Foreign Direct Investments and Human Capital Development in Subsaharan Africa

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Abstract
The objective of the present study is to estimate the impact of foreign direct investments on human capital development in 32 Subsaharan African countries over the period 1980 – 2005. Human capital is captured by the percentage of children in full-time education in primary and secondary schools. Panel data regressions are used for the estimations. The results show a correlation not only between FDI and the percentage of children in full-time education in primary school but also between the FDI and the percentage of children in full-time education in secondary school. These results are not significant for that. This shows that FDI directed towards Sub-Saharan Africa still remain insufficient. That is why a lot of effort should be made in order to favour the attraction of FDI in this part of the continent. The other variables which have a positive and significant impact on the percentage of children in full-time education are: the domestic investment rate, public sector expenditures, life expectancy at birth and the growth rate of the gross domestic product per capita.

Key words: Foreign Direct Investment, Human Capital, Sub-Saharan African Countries

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1. Introduction

The importance of human capital in economic development is no more to be proved nowadays. It has been shown that the aim (end or purpose) of development is the human being who is at the same time the actor and the beneficiary of development (Fongang, 2006). As actor of development, the human being should bring out his/her human potential symbolised by the labour force through his/her job (employment). The concern to capitalise this human potential in order to make it more efficient induces the approach of human development to promote, in a sustainable manner, the investment on human beings (Fongang, 2006). Unfortunately, the African continent is characterised by an insufficiency of available financial resources for the financing of social investments. After independences, the African leaders have focussed their hopes on Public Aid for Development (or the Official Aid for Development) (OAD) and indebtedness. However, several studies show that the OAD have not had the expected impact on economic development. Furthermore the debt crisis of the early of 1980s has compelled many States to some successive rescheduling which by increasing the interests have contributed to the indefensibility of the indebtedness. That is why many countries are more and more interested in foreign direct investments (FDI), considered as more productive and more stable financings.

It is with this concern that since the early of 1990s, some reforms are set up to attract FDI towards the African continent (CNUCED, 1999)[7]. The combined effects of these reforms, the action of the New Partnership for African Development (NEPAD) and the irreversible process of globalisation, have favoured the increase of FDI inflows towards this continent during the 1990 decade. According to the statistics gathered by (Pigato, 2000), the FDI inflows towards Sub-Saharan

[7] These reforms concern among others the development of the investments code, the bilateral agreements of investments, and the adoption of regulations more favourable to the liberalisation and the protection of private inflows of capital in general and to the FDI in particular.

African countries have increased from 1455 millions dollars in 1987-1990 to 1807 millions dollars in 1991-1994 and to 5583 millions dollars for the 1995-1998 period. The growth rate between these periods stands at 24.2%and 208.9% respectively. Do these capitals contribute to the improvement of the human capital?

In the broad sense of the term, human capital can be defined as a set of knowledge, qualifications, abilities, and individual qualities which facilitate the creation of the economic, social and personal welfare (OECD, 2001). In a more economic restrictive sense, it corresponds to the set of knowledge and technical aptitudes which can be of service to the individuals for the production activities of goods and services. Do the FDI act upon the human capital in the Subsaharan African Countries? Do they contribute to the amelioration of the populations' knowledge in these countries?

The study is carried out for 32 African countries located in Subsaharan Africa spanning the 1980-2005 period. Panel data regressions are used for the estimations. The percentages of children in full-time education are used as proxies of human capital. The objective is to assess the impact of the FDI on the percentages of children in full-time education in the Subsaharan African countries. The first part presents the literature review while the methodology is exposed in the second part. The results and the discussions are proposed in the third part.

2. Critical review of literature

The notion of human capital experiences an evolution with time. Many theoretical and empirical works have established the link (relation) between investments and development of human capital. The presentation of the theoretical anchorage needs to be presented before the empirical aspects.

2.1. Theoretical review of literature

This section is devoted to the presentation of the human capital theory. The transformations which this theory experiences permit to distinguish the neoclassical conceptions from the contemporary approaches and to draw from them a certain number of limits. It then becomes very interesting to present the theoretical relation between FDI and the human capital.

1.1.1. The neoclassical theory of human capital

The original conception of human capital has experienced some extensions and some criticisms. The latter have inspired many authors to develop new theoretical conceptions of human capital.

The original conception of human capital

Though Adam Smith (1776) had been the one who began to prepare the ground from a comparison between the work of an educated employee and that of a machine, the theory of human capital has got a new impetus in a decisive manner with the works of the authors such as Denison (1962), Becker (1964), Schultz (1963) and many others. In explaining the contribution of the production factors such as the financial capital and the labour force to the economic growth in the United States, Schultz (1963) and Denison (1962) discover the existence of a residual which they attribute (impute or ascribe) to the level of education of the workers. That is why Becker (1964) admits that we can summarise the theory of human capital into five main postulates:

1. the existence of a relation between the society investments in education and economic growth;
2. the existence of a relation between individual investments in education and the economic profitability of this investment;
3. the existence of relations between the distribution of investment in education within the population and the distribution of the subsequent benefits;
4. the demand for education as a response to its profitability and as a response of investment;
5. the investment in the training and the financial division between the worker and the firm.

Education is then viewed as an investment, insofar as it is similar to an instrument for the improvement of productivity and increase of earnings (Kamanzi, 2006). This economic conception of education is based on two postulates taken up by Forquin (1997):

- in an industrial society, the proportion of employments which requires a low level of ability diminishes while that requiring a high level of ability increases;
- the levels of education required for the exercise of jobs increases because the same employments require more abilities.

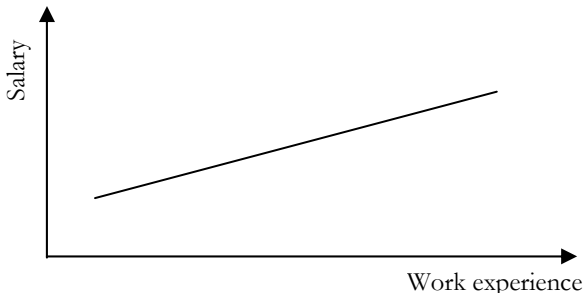
These different postulates show that there exists a positive relation between the accumulated training and the incomes. On a microeconomic level, the expenditures in the educative sector constitute an investment, inasmuch as they provide to the individuals the possibility of acquiring knowledge susceptible to prepare them for the productive sector. Education or training then permits individuals to improve their opportunities of access to the better paid and more prestigious employments (Kamanzi, 2006). From the macroeconomic angle, the extra earnings related to the training of employees generate benefits for the community, insofar as the most educated workers are better remunerated, and consequently they are more imposed.

According to Becker (1964); the differences of salaries are explained by the gaps of productivity, attributable to the inequalities of human capital accumulated by the individuals during their school or academic degree course. This is better understood through the main hypothesis of the theory of human capital according to which, for a given added value, corresponds a marginal productivity of the worker. That is why Sylvester (1988) admits that the neoclassical model of the hierarchy of incomes between the workers is based on three basic concepts: the production function for the employers, the utility[8] for the workers and the optimisation behaviours and attitudes of these agents in the market. He shows that the Becker's model constitutes an important progress inasmuch as the explanations of the differences of incomes come from an objective criterion.

The extensions of the neoclassical model

The human capital model developed by Mincer (1974) remains an extension of the neoclassical basic model. The author admits that human capital is acquired following two complementary forms: the school investments on the one hand and the investments in the work experience on the other hand. The relation between the salary and the work experience is explained by graph 1 below. This relation is explained by the fact that the intensity of the occupational investments diminishes with the age, taking into account the fact that the cost-salary opportunity of the training increases when the period during which the investments can be achieved reduces (Jarousse and Mingat, 1986).

Graph 1: relation between salary and work experience



Source : Mincer, 1974

Mincer proposes a model which relates the observed actual salary on the one hand to the school capital of the individual and the occupational investments in the following quadratic form:

$$\log S_i = \alpha + \beta X_i + \gamma_1 age_i + \gamma_2 age_i^2 + \mu_i \qquad (1)$$

Where S_i stands for the monthly salary of the individual i ;
X_i stands for the number of years of study of the individual i ;
Age, is a variable measuring the work experience of the individual i.

[8] It is a question here of the expected material and/or financial earnings as a result of investment.

The constant term α stands for the salary of the individual who earns the minimum of the human capital. Consider two individuals of the same age. One has one more school year than the other. The difference of salary between them is represented by the constant term β and is given as follows:

$$\log S_1 - \log S_2 = \beta \quad (2)$$

If r stands for the productivity of one year of study, we can write:

$$S_1 = S_0(1+r) \quad (3)$$

We can also write :

$$\log(\frac{S_1}{S_0}) = \log(1+r) = \beta \quad (4)$$

We can therefore estimate the productivity (r) of the studies done by an individual from the estimation of β in equation (1) above:

$$r = \exp.\beta - 1$$

By introducing in equation (1) a quadratic term of the number of the years of study X, the marginal productivity of one extra year of study is equal to:

$$\log S_i = \alpha + \beta_1 X_i + \beta_2 X_1^2 + ... \quad (5)$$

The rate of marginal productivity is given by :

$$\frac{\delta \log S}{\delta X} = \beta_1 + 2\beta_2 X \quad (6)$$

with the hypothesis of decreasing marginal productivities.

The parameters γ_1, and γ_2 allow us to calculate the impact of the work experience on the salary.

γ_1, is the growth rate of the salary with respect to the age;

If γ_2 is negative, we get the age corresponding to the maximum of the salary (age*).

The partial derivative of the log of salary with respect to the age is equal to:

$$\frac{\delta \log S}{\delta age} = \gamma_1 + 2\gamma_2 age \quad (7)$$

It is obvious that $\delta \log S$ is equal to $\delta S / S$, that is to say the salary growth rate and that $\delta \log S / \delta age$ stands for the salary growth rate with respect to the age g. If γ_2 is different from zero, g is not constant, but varies with age. We then calculate the average age of the sample. The maximum salary of the average individual is then obtained at the age for which we have: g = 0. That is to say : $\gamma_1 + 2\gamma_2 age^* = 0$.

We therefore have: $age^* = -\frac{\gamma_1}{2\gamma_2}$ (8)

In spite of its pertinence, there is not a general agreement among researchers about the neoclassical theory of human capital. This is what explains the development of new approaches.

1.1.2. The other approaches of the human capital theory

Contrary to the neoclassical theory, the new approaches highlight the influence of social factors on the agreements between employer and employee (Kamanzi, 2006). These new theories challenge (question) the linear relation between the education and the socioeconomic status of the job exercised. In addition, the productivity and the salary of the individual depend on other factors. That is why Kamanzi (2006) summarises the other approaches of the human capital model in three concepts which correspond each to one economic theory.

The model of signalling or the theory of the filter

This theory, which is stated by Spence (1974) and by Carnoy and Carter (1975) shows that the employers take into consideration other non economic characteristics when recruiting the

employees and also when defining the functions and salaries. The theory of the filter refers to these different characteristics through terms such as *''indexes"* or *"signalling"* (Kamanzi, 2006). The concept *of indexes* is the set of the non economic and invariable sociological characteristics of workers which generate inequalities in the hierarchy of jobs and salaries: sex, ethnic group, socioeconomic origin, etc. Carnoy and Carter (1975) give prominence to the concept of signalling in the theory of the filter. This concept refers to the modifiable aspects of the personality such as the work experience, the general knowledge, the level of prestige of the training school, etc. (Lee and Brinton, 1996). In these conditions, the employer is inspired by different signallings to eliminate some candidates who, nevertheless, have the same level of education than those who have been selected. Education is more an adaptability criterion to the job than a skilfulness criterion to the employment (Kamanzi, 2006).

The characteristics of the available jobs in the market or the theory of competition for the employment

According to this approach, the income of the worker is a function of his/her relative position in the hierarchy of posts of job and of the distribution of access chances to the job (Thurow, 1971). The advocates of this thesis consider that there exists no predetermined abilities for a job. The skills are acquired during the job when we get a position in the hierarchy of the company. Though the theory of competition acknowledges the merit of education in the individual's training, it questions the assertion that education is the guarantee of skills to productivity. The job-seekers are more recruited with respect to their aptitudes to be trained than in function of their immediate skills to produce. Every actor of the labour market is assumed to be rational: on one side the employer chooses the employees with respect to the expected productivity and to the cost to bear for their training. On the other side, the employee adapts his/her demand in function of the market characteristics. He/She can make use of his/her level of education to protect his/her job in the competition context (Thurow, 1971) by developing adaptation capacities to the instability arising out of certain economic conditions.

The structure of the labour market or the theory of the segmentation and of the distribution of employment

The supporters of the segmentation theory of employment (Doeringer and Piore, 1971; Piore, 1973) consider that the distribution of salaries and of the socioeconomic status depend more on the labour market structure than on the level of education. They question the neoclassical distinction between qualified employments and unqualified employments. They assume that the labour market has two sectors: the primary sector and the secondary sector. The distinction is more reliant on the quality of the employments than on the level of qualification required. The jobs in the primary sector are less demanding in terms of skill. The employees who are generally stemming from underprivileged groups are less remunerated. On the other hand, in the secondary sector, more demanding in terms of training, the employees are better paid. This sector is characterised by a hierarchical organisation of employments, opportunities of promotion and certain stability. The segmentation theory admits that the valorisation of schooling depends on the type of market where the individual is employed (Granaham and Shakow, 1990; Maxwell, 1987). The human capital theory permits to assess the links between the level of qualification and that of its remuneration. Despite the efforts of construction of all these authors, this model has been subjected to criticisms. The human capital theory does not indicate the minimum level of education from which the employee can be more productive. It is not possible to know what additional level of education is necessary for a marginal productivity. Moreover, education can only contribute to the growth if the economic structures can absorb the educated persons (persons provided with schooling). Forquin (1997) minimises the influence of education on the productivity by stressing that a training which is specifically vocational could come more from the field experience than from the classical school system. In assuming that the labour market is homogenous, the human capital theory is short of precision on the distribution of social ranks in the enterprise. It does not explain why the individuals having the same level of qualification are unequally shared out in the hierarchy. Furthermore, it is not possible to determine in advance the experiences related to an employment by the employer or the job-seeker. In spite of these limits (insufficiencies), these

different theoretical conceptions establish a relation between foreign direct investments and human capital.

1.1.3. Theoretical relation between FDI and human capital

According to the literature, FDI produce two types of effects considered as "spillovers" on the human capital: it is a question of exogenous effects and endogenous effects. Marc Dougall (1960) considered as one of the pioneers of the external effects of FDI, has studied their impact on the general welfare. Caves (1971) has examined their incidence on the social welfare and the industrial structure. The interest of these works was to bring out the costs and the benefits of FDI. These authors have shown that the external effects of FDI depended on public takings, fiscal policy, terms of exchange, the structure of the trade balance of the host countries (Toufik and Bouoiyour, 2002).

More recent studies aimed at examining the causes and consequences of the spillovers for the country of origin as well as the reception country. Findlay (1978) has elaborated a dynamic model with FDI and transfer of technology between the advanced countries and the less advanced countries in terms of technological development. He assumes that the world is composed of two regions: the advanced region and the delayed region. He considers A(t) as the index of technological efficiency in the advanced region:

$$A(t) = Aoe^{nt} \tag{9}$$

With A_0 the initial level of technology and n the technological efficiency growth rate, assumed to be constant

$$dB(t)/dt = \lambda\left[Aoe^{nt} - B(t)\right] \tag{10}$$

With B(t) the technological level of the less advanced region (the delayed region) and λ a positive constant which is considered as the convergence rate depending on several factors which affect the spillovers in the delayed countries. Findlay (1978) shows that the greater the gap between A(t) and B(t), more important are the technological effects in the less advanced region. The growth rate of the level of technology is defined as follows:

$$\frac{dB(t)/dt}{B(t)} = f\left(\frac{B(t)}{A(t)}, \frac{K_f}{K_d}\right) \tag{11}$$

$$\partial f / \partial\left[\frac{B(t)}{A(t)}\right] < 0 \text{ et } \partial f / \partial\left[\frac{Kf}{Kd}\right] > 0 \tag{12}$$

with $\frac{B(t)}{A(t)}$ *the inverse of the technological gap and* $\frac{K_f}{K_d}$ *the degree of penetration of capitals from the advanced region. The equation (12) indicates that the technological diffusion rate increases with FDI and the technological gap between the two regions (Toufik and Bouoiyour, 2002).*

The main criticisms to this model concern the lack of realism of the hypothesis stating that the investors are motivated to be established in the countries experiencing a technological backwardness. In postulating that the FDI are attracted in a country by the high profitability of capital, the qualification of its labour force, the existence of a well structured innovation system, Wang (1990) challenges the model of Findlay (1978). Through a dynamic model having two countries, Wang (1990) gives prominence to the importance of human capital accumulation as a factor of attraction of foreign capital on the one hand and to the impact of FDI with high technology on the increase of the macroeconomic aggregates.

According to the model of Wang and Blomström (1992), the transfer of technology by a multinational company bears a cost C_f, decreasing with the frequencies of transfer and a fixed cost I_f. The domestic (local) firm bears a training cost C_d and realises a fixed investment I_d for the acquisition of the new technology of production. These authors consider that the technology affects the preferences of the consumers which are defined by a utility function depending on the attractiveness of the products of each firm. This attractiveness is a decreasing function of the level of technology K_i of the firm i, with i = f for foreign firms and i = d for the local firm. The technological gap between the two firms is defined by: k = Kf/Kd. *Wang and Blomström*

(1992) assume that the instantaneous variation rate of the level of technology by the firm is proportional to I_f, we then have:

$$dKf / dt = IfKf \quad (13)$$

Moreover, the level K_d attained by the domestic firm depends on its capacity of absorption of the new technology and on the K_f. Wang and Blomström (1992) admit a linear relation between K_f and K_d:

$$dk_d / dt = \phi(I_d) K_f \quad (14)$$

with $\phi(I_d)$ the absorption capacity of the domestic firm. We have:

$$\phi'(I_d) > 0 \quad (15)$$

$$\phi''(I_d) < 0 \quad (16)$$

and $$\phi(0) = v \quad (17)$$

The absorption capacity is increasing and concave in I_d. v is the capacity of absorption which corresponds to a nil value of I_d. We have:

$$dK_d / dt = \phi(I_d) kKd \quad (18)$$

Given that *k = Kf/Kd*, we have:

$$\frac{\dot{k}}{k} = \frac{\dot{K}_f}{K_f} - \frac{\dot{K}_d}{K_d} \quad (19)$$

The differential equation obtained is as follows:

$$k = \left[I_f - \phi(I_d) K \right] K \quad (20)$$

The equation (20) indicates that the technological gap between the multinational company and the local firm increases with I_f and decreases with the absorption capacity of the local firm.

The different models presented have been subjected to numerous empirical verifications. The results vary from one country to another, from one region to another or from one context to another.

1.2. The empirical review of literature

FDI encompasses a set of assets constituted of new technologies, knowledge and marketing networks (Duming, 1993). The appropriation of this technology improves productivities through capital productivity and contributes, therefore, to the development of human capital. A relation can be drawn between FDI and labour factor productivity on the one hand and between FDI and human capital on the other hand.

1.2.1. FDI and productivity of the labour factor

The quality of the transfer of technology often depends on the intensity of the relations between the foreign firms and the local enterprises as well as on the absorption capacity of the new technologies by the host economies. For many other studies, FDI seem more important for the geographical distribution of technologies than the explicit sales of technologies (Blomström, Lipsey et Zejan, 1994). The transfer of technology is also assessed through the spillovers related to the research and development. Coe and Helpman (1995), Engelbert (1996), Griffith, Redding and Reenen (2000) show that foreign research and development works play a positive role on the productivity of the factors of production when they interact with the research and development works of the host country. This interaction facilitates the assimilation of the foreign technology and speeds up the diffusion process of knowledge (Catin, Ghio and Van Huffel, 2002).

From the moment where the firm is a training place for the individual in the same way that the education system and the parental education which constitute transmission instruments of

knowledge (Levy-Garboua, 1994), each worker is at the same time a transmitter and a potential beneficiary of knowledge. This gives to the training its character of generator of externalities. The workers and the local executives improve their qualification in working in the subsidiaries of the multinational companies. At the conclusion of the work mobility, they can transfer their experience to the home firms (Blomström et Koko, 1998). The inflow of FDI favours a transfer of technologies and knowledge which contributes to the improvement of the workers knowledge in the host countries and reinforces the human capital development.

1.2.2. FDI and human capital

According to the literature, the subsidiaries of multinational companies would diffuse towards the local firms some positive externalities or spillovers, designation of authors such as (Blomström, 1989) and the scope (extent) of these positive externalities depends on the level of development of human capital (Toufik and Bouoiyour, 2002). The presence of the spillovers is confirmed by a positive correlation between FDI and the productivity indicators, established by studies using cross section data (Blomström et al., 1994) which admit that multinational companies contribute to the improvement of the productive efficiency.

In general, the externalities have an effect when the multinational companies can not internalise the beneficial effects of its presence in the reception countries (Blomström et Koko, 1998). So, the productivity of the reception countries improves when foreign firms bring in new technologies, train workers and managers who later on will exercise in the local firms. The pressure exerted by the multinational companies forces the local firms to work more efficiently and to benefit more from the positive externalities. It is from that angle that Kokko (1994) proposes that FDI should be directed towards industries where the technological capacity is relatively important, in such a way that the multinational companies could not supplant the local firms. That is why it is admitted that the technological externalities depend on the peculiar characteristics of the host countries: human capital, culture, industrial policies and the initial technical capacity (Kokko, 1994).

In this context, the level of human capital plays a catalyst role in the effects of FDI on the productivity indicators (Toufik and Bouoiyour, 2002). The idea according to which human capital constitutes a source of externalities (Lucas, 1988) tends to consider that a worker of a given qualification is more productive and better paid in a country which is highly endowed in human capital. The theoretical relation between education and development is appreciated through the indicator of human development (IHD). That is why many authors think that investing in education leads to the future improvement of human capital (Romer, 1986; Lucas, 1988; Barro, 1991). Education is then appreciated as a mean of preparing and adapting himself/herself to the permanent transformations of the environment and to the conditions of work (World Bank, 1991 and 1995).

From that perspective, the level of development of human capital is apprehended through the accumulation rate of human capital which reflects the education level of the population (Barro and Lee, 1993). The empirical study of Arturo (2001) carried out on 138 developing countries and which lies within this logic reveals a positive impact of FDI on the human capital development apprehended by the percentage of children in full-time education. Though some African countries have been taken in the sample, it becomes important to look into the specific case of the Subsaharan African countries.

2. Méthodology

2.1. The equations and the variables used

To evaluate the impact of FDI on the development of human capital in the Subsaharan African countries, the Arturo (2001) equation of human capital will be estimated. Its specification is as follows:

$$TS_{i,t} = \alpha_i + \beta_i^{'} X_{i,t} + \xi_{i,t} \qquad (21)$$

with $TS_{i,t}$ the explained variable. It is the percentage of children in full-time education of the country i for the period t. It is a proxy factor of the human capital. We shall have two regressions:

the first one with $TSP_{i,t}$ as the percentage of children in full-time education of the primary school of the country i at period t; and the second regression with $TSS_{i,t}$ as percentage of children in full-time education of the secondary school of country i at period t. The explanatory variables are:

FDI/GDP$_{i,t}$ stands for the average ratio FDI/GDP of country i lagged with five years.

IDO/GDP$_{i,t}$ stands for the average ratio of the domestic investments over the GDP of country i lagged with five years.

CONSPUB/GDP$_{i,t}$ stands for the government expenditures of country i at period t.
This indicator allows us to evaluate the level of waste of resources of the productive sector in favour of the non productive sector such as the armament. These investments in the non productive sector have a tendency for marginalising certain sectors such as that of education.

LOGPOP$_{i,t}$ stands for the logarithm of the population of country i at period t.

TCGDP$_{i,t}$ stands for the growth rate of the GDP per capita of country i at period t.

TEL$_{i,t}$ stands for the number of telephone lines for 1000 inhabitants used as indicator of infrastructures.

EXV$_{i,t}$ stands for life expectancy of country i at period t.

2.2. The techniques of regression used
The panel data regressions are used in the present study over the period 1980-2005. The data are collected with 2 or 3 years interval for each of the 32 countries selected. This gives us 11 observations per country and 352 observations in total. The two models of the study are first of all estimated using the ordinary least squares (OLS). We make the assumption that we have a homogenous panel or a model with common effects. That is to say that there are no specific effects for each country. The test of Fisher shows that the model is globally significant at 5% level of significance (Prob > F = 0.0000). In order to conclude as to the existence or not of the individual fixed effects, it is advisable to proceed to the estimation of the fixed effects model. But, considering the fact that the model can be affected by the autocorrelation and the heteroskedasticity, It is imperative to carry out adequate tests in order to choose one method of estimation which can solve the possible problems. As regards the test of autocorrelation, we are going to use the Wooldridge procedure in presence of panel data. For the first regression relative to the percentage of children in full-time education in primary school, the results are as follows:
H0: no first order autocorrelation
F(1, 31) = 35.984
Prob > F = 0.0000

The fact that Prob > F = 0.0000 < 0.05 leads us to reject the null hypothesis. There exists a first order autocorrelation (AR1) which should be corrected during the estimation of the fixed effects model. As to the equation of the percentage of children in full-time education in the secondary school, we get different results:
Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
F(1, 10) = 0.003
Prob > F = 0.9605

The fact that Prob > F = 0.9605 > 0.05 leads us to accept the null hypothesis. There exists no first order autocorrelation (AR1).

The null hypothesis of the fixed effects model is that all the specific effects are null (u_i=0). The problem which arises at this stage is to know whether these country specific effects are

deterministic or random. To answer this question, it would be proper to do the estimation of the random effects model and to carry out the Hausman[9] specification test.

The results of the annex 1 show that the statistic of Hausman for the equation of TSP leads us to accept the fixed effects model for Prob>chi2 = 0.0002 < 0.05. However, since the model faces both the problem of autocorrelation and that of heteroskedasticity, it would be proper to correct these problems in order to make the results more reliable. The method of general least squares (GLS) with panel data solve the problem of first order autocorrelation (AR1) while rendering the model homoskedastic.

The results of the annex 2 show that the statistic of Hausman is negative for the fixed effects model is heteroskedastic. The best method of estimation of a model with panel data when the fixed effects model is heteroskedastic is the general least squares method (GLS).

3. Results and discussions

The results of the annexes 3 and 4 show a positive relation between FDI and the human capital apprehended by the percentage of children in full-time education in the primary school and secondary school. We can however point out that these results are not significant. This would justify the insufficiency of foreign private capitals in the Subsaharan African countries. These results can also be justify by the fact that the proportion of FDI going to this part of the continent and which are invested in the education sector remains very low. In most of the States, it is demanded to foreign investors that they should carry out collective social investments in the localities where are located their firms. The construction of schools is then one of the priorities. The fact that the results are not significant could be the expression of the laxness of some investors to implement these instructions (prescriptions) in many countries.

The other variables which have a positive correlation with the percentage of children in full-time education are: the domestic investment rate, the growth rate of the real GDP per capita, the life expectancy at birth and the infrastructures. The result of the variable "life expectancy at birth" is significant with respect to the percentage of children in full-time education in primary school as well as with respect to the percentage of children in full-time education in secondary school. This result is logical being given that the parents longevity permits them to efficiently take care of the schooling (education) of children. The results of the other variables are not significant with respect to the percentage of children in full-time education in primary school. This seems ambiguous. On the other hand, these results are significant with respect to the percentage of children in full-time education in secondary school. It is an encouraging result. It means that the educative sector is taken into account in domestic investments and government expenditures. The accumulated wealth through economic growth is beneficial to the education sector in the Subsaharan African countries.

We can however notice a negative correlation between the variable "population" and the percentage of children in full-time education in primary school. This result is significant. It means that an increase in population would lead to a deterioration of the percentage of children in full-time education in primary school. This result seems logical insofar as any increase of the population leads to an increase of the population in age to go to school which necessitates additional investments for a better school coverage. When investments do not follow, there would have a degradation of the quality of education. From another angle, demographic growth can lead to an increase of the unemployment rate if the structures of the economy are unable to absorb the extra population in age to work. The lack or insufficiency of incomes which characterised unemployed persons remains a real handicap with respect to the financing of children education.

[9] It is a matter of a specification test which permits to determine whether the coefficients of the two estimations (fixed and random) are statistically different. This test is based on the principle that under the null hypothesis of independence between the errors terms and the explanatory variables, the two estimators are unbiased, so the estimated coefficients would differ a bit. The test of Hausman compares the matrix of the variance-covariance of the two estimators.

Therefore, children who can not go to school will contribute to the deterioration of the percentage of children in full-time education.

Conclusion

This study shows a correlation between foreign direct investments and human capital development in Subsaharan Africa. This result incites two recommendations: firstly, the intensification of attraction strategies of FDI in Subsaharan Africa through insecurity alleviation, the improvement of the business environment and especially the governance improvement. The strategies could vary in function of the specificities of each country. The development of the education sector through FDI becomes important inasmuch as it can activate economic growth and contribute therefore to poverty alleviation. Secondly, education constitutes a privileged mean to get set and to adapt himself/herself to permanent transformations of the environment and to the work conditions (World Bank, 1991 and 1995). The theoretical relation between education and development is appreciated through the indicator of human development (IHD). This composite index, published yearly by the United Nations Programme for Development (UNPD), is made up of three variables: education, life expectancy and the level of income. It gives the average gap which exists between the actual possibilities and the potential possibilities of the individuals. Education seems to be the determining variable of the IHD insofar as it acts upon the two other variables and remains the essential component of human capital. That is why many authors think that investing in education leads to the future improvement of the human work (Romer, 1986; Lucas, 1988; Barro, 1991). All the previous developments justify the emergency of an increase of FDI towards the African continent.

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ANNEX

Annex 1: Results of the test of HAUSMAN for the equation of TSP

	---- Coefficients ----			
	(b) fixe	(B) .	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
idepib	.1007289	16.68803	-16.5873	.
idopib	.0286027	10.67667	-10.64806	.
consgpibipub	.1766699	30.97084	-30.79417	.
tcpib	.0831244	17.07169	-16.98856	.
exv	.1838342	46.03445	-45.85061	.1006557
tel	.0406295	20.02066	-19.98003	.0373793
logpop	4.8563	106.1706	-101.3143	3.893342

b = consistent under Ho and Ha; obtained from xtregar
B = inconsistent under Ha, efficient under Ho; obtained from regress
Test: Ho: difference in coefficients not systematic
chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B) = 50408.74
Prob>chi2 = 0.0000
(V_b-V_B is not positive definite)

Annex 2: Results of the test of HAUSMAN for the equation of TSS

	---- Coefficients ----			
	(b) fixe	(B) .	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
Idepib	-.133432	-.0872545	-.0461775.	
Idopib	.0969492	.1234042	-.0264549.	
Consgpibipub	.2140509	.213351	.0006999.	
Tcpib	.0276751	.0463141	-.0186391 .	
Exv	-.9274134	-.8200587	-.1073547.	
Tel	.1455353	.1682768	-.0227415.	
Logpop	7.046739	1.184821	5.861918	1.071082

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg
Test: Ho: difference in coefficients not systematic
chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B) = 8.11
Prob>chi2 = 0.3228
(V_b-V_B is not positive definite)

Annex 3: Results of the estimations for the equation of TSP

Cross-sectional time-series FGLS regression
Coefficients: generalized least squares
Panels: heteroskedastic
Correlation: common AR(1) coefficient for all panels (0.8362)
Estimated covariances = 32 Number of obs = 352
Estimated autocorrelations = 1 Number of groups = 32
Estimated coefficients =8 Time periods = 11
Wald chi2(7) = 35.77
Prob > chi2 = 0.0000

tsp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
idepib	.0964681	.1123002	0.86	0.390	-.1236363	.3165725
idopib	.0651703	.0793951	0.82	0.412	-.0904413	.2207818
conspub	.2436284	.1306388	1.86	0.062	-.0124188	.4996757
tcpib	.085259	.0628626	1.36	0.175	-.0379484	.2084683

exv	.42924	.2143767	2.00	0.045	.009078	.8494191
tel	.04379	.029965	1.46	0.144	-.0149323	.1025281
logpop	-2.58366	1.244556	-2.08	0.038	-5.022952	-.1443811
_cons	96.207	24.45088	3.93	0.000	48.28448	144.1302

Annex 4: Results of the estimations for the equation of TSS

Cross-sectional time-series FGLS regression
Coefficients: generalized least squares
Panels: heteroskedastic
Correlation: no autocorrelation
Estimated covariances = 32 Number of obs = 352
Estimated autocorrelations = 0 Number of groups = 32
Estimated-coefficients=8
Time periods = 11
Wald chi2(7) = 175.85
Log likelihood = -1589.527 Prob > chi2 = 0.0000

tss	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
idepib	.2429946	.3039858	0.80	0.424	-.3528067	.8387959
idopib	.6200465	.1640701	3.78	0.000	.2984751	.9416179
consgpib	.9283716	.192344	4.83	0.000	.5513844	1.305359
tcpib	.2583203	.1946575	1.33	0.184	-.1232014	.639842
exv	.59843	.1657101	3.61	0.000	.2736441	.9232159
tel	.0566087	.0250011	2.26	0.024	.0076074	.1056099
logpop	.4174718	.9016432	0.46	0.643	-1.349716	2.18466
cons	20.7232	18.78255	1.10	0.270	-16.08983	57.5364