools of the public service is subject to a prior pass in a competitive entrance examination (Education Strategy Paper, Cameroon 2006).

Individuals seek to be educated in Cameroon (and elsewhere) for various reasons and mainly because they want to be integrated in the labour market and as well receive the wages (high) that accompany it. Individuals who have acquired a level of education they deem satisfactory decide whether or not to offer their labour in a market.

Thus, the analysis of the effects of education on labour supply in Cameroon requires that the choices of individual be explained while taking into consideration their decisions to participate in the labour market and the type of employment they choose in a segmented labour market. A distinction between individuals who do not participate, those working in the informal sector, those working in the formal sector and those working in the formal private sector of Cameroon's workforce must be made.

Generally, individuals have four choices available in the labour market of Cameroon. The informal segment includes workers of private non-agricultural enterprises and those of private agricultural enterprises. This segment represents just over 80% of the considered sample (ECAM III, 2007)[4]. On the other hand, the public segment includes workers of the public administration, public enterprises and international organizations which represent nearly 11% of the number considered. Finally, the formal private segment includes formal workers in private enterprises which account for just over 9% of the number considered.

Usually, multiple occupational choice modelling entails multinomial logistic (NL) estimates. However, the methodological weaknesses that characterize such estimates led us to elaborate a model of multi-sectorial participation in the labour market - the nested logit model (NLM). This could improve the quality of interpretations of people's choices as regards their labour supply.

3. Literature review

Education plays an important role in most countries (Psacharopoulos and Patrinos, 2002). Its individual and collective demand is motivated by the private and social outcomes resulting from its accumulation (Becker, 1964). Individuals who acquire education and maximize their utility (or satisfaction) are faced with choices. They can either decide to participate in the labour market, or stay in a state of inactivity (Cahuc and Zylberberg, 1996). Also, when an

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[4] According to the National Institute of Statistics (NIS, 2005), this segment represents about 90% of the occupied active population of Cameroon.

individual decides to participate in the labour market, he/she often seeks information about the potential job opportunities that exist in that domain in particular.

He/she emits signals to potential employers who may be interested in the profile that he/she presents (Spence, 1973). According to the theory of human capital (Schultz, 1961, Becker 1962, 1964), if a rational agent decides to further his studies, it is simply because from a financial perspective, he estimates that the expected increase in his revenue throughout his active life shall cover the cost that he must initially bear for the education. Therefore, individuals acquire education with the main objective of obtaining a job which would give them revenue that is an increasing function of the educational level they attained (Mincer 1958, 1974; Nga Ndjobo and al., 2011). However despite the education acquired, some individuals choose not to offer their labour in the market, especially if the wages are below a certain standard value[5] (Cahuc and Zylberberg, 2003).

The labour market in Cameroon

Sub paragraph 2 of section 1 of Law n[o]. 92/007 of 14 August 1992 which promulgates the Labour Code of Cameroon defines an "worker", irrespective of sex or nationality, who has undertaken to place his services in return for remuneration, under the direction and control of another person, whether an individual or a public or private corporation, considered as the "employer". Also, to determine the quality of a worker, the legal status of the employer or the employee is not supposed to be considered. This definition describes relations between different actors in the labour market in Cameroon.

Like all persons who constitute the workforce, those who have graduated from the educational system of Cameroon can either decided to focus on domestic activities, or to seek employment in the market. The labour market of Cameroon is composed of two main juxtaposed segments: a modern structured or formal segment which consists of the formal public[6] and private[7] sectors and an unstructured informal segment (Abessolo, 1997). The Labour Code (1992) determines the rules of recruitment or hiring, dismissal procedures, forms of contract and working conditions for parastatals as well as for the private public

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[5] This standard wage value is the reserve wage in the theory of labour offer. While in the theory of job search (or job prospecting), this standard wage value is the reservation salary.

[6] Jobs of the public sector are mostly concentrated on the unmerchantable branches (EESI, 2005).

[7] A quarter of occupied active people of this sector work in enterprises of less than 20 people, and a third works in enterprises of more than 100 people (EESI 2005).

sector. It sets the contours of trade union activities as well as guidelines for the determination of wages. In the public service, the general status of the Public Service regulates labour relations (Noumba, 2001).

The state plays an important role in the labour market of Cameroon. It plays both the role of the employer and the agent in charge of regulating, controlling and conciliating or advising. As an employer, the State has three categories of agents: civil servants recruited by direct competitive entrance examinations or through professional entrance examinations[8]; contract workers[9]; State officers who are directly recruited without writing any competitive examination[10]. These various employees must have a number of individual socioeconomic characteristics. For example, contract workers, must at least be holders of an advance level certificate of the secondary education (a certificate obtained after seven years of secondary education). The minimum certificate required for state agents is the First School Leaving Certificate (Primary studies). Recruitment into the army is either through a competitive examination or on the basis of a physical fitness test (without written examinations). The State only has monopoly over these categories of workers employed by the State (Noumba, 2001).

The state is also involved in the recruitment of workers in the formal private sector and parastatals, although it does not have monopoly in these sectors. In most cases, companies of these sectors recruit their staff on the principle of freedom of hiring and on the type of employment contract (Labour Code of Cameroon, 1992). However, the State through the President of the Republic "may prohibit or restrict by decree, after consultation with the National Labour Council, certain hiring in specific regions" (Labour Code, 1974). Workers of the formal segment of the labour market in Cameroon are subject to one of the two plans established by the legislation. The 40 hours plan applicable to industrial and commercial establishments, as well as to the public service and the 48 hours plan which is applicable to the agricultural sector and activities related to agriculture.

In addition, the weekly working hours for domestic servants is 54 hours and 56 hours for guards and drivers. The average weekly work is therefore 39 hours (NIS, 2005). That is

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[8] Civil servants are recruited by an order of integration signed by the Minister of the Public Service after approval by the Prime Minister.
[9] Contract workers are recruited into each service and are bound to the State by a contract signed by the Minister or by the public institution concerned.
[10] The current Labour Code also provides for the hiring of temporary workers.

therefore why mention shall be made of visible underemployment when workers involuntarily work less than 35 hours per week in their main job, for reasons related to the employer or because of poor economic conditions. On the other hand, invisible underemployment occurs when workers earn less than the minimum hourly wage guaranteed. General underemployment encompasses all forms of distortions in the labour market. It includes visible underemployment, invisible underemployment and unemployment, affecting more than three quarters of the workforce in Cameroon (INS, 2005).

Also, the current Labour Code (article 61 paragraph 2) in Cameroon talks of "equal conditions of work, professional competence, wages are equal for all workers, whatever their origin, sex, age, status of their religious denomination in accordance with this section". The law also stipulates that a minimum salary should be fixed. However, there is no mechanism through which the unemployed are compensated in Cameroon. This leads most people of working age to engage in income generating activities, whether or not they correspond to their initial qualifications. Also, those who fail to integrate the structured segment of the market[11] move to the unstructured segment.

The informal sector is the set of production units that do not have a tax number and / or do not have any formal accounting (NIS, 2005). This sector is characterized by job insecurity, low, irregular and often almost non-existent wages, insufficient pension insurance, etc. The entire informal sector comprises just over 90% of the total number of employed workers (INS, 2005), including 55.2% of total employment in the informal agricultural sector, and 72.9% of rural employment (EESI, 2005). Also, agricultural workers have similar characteristics to workers of the informal non-agricultural sector. These sectors are highly feminized. Part of migrants representing over a third of the agricultural workers have a low education level (Abessolo and Tchana, 2009).

Workers of the modern segment of the labour market have characteristics which are clearly opposed to those of the unstructured segment of the market. Women for example, represent almost a third of workers of the public service and are much less present in the formal private sector. In addition, workers of the public sector have a much higher level of education than the general population. Although it represents only 4.9% of total number of workers, 64% of

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[11] Job-seekers in Cameroon are looking for a paid employment (60%). %). If more than 22% preferred self-employment, less than 20% are indifferent to the type of employment sought. On the contrary, 70% want a full time permanent job with an average working week of 44 hours (EESI, 2005).

executives belong to this sector. Executives represent over 60% of the administration and only 28% of the staff of public enterprises and parastatals. The education level of employees of this sector is far higher; about 12 years of successful schooling (Abessolo and Tchana, 2009).

4. Methodology

The nested logit model[12] is increasingly used in practical issues. This can be justified by its ability to take into account similarities between alternative pairs when analyzing. There are two different specifications of this model: Utility Maximization Nested Logit (UMNL) model and the Non-Normalized Nested Logit (NNNL) model. The UMNL model is usually preferred since the latter specification is not consistent with the random utility theory (RUT), (Silberhorn, Boztuğ and Hildebrandt, 2006).

Very often, discrete choice modeling in the context of the random utility theory is made by using the logit model (LM) (Guadagni and Little, 1983). However, this type of model assumes proportional substitution criteria (property of the independence of irrelevant alternatives, IIA), that is to say that the ratio of choice probabilities of two alternatives (P_j/P_k) does not depend on the presence or absence of other alternatives in the model. In order to bypass this restrictive assumption among alternatives, several extensions of the LM model have been developed, all however, with a general solution allowing correlations between the error terms of alternatives (Silberhorn, Boztuğ and Hildebrandt, 2006). In addition, unlike the multivariate probit model, for example, whose estimate can be complex given the current state of knowledge and technological means[13], the nested logit model can be easily used in practical applications (Guadagni and Little, 1998; Ortúzar De Dios, 2001).

The nested logit model (NLM) is a combination of standard logit models that differ from the others by the fact that the components of the alternative choice error do not necessarily have the same distribution. In addition, the NLM considers more general substitution alternatives. The idea behind this model is in a group of similar alternatives within sub-groups, aiming at creating a structure of hierarchical alternatives (Ben-Akiva and Lerman,

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[12] Ben-Akiva (1973) was the first to present this model.
[13] McFadden (1984), Amemiya (1985), Greene (1997) for example, confirm it. However, although considerable difficulties in interpreting the coefficients exist, this model is now calculable.

1985; Train, 2003) which does not necessarily require that individuals' process of choosing should be sequential. Error terms of alternatives within a sub-group are correlated to each other, while those of alternatives in different sub-groups are not correlated. Thus, the assumption of IIA is maintained within each sub-group, but the variance may differ between the various sub-groups. The process of the nested logit model adapts to a violation or partial relaxation of the IIA property.

Within the confines of our work, the problem of choice faced by persons who constitute the labour supply of Cameroon is presented as a problem of choice at two levels. The partition of choices into subsets or subgroups is thus feasible, since one can naturally distinguish the choice not to work from all the other choices that are choices to work, but in different segments of the labour market. So if people decide not to participate in the labour market, they will not work. But on the contrary, if they decide to participate in the labour market, they must choose between working in the informal sector, the public sector and the formal private sector. This hierarchical structure of our model[14] may be reproduced in the form of the following decision tree:

Figure 1: nested logit model for participation in the labour market in Cameroon
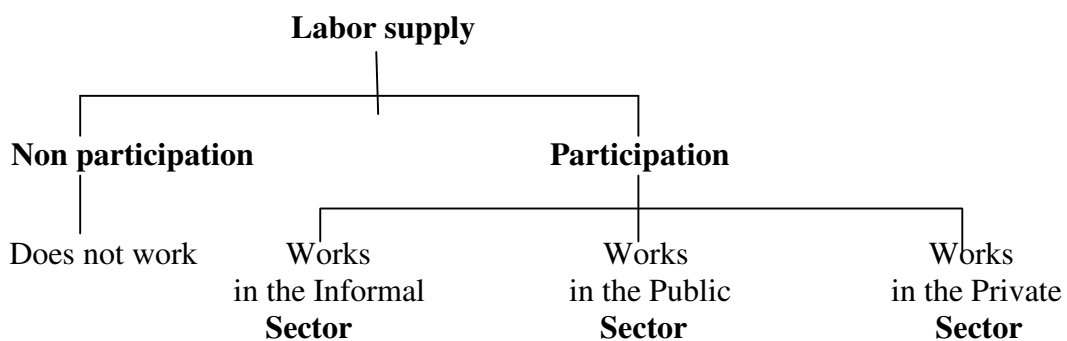
 Source: Authors.

The mathematical specification of the NLM model resulting, as for the nested logit model, the probability that a worker works in one of the segments of the labour market, knowing that he has chosen to work, is estimated using the following equation:

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[14] The situation we define here is obvious. However, when this is not the case, it is possible to arrange the alternatives into subgroups. Thus, when the assumption of IIA is (or is satisfied) between two alternatives, they can be arranged in the same subset or subgroup.

$$\Pr ob(Y_i = j|p) = \frac{\exp(\beta'_j z_i)}{\sum_{k=1}^{3} \exp(\beta'_k z_i)} \qquad (a)$$

The difference between the LM and NLM is seen at the level of assessing the probability not to work rather than participate in the labour market. This probability becomes:

$$\Pr ob(Y_i = 0) = \frac{\exp(\beta'_0 z_{i0})}{\exp(\beta'_0 z_{i0}) + \exp(\lambda \cdot I_i)} \qquad (b) \quad \text{with } I_i = \ln\left(\sum_{k=1}^{3} \exp(\beta'_k z_i)\right)$$

In this formulation, the vector z_{i0} corresponds to a specific set of variables explaining the choice to participate or not in the labour market. They can be different from the explanatory variables of the choice of a particular segment of the labour market (z_i). The term I_i represents the inclusive value for the sub-group of choice in question (choices of segments in the labour market). In this formulation, if λ is equal to 1, the NLM is reduced to a standard LM. Thus, by permitting λ to differ from the unit, the NLM brings forth the assumption of IIA through the various "branches" of the decision tree. It is maintained between the choices belonging to the same subgroup, but is released between the subgroups. The probability of choosing a particular segment of the labour market is written thus:

$$\Pr ob(Y_i = j) = \Pr ob(Y_i = j|p) \cdot (1 - \Pr ob(Y_i = 0))$$

The parameters of the NLM thus defined can be estimated by the usual techniques of maximum likelihood[15]. The λ parameter can be used to test the hypothesis of IIA.

Indeed, a test of the null hypothesis $\lambda = 1$ will be an effective test of the relevance of the latter in the LM. It should be noted that the NLM which has two levels can be easily extended to three or more levels. Its complexity increases geometrically with the number of levels in

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[15] It is assumed that residues ε in the stochastic utility function have independent distributions of GEV type (Generalized Extreme-Value). It is also possible to estimate a NLM through a sequential method with steps (Maddala, 1983). The β_j are first of all estimated in equation (a), then the inclusive value I_i is calculated. Then the β_0 can finally be calculated using the equation (b). However, this method leads to a loss of efficiency in the case that interests us. But then, it is very useful in the evaluation of large models for which the method of maximum likelihood is difficult to use.

the decision tree. However, it is very flexible and is widely used, particularly in the modelling of consumers' choices.

Variables and characteristics of the main segments of the labour market in Cameroon

Verification of assumptions of the specified model required the use of data from the database ECAM III households census conducted in 2007. This data is relative to the characteristics of individuals. The related sample consists of 11 391 observations corresponding to individual who are heads of households including 8 350 men and 3 041 women[16]. Among them, just over 93% carry out an activity that brings them wages in one of the segments of the labour market, out of which 7 886 men and 2 718 women. In this study, the supply of labour refers to people who have exercised an economic activity within the last 12 months or being engaged in a process of job search. By observing this database, we can realize that the participation rate of women is low as compared with that of men low. These rates are 25.63% and 74.36%[17] respectively.

The two-level nested logit model that we implement in the context of this work is a multi-sectorial participation model in the labour market. It is a discrete choice model that highlights several alternatives. The person concerned chooses the alternative associated with the highest utility. The characteristics of the decision maker and the choice of alternatives determine the utilities of alternatives. Demographic characteristics do not have a direct contribution to utility as such, but rather serve as proxy variables for the observable heterogeneity of the decision maker (s).

The tree structure of the specified model requires that data be presented in a panel form rather than a cross form as is usually the case for the estimation of classical models of participation. This data structure requires that a line characteristics for each choice before an individual be written. However, though this approach is more complex, it has two important advantages: First, it permits where necessary, to select different variables according to the alternative that one wishes to explain. On the other hand, it allows the consideration of the

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[16] See Table I in Appendix.
[17] These rates cover the supply of labour, that is, they include the unemployed, who do not work, but still "offer" their labour in the market. See Table I in Appendix.

attributes associated with the different choices that individual may make. This means that this approach takes into account the various variables for the same individual, depending on the choice he makes.

The model that has thus been developed required the use of dependent variables and two types of variables:

• A "type" variable, dependent on the equation of the first level of choice or top level. It identifies alternatives of that level of choice, that is to say the possibility of an individual's choice between participation and non participation in the labour market.

• A dependent variable "labour supply" relating to the equation of the second level of choice or bottom-level. A "work" variable that identifies the various alternatives that individuals face once they have decided to work.

• The explanatory variables for the choice to participate or not participate in the labour market (the first level of choice or top level). These variables are mainly related to the demographic and social and family context of the individual. These are variables specific to individuals.

• The explanatory variables in the selection of a segment of the labour market (the second level of choice or bottom-level). These variables are mainly the individual characteristics of the segment of the labour market that is to be chosen and its potential productivity. They surface after individuals have decided to work. They maximize their utility. In addition, the ability to include "attributes of choice"[18] allows a much more relevant use of the variable "imputed income" often implemented in the explanatory models of participation in the labour market. These variables are specific to different segments of the labour market.

In our work, the variables specific to individuals include: age which corresponds to the individual's completed number of years. It goes from 11 to 95 years and more; squared age (divided by 100)[19], the type of individual; the individual's marital status; the individual's place of residence; size of the household from which the individual is from.

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[18] That is, dependent variables, for the choice made by every individual.
[19] Dividing by one hundred helps to avoid some inconveniences related to effects of scale.

Variables which are specific to the various segments of the labour market for their on average levels of education. They represent the average number of years of successful studies per segment of the labour market and region[20]; to the average number of hours worked by segment of the labour market and per region; and to income charged. They express the income that individuals can expect from their participation in various segments of the labour market. It corresponds to the average level of income[21] in force in the various segments of the labour market and by region.

The advantage of the model we implement in the context of this study is that the charged income will be measured for each individual in each segment of the labour market. They will be evaluated from the functions of corresponding earnings (at different segments of the labour market). Taking into account the influence of market conditions on individuals' decisions is no longer done according to the conditions (expected income) "in the labour market" broadly, but according to the expected revenues from participation in each segment of this market. We can infer each individual's expected income from participation in the labour market as worker of the informal sector, public sector, worker of the public sector or worker of the formal private sector. Thus, we introduce "attributes of choice" for each individual in this model.

5. Results, analysis and interpretation

Labour supply in the context of this study is on participation and non participation in the labour market in Cameroon. On this basis, we estimated a nested logit model. Nevertheless, we begin this section with a presentation of summary statistics of variables used in the estimation of the model specified.

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[20] In the database of ECAM III households' census that we have used, Cameroon is divided into twelve (12) Regions rather than ten (10) as it is officially established. These ten (10) official Regions are: Adamawa, Centre, East, Far-North, Littoral, North, North-West, West, South, South-West, to which the cities of Douala and Yaoundé are added.

[21] Income is approximated in this work by per capita expenditure.

Brief summary descriptive statistics of variables used

Table II here in attached summarizes the descriptive statistics of variables from the database of ECAM III (2007). This database which consists of 11 931 observations was compiled into four, so as to consider the four alternatives faced by those who choose to offer their labour in the market. This therefore raised the number of transformed observations to 45 564. We notice that the average age of the population is about 42 years. The average number of successful years of studies is 9.5 years[22].

Main effects of the various variables specific to individuals and various segments of participation in the labour market in Cameroon

The main results of the estimation of the nested logit model are presented in Table III in the Appendix. The estimation of the nested logit model is done using software known as STATA 10. The coefficients to which we arrive at the end of our estimates are all significant. They can be interpreted in the usual way. Thus, the positive sign of the coefficients associated with household size and area of residence shows that the probability of not participating in the labour market is higher than that of participating for people coming from large households and for those living in urban areas. All things being equal, this probability is inferior to that of participating, for people from small households and for those living in rural areas.

In addition, the negative sign of the coefficient associated with age followed by the positive sign associated with age squared (divided by a hundred) reflects the fact that non-participation in the labour market in Cameroon is a concave function of individuals' age , which means that it increases with the age of individuals, but at a decreasing rate. In other words, this means that the lesser the people are old, the more they participate in the labour market in Cameroon.

In addition, the negative sign of the coefficients associated with gender and marital status of individuals indicate that the probability of not participating in the labour market is lower than that to participate, for males and for those married or cohabiting. In other words, males and

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[22] See Table II in Appendices.

those married or cohabiting are more likely than others to participate in the labour market in Cameroon.

Also, we find that the coefficients associated with explanatory variables (predictors) of "Work" identifying the various segments of the labour market, involved in the second level of choice or bottom-level, are negative though they are significant. Thus, the negativity of the coefficients associated with the charged income and the average number of hours worked on each sector (alternative) indicates that individuals who choose to participate in the labour market in Cameroon, less likely choose to practice in domains that have less number of working hours and lower income levels as compared to others. Participation in a sector of the labour market in Cameroon would be an increasing function of the average charged income and average hours worked established. Those who decide to work more likely choose to work in enterprises in that offer a higher income and higher number of working hours than those of other sectors.

Again, we find that coefficients associated with the variable "education" (average number of years of successful studies) and that of "education squared (divided by 100)" are very significant and also negative signs. This indicates that those who choose to work do so in the market segment that values their level education most. Indeed, for these individuals, it is less likely to choose to work in sectors associated with lower educational levels than those of others. In addition, we can say that they are orientated more towards market segments in which they would find the average education level at least equal to theirs. Having first influenced their decision to participate in the labour market, the level of education of individuals will then influence their choice of the sector in which to work.

Descriptive statistics of the various alternatives considered in this model indicates that at the first level of the model there are two alternatives: "not participating" and "participating". These alternatives respectively refer to the two main results of labour supply. Duplication in four (equivalent to the number of alternatives of the second level of choice or bottom-level) and overlay (juxtaposition) of the basic ECAM III (2007) leading to an initial final database constituted of 45,564 observations[23], enabled us to notice that 43 216

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[23] 45 564 corresponds to 11 391, the initial number of observations of ECAM III multiplied by four.

observations[24] were used in the estimation of our model. The alternative "not involved" is concerned with 10 804 observations of which 1029 were selected. The alternative "not participating" in turn, has a total of 32 412 observations of which 9775 were selected. Thus, out of the 10 804 cases selected, 9.52% concern the alternative "not involved" and 90.48%, the alternative "participates".

At the second level of choice or bottom-level, we have just four alternatives[25]: "not working", "working in the informal sector", "working in the formal public sector" and "working in the formal private sector." Each of these alternatives is involved in 10 804 observations of which 1029; 7835; 1030 and 910 were selected, respectively. These percentages highlight the place of each of these alternatives in the labour market in Cameroon. This shows that participation in the informal sector accounts for just over 80% of the total labour force, and 72.52% of the total labour supply. Similarly, participation rates in the formal public and private sectors are substantially equal, including 10.52% and 9.3% of the total labour force respectively. These percentages correspond to 9.53% and 8.42% of total labour supply.

The different rates mentioned above help to see the importance of the informal sector in the labour market in Cameroon. More than eight (8) out of ten (10) workers correspond to more than seven (7) active persons in ten (10) engaged in this sector in Cameroon. This reflects how informal labour market in Cameroon is.

In addition, based on the results obtained in post-estimation[26], we can determine a number of probabilities associated with each of the observations in our sample. Among these probabilities, we can consider: *(i)* the probability of choosing an alternative of the first top level choice rather than the other. We termed it as $p1 = \Pr(Type)$; *(ii)* the probability of choosing one of the alternatives of the second level or bottom-level choice rather than the other. We termed it as $p2 = \Pr(Travail)$; *(iii)* the probability of choosing an alternative in the second level of choice or bottom-level, given a particular choice in the first level of top level choice. We termed it as $condp = \Pr(Travail|Type)$, and finally, *(iv)* the value of the inclusive value for various scenarios[27]. We termed it as *IV*.

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[24] See Table VII (in Appendices) for the description of percentages relating to the various alternatives of the first level of choice or top level.

[25] See Table VIII (attached) for the description of the percentages of the various alternatives of the second level of choice or bottom-level.

[26] See Tables VII to IX (attached).

[27] See Table IX (attached).

Thus, for the first observation of the database for instance[28], considering the values of independent variables corresponding to the individual, the probability that he chooses to participate in the labour market is equal to 0.911 and the probability that he chooses not to participate is equal to 0.088. The probability that an individual 1 chooses each of the four alternatives of the bottom-level is given by *p2*. In other words, the probability that an individual 1 does not work is 0.088. It is 0.557 when it comes to working in the informal sector; 0.159 when it comes to working in the formal public sector, and 0.194 when it comes to working in the formal private sector. Finally, the probability that an individual 1 chooses not to work knowing that he chose not to participate in the labour market is 1. Similarly, the probability of him working in the informal sector knowing that he has chosen to work is 0.61. This probability is 0.17 and 0.21 respectively, if the individual chooses to work in the formal public and private sectors, knowing that he has chosen to work.

We can conduct the same analysis for all observations in our sample database, especially for the first four of them, whose relative probabilities are found in Table IX (in Appendix).

On the basis of measuring the impacts of education on the participation of individuals in the labour market, obtained after the estimation of the multinomial logit model, we could conclude the same orders on the effects of education, on the various probabilities mentioned above.

6. Conclusion

Individuals acquire education either for themselves or to influence the functioning of the labour market. In the latter case, they decide to participate in the labour market. They are thus led to search for information relating to the various potential job opportunities existing in this market. In Cameroon, three main alternatives are available to those that emit signals to the labour market: work in the informal sector which englobes about 90% of total number of employed (NIS, 2005); work in the formal public sector, or work in the formal private sector. However, the use of nested logit model enabled us to assess the impact of education on labour supply in Cameroon, as a process on two levels. We therefore noticed that individuals choose to work in the market segments that value their education level most. Thus, for these individuals, it is more likely to choose to work in sectors associated

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[28] See Table IX (attached).

with educational levels lower than those of others. Similarly, these individuals tend to base their choices primarily to the sectors in which the average level of education is at most equivalent to theirs. Thus, the signals that individuals send to employers, which are reflected by their requests for access to certain industries instead of others, are obviously determined by their various levels of education. In addition, participation in a sector of the labour market in Cameroon is a decreasing function of average paid income and average working hours established there.

At a second level, requests for access to certain sectors instead of others would therefore depend on the result of the analysis of the various levels of education, the levels of paid income, and the average number of working hours associated with each of the sectors of the labour market in Cameroon. The first level of choice is determined by a number of socio-demographic factors.

References

Abessolo, Y. (1997). *Capital humain, salaires et segmentation du marché du travail en économie sous-développée : le cas du Cameroun*. Université Montesquieu-Bordeaux IV, CED.

Abessolo,Y. and E. Tchana (2009). *Etude nationale sur les politiques du marché du travail (Cameroun)*. APERP. OIT - Bureau Sous-Régional pour l'Afrique centrale. Février.

Amemiya, T. (1985). *Advanced Econometrics*. Cambridge: Harvard University Press.

Becker, G. S. (1962). 'Investment in Human Capital: A Theoretical Analysis'. *The Journal of Political Economy*, Vol. 70, No. 5, Part 2: Investment in Human Beings (Oct., 1962), pp. 9-49.

Becker, G. S. (1964). *Human Capital, A Theoretical and Empirical Analysis*. Columbia University Press for the National Bureau of Economic Research, New York.

Ben-Akiva, M. and S.R. Lerman (1985). *Discrete Choice Analysis: Theory and Application to Travel Demand*, sixth printing 1994 edn. The MIT Press, Cambridge/Massachussetts.

Ben-Akiva, M. (1973). 'Structure of Passenger Travel Demand Models'. *Transportation Research Board Record*, n°526, Washington, D.C.

Cahuc, P. and A. Zylberberg (1996). *Economie du travail – La formation des salaires et les déterminants du chômage*. De Boeck & Larcier s.a.

Cahuc, P. and A. Zylberberg (2003). *La microéconomie du marché du travail*. Paris, Editions La Découverte.

Commission Technique d'Elaboration de la Stratégie Sectorielle de l'Education (2006). *Document de Stratégie Sectorielle de l'éducation*. Cameroun.

De Dios Ortúzar, J. (2001). 'On the Development of the Nested Logit Model'. *Transportation Research Part B 35(2)*, pp. 213-216.

Greene, W. (1997). *Econometric Analysis*, 3rd ed., Prentice Hall.

Guadagni, P.M. and J. D. C. Little (1983). 'A Logit Model of Brand Choice Calibrated on Scanner Data'. *Marketing Science 2(3)*, pp. 203-238.

Guadagni, P.M. and J. D. C. Little (1998). 'When and What to Buy: A Nested Logit Model of Coffee Purchase'. *Journal of Forecasting 17(3/4)*, pp. 303-326.

McFadden, D. (1973). Conditional Logit Analysis of Qualitative Choice Behavior. *In P. Zarembka, ed., Frontiers in Econometrics,* New York: Academic Press.

McFadden, D. (1984). Econometric Analysis of Qualitative Response Model. *Handbook of Econometrics*, vol. II, Z. Griliches et M. D. intriligator (eds), Elsevier Science Publishers.

McFadden, D. (1987). 'Regression Based Specification Tests For The Multinomial Logit Model'. *Journal of Econometrics*, 34, pp. 63-82.

Mincer, J. (1958). 'Investments in Human Capital and Personal Income Distribution'. *Journal of Political Economy*, 56 (4), pp. 281-302.

Mincer, J. (1974). *Schooling, Experience and Earnings*. New-York, National Bureau of Economic Research and Columbia University Press.

Nerlove, M. and S. Press (1973). Univariate and Multivariate Log-linear and Logistic Models. *RAND-R1306-EDA/NIH*, Santa Monica.

Nga Ndjobo, P. M., B. Kamgnia Dia and B. N. Epo (2011). 'Une analyse empirique de la rentabilité privée de l'éducation au Cameroun : estimation d'un modèle Tobit de type III structurel'. *Revue Africaine de Recherche en Education*, 3e édition. Juillet.

Noumba, I. (2001). *Le marché du travail au Cameroun*. GRAPES – FSEG - Université de Yaoundé II.

Psacharopoulos, G. and H. A. Patrinos (2002). Returns to investment in education: A further update. *Working Paper 2881*, World Bank, Washington D. C., Septembre.

Schultz, T. W. (1961). 'Investment in Human Capital'. *American Economic Review,* 51, n°.1, mars, pp. 1-17.

Silberhorn, N., Y. Boztuǧ and L. Hildebrandt (2006). Estimation with the Nested Logit Model: Specifications and Software Particularities, *SFB 649 Discussion Paper 2006-017*, Institute of Marketing, Humboldt-Universität zu Berlin, Germany.

Spence, M. (1973). 'Job Market Signalling'. *The Quarterly Journal of Economics*, vol. 87, Issue 3 (Aug., 1973), pp. 355-374.

Train, K. E. (2003). *Discrete Choice Methods with Simulation*. Cambridge University Press.

Appendix

Table I. Descriptive statistics on the participation of individuals in the labor market in Cameroon

Carry out an economic activity within the last twelve months	Sex of the head of the household		TOTAL
	Male	**Female**	
Participated	7 886	2 718	**10 604**
Did not participate	461	323	**784**
TOTAL	**8 347**	**3 041**	**11 388**

<u>**Source**</u>: Computed by Authors using Stata 10.

Table II. Descriptive statistics of variables in the estimation of the nested logit model

Variables	observations	Average	Standard error	Minimum	Maximum
Endogenous Variables					
Labour supply	45564	0.25	0.4330175	0	1
Work (Does not work=0 ; works in the informal sectorl=1 ; works in the public sectorl=2 ; works in the formal private sector=3)	45564	1.5	1.118046	0	3
Type	45564	1.75	0.4330175	1	2
Explanatory Variables					
Age	45564	41.92046	15.18794	11	99
Age squared (divided by 100)	45564	19.87994	14.65321	1.21	98.01
Gender (Male =1 and 0 if not)	45564	0.7330349	0.4423789	0	1
Household size	45564	4.493899	3.06855	1	43
Marital status (maried or cohabiting=1 and 0 if not)	45564	0.62128	0.4850735	0	1
Place of residence (urban = 1 and 0 if not)	45564	0.5587745	0.496539	0	1
Average number of successful studies	45564	9.580048	5.019358	2.074485	42.94203
Average number of successful studies squared (divided by 100)	45564	0.9539151	0.5591975	0.0430349	1.973573
Logarithm of average worked hours	44977	2.897227	1.69061	0	4.077995
Logarithm of average paid income	45564	9.943933	5.749961	0	13.91429
Control Variables					
Group (Identifying every household head)	45564	5696	3288.335	1	11391
Participation in the labour market	45564	0.75	0.4330175	0	1

<u>**Source**</u>: Computed by Authors using Stata 10.

Table III. Estimators obtained from estimating the nested logit model of participation in the labour market in Cameroon

VARIABLES	
variables dependent on the equation of the second level of choice or bottom-level	
Labour supply **Work**	
Independent Variables	
Logarithm of average paid income	- 0.043*** (0.011)
Average number of successful studies	- 0.016*** (0.004)
Average number of successful studies squared (divided by 100)	- 0.046*** (0012)
Logarithm of average worked hours	- 0.344*** (0.054)
Variable dependent on the first level of choice or top level	
Type	
Independent Variables	
potential Age	- 0.219*** (0.011)
potential Age squared (divided by 100)	0.240*** (0.011)
Gender (Male =1 and 0 if not)	- 0.469*** (0.085)
Household size	0.036** (0.013)
Marital status (maried or cohabiting=1 and 0 if not)	- 0.637*** (0.090)
Place of residence (urban = 1 and 0 if not)	1.023*** (0.081)
Control Variable	
Type	
$\lambda_{ne\_participe\_pas} = 1$	1 (constrained)
$\lambda_{participe}$	0.085 (0.013)
Number of observations = 43216 Number of cases = 10804 Alternatives per case: Minimum = 4 Average = 4.0 Maximum = 4 Wald chi2(10) = 3958.16 Log likelihood = -8926.6901 Prob > chi2 = 0.0000 Test LR for IIA (tau = 1): chi2(1) = 404.29 Prob > chi2 = 0.0000	

Note : standard-errors are reported in parentheses.

*, ** and *** reflect the fact that the parameter is statistically different from zero, respectively, significance levels 10%, 5% and 1%.

Source: Computed by Authors using Stata 10.

Table IV. Labour supply by gender in Cameroon

Carry out an economic activity within the last twelve months	Sex of the head of the household		TOTAL
	Male	**Female**	
Yes	7 886	2 718	**10 604**
No	457	323	**780**
Absent data	4	0	**4**
TOTAL	**8 347**	**3 041**	**11 388**

Source: Computed by Authors using Stata 10.

Table V. Descriptive statistics of variables in the analysis of the impact of education on labour supply in Cameroon

```
    Variable |     Obs      Weight        Mean   Std. Dev.       Min        Max
-------------+--------------------------------------------------------------------
   Job offer |   45564  71514753.3         .25   .4330175         0          1
        Work |   45564  71514753.3         1.5   1.118046         0          3
        type |   45564  71514753.3        1.75   .4330175         1          2
         age |   45564  71514753.3    44.39514   14.27866        11         99
        age2 |   45564  71514753.3    2174.804   1412.572       121       9801
-------------+--------------------------------------------------------------------
        Male |   45564  71514753.3    .7907388   .4067857         0                1
Household size |  45564  71514753.3    6.476292   3.986745         1         43
    Marunion |   45564  71514753.3    .7757005   .4171248         0          1
       urban |   45564  71514753.3    .3531326   .4779487         0          1
years of study |  45564  71514753.3    9.299676   5.008958  2.074485   42.94203
-------------+--------------------------------------------------------------------
 annees_et~22 |  45564  71514753.3    .9206993   .5667228   .0430349   1.973573
Log_nombre~s |   44977  70682067.8    2.902717   1.692274         0   4.077995
  Log_income |   45564  71514753.3    9.939552   5.747786         0   13.91429
      id_men |   45564  71514753.3    5373.009   3170.411         1      11391
```

Source: Computed by Authors using Stata 10.

Table VI. Estimation of the nested logit model fitted to participate in the labor market in Cameroon

```
RUM-consistent nested logit regression        Number of obs      =      43216
Case variable: id_men                          Number of cases    =      10804

Alternative variable: work                     Alts per case: min =          4
                                                              avg =        4.0
                                                              max =          4

                                               Wald chi2(10)      =    3958.16
Log likelihood = -8926.6901                    Prob > chi2        =     0.0000

 ( 1)  [does not participate]_cons = 1
------------------------------------------------------------------------------
Job      offer |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
travail        |
  Log_revenu |  -.0432106   .0110076    -3.93   0.000    -.0647851   -.0216361
annees_etu~s |  -.0168514   .0040016    -4.21   0.000    -.0246944   -.0090084
annees_et~22 |  -.0460337   .0126059    -3.65   0.000    -.0707408   -.0213267
Log_nombre~s |  -.3445633   .0547929    -6.29   0.000    -.4519555   -.2371712
-------------+----------------------------------------------------------------
type equations
------------------------------------------------------------------------------
ne_partici~s |
         age |  -.2194275   .0113966   -19.25   0.000    -.2417644   -.1970906
       age22 |   .2400367    .011479    20.91   0.000     .2175383    .2625351
    masculin |  -.4690224   .0850299    -5.52   0.000    -.6356779   -.3023668
   tailmenag |   .0361069   .0136306     2.65   0.008     .0093914    .0628224
    marunion |  -.6377334   .0905807    -7.04   0.000    -.8152682   -.4601985
      urbain |   1.023681   .0816354    12.54   0.000     .8636783    1.183683
-------------+----------------------------------------------------------------
participe      |
         age |     (base)
       age22 |     (base)
    masculin |     (base)
   tailmenag |     (base)
    marunion |     (base)
      urbain |     (base)
------------------------------------------------------------------------------
dissimilarity parameters
------------------------------------------------------------------------------
type           |
/ne_partic~u |          1          .                         .            .
/participe~u |   .0853631    .013439                    .059023    .1117031
------------------------------------------------------------------------------
LR test for IIA (tau = 1):            chi2(1) =   404.29  Prob > chi2 = 0.0000
------------------------------------------------------------------------------
```
<u>**Source**</u>: Computed by Authors using Stata 10.

Table VII. Percentages and frequencies relative to the various alternatives of the first level of choice or top level

```
Alternatives summary for type
+---------------------------------------------------------------------------
|            Alternative                    | Cases    Frequency    Percent
|   index        value          label      | present  selected     selected
|-------------------------------------------+-------------------------------
|     1            1 does not participate   |  10804      1029        9.52
|     2            2        participates    |  32412      9775       90.48
+---------------------------------------------------------------------------
```
<u>Source</u>: Computed by Authors using Stata 10.

Table VIII. Percentages and frequencies relative to the various alternatives of the second level of choice or bottom-level

```
Alternatives summary for travail
+---------------------------------------------------------------------------
|            Alternative                    | Cases    Frequency    Percent
|   index        value          label      | present  selected     selected
|-------------------------------------------+-------------------------------
|     1            0              0         |  10804      1029        9.52
|     2            1              1         |  10804      7835       72.52
|     3            2              2         |  10804      1030        9.53
|     4            3              3         |  10804       910        8.42
+---------------------------------------------------------------------------
```
<u>Source</u>: Computed by Authors using Stata 10.

Table IX. Probability of choosing an alternative in the second level of choice or bottom-level, given a particular choice in the first level of choice or top level

```
      | id_men | travail |            type | offre_~d |       p1 |       p2 |   condp |        iv |
      |--------+---------+-----------------+----------+----------+----------+---------+-----------|
 1.   |      1 |       0 | ne_participe_pas|        0 | .0885085 | .0885085 |       1 | -.1964818 |
 2.   |      1 |       1 |        participe|        0 | .9114915 | .5578365 | .612004 | -24.67634 |
 3.   |      1 |       2 |        participe|        0 | .9114915 |  .159497 |.1749846 | -24.67634 |
 4.   |      1 |       3 |        participe|        1 | .9114915 |  .194158 |.2130114 | -24.67634 |
      |--------+---------+-----------------+----------+----------+----------+---------+-----------|
 5.   |      2 |       0 | ne_participe_pas|        0 |  .132761 |  .132761 |       1 | -.1964818 |
 6.   |      2 |       1 |        participe|        1 |  .867239 | .5307538 | .612004 | -24.67634 |
 7.   |      2 |       2 |        participe|        0 |  .867239 | .1517535 |.1749846 | -24.67634 |
 8.   |      2 |       3 |        participe|        0 |  .867239 | .1847318 |.2130114 | -24.67634 |
      |--------+---------+-----------------+----------+----------+----------+---------+-----------|
 9.   |      3 |       0 | ne_participe_pas|        0 | .0438306 | .0438306 |       1 | -.1964818 |
10.   |      3 |       1 |        participe|        1 | .9561694 | .5851796 | .612004 | -24.67634 |
11.   |      3 |       2 |        participe|        0 | .9561694 | .1673149 |.1749846 | -24.67634 |
12.   |      3 |       3 |        participe|        0 | .9561694 | .2036749 |.2130114 | -24.67634 |
      |--------+---------+-----------------+----------+----------+----------+---------+-----------|
13.   |      4 |       0 | ne_participe_pas|        0 | .0521887 | .0521887 |       1 | -.1964818 |
14.   |      4 |       1 |        participe|        0 | .9478112 | .5800643 | .612004 | -24.67634 |
15.   |      4 |       2 |        participe|        0 | .9478112 | .1658524 |.1749846 | -24.67634 |
16.   |      4 |       3 |        participe|        1 | .9478112 | .2018946 |.2130114 | -24.67634 |
      +----------------------------------------------------------------------------------------+
```
<u>Source</u>: Computed by Authors using Stata 10.