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THE EFFECTS OF FOREIGN DIRECT INVESTMENTS ON HUMAN CAPITAL IN THE WEST AFRICAN ECONOMIC AND MONETARY UNION (WAEMU)

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Abstract. *Since the end of the 1980s, most developing countries, particularly those in the WAEMU, have resorted to foreign capital, notably Foreign Direct Investment (FDI) as a new source of financing. The general observation is that WAEMU countries have difficulty mobilizing and taking advantage of the opportunities offered by foreign capital to initiate their development. The aim of this research is to show the contribution of FDI to the human capital accumulation in WAEMU countries. So, the effects of foreign direct investment and public education spending on human capital are analyses. The data used cover the period 2000-2020 where countries have implemented structural adjustment programs. In order to highlight the effects of foreign direct investments on human capital in the WAEMU, after a theoretical and empirical discussion on foreign direct investments on human capital, an Auto Regressive Distributive Lag (ARDL) model was constructed. The results show that foreign direct investment have a positive significant impact on human capital, which, in terms of economic policy implications means that FDI are means of improving the accumulation of human capital in WAEMU.*

Keywords: *Human capital, Education spending, Development, Foreign direct investment, WAEMU.*

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Introduction

Globalization is one of the most controversial subjects and which particularly concerns the role that developing countries have to play and the benefits they can derive from it. One of the channels through which globalization can help developing countries remains foreign direct investment (FDI) Bie (Mughal and Vechiu, 2015). The Organization for Economic Cooperation and Development (OECD, 2002) defines FDI as any investment within the scope envisaged by a new or existing enterprise aimed at establishing new capacity abroad or increasing the capacity to produce goods or provide services, to expand the range of products manufactured or services provided, to increase the productivity of the company or to improve the quality of goods or services. According to reports from the Central Bank of West African States from 2013 on FDI in the West African Economic and Monetary Union (WAEMU) and the United Nations Conference on Trade and

Development (UNCTAD, 2015) on investment in the world, direct investment flows towards WAEMU countries have demonstrated resilience in the face of the recent economic and financial crisis. Indeed, these flows accelerated at the height of the crisis, displaying an average annual growth rate of 18.8% over the period from 2006 to 2012, compared to only 3.5% between 2000 and 2005, with a small decline of 6% between 2013 and 2015 due to the fragility of the global economy and investors' uncertainty regarding public policies (UNCTAD, 2015). The evolution of FDI results in particular from the renewed interest in the level of more qualified education of the populations and in the mining resources of the WAEMU countries, the exploitation of which has become profitable thanks to the surge international commodity prices in the mid-years. Almost half of the flows recently recorded in the Union (49.9%) are intended for the extractive industries sector. This sector is followed by telecommunications (14.8%), manufacturing industries (11.9%), financial intermediation (9.4%) and trade (7.1%). However, analysis of the UNCTAD FDI Performance Index (FDI) (2015), which measures a country's ability to attract and retain foreign investors, indicates that the amounts of FDI received by the WAEMU still remain weak compared to other regions of Africa and the world and to the needs of the countries. This relative weakness in the attractiveness of the countries of the Union is corroborated by the results of the World Bank (WB) Doing Business 2013 survey report. Thus, the high incidence of poverty in the WAEMU countries could be the result of the low rate of investment in these countries, in particular that of the entry of FDI and the sectoral distribution of FDI in the countries of the Union (Abdouni and Hanchane, 2010).

The economic literature shows that a low amount of investment does not often accelerate growth in countries (Barro, 2001; De Mello, 2000; Li and Liu, 2005; Bende Nabende et al. 2003) and low growth can essentially be a source of poverty (Akyüz and Gore, 2001; Lahimer, 2009). According to the “pull factor” theory (Krugman, 1991; Markusen et al., 1997; Braconier et al., 2002), the main determinants of FDI are essentially economic factors, which include gross domestic product (GDP, the level of investment, household expenditure, international trade in goods and services, gross internal savings), political and politico-economic factors, which take into account stability, security and governance in the host country, the availability of human capital and a social factor represented by education. The general observation is that WAEMU countries have difficulty mobilizing and taking advantage of the opportunities offered by foreign capital to initiate their development. Education, as a factor of influence on the progress and sustainability of a company, requires constant investment in qualified and overqualified human capital. The process of acquiring people with skills, education and experience is crucial for a country's development, and FDI has demonstrated its usefulness in developing human capital. The knowledge society focuses on improving the quality of human resources, increasing investments in education, and encouraging local initiative. This process creates the conditions for developing and consolidating an administrative system that actively and effectively participates in both the resolution of internal problems and those related to the particular needs of investors.

From this observation, several questions arise which led us to the following main question: What is the effect of foreign direct investments on human capital in the WAEMU? This involves specifically answering the following questions: (i) What are the determinants of foreign direct investment on human capital in WAEMU? (ii) What is the effect of education spending on human capital in WAEMU countries? The main objective is to evaluate the effect of FDI on the human capital of WAEMU countries. More specifically, this involves: (i) Measuring the effect of foreign direct investment on human capital; (ii) Analyse the effect of public education spending on human capital. This article seeks to analyse the different theoretical relationships linking foreign direct investment and certain variables considered to be able to explain its evolution. To do this, the following hypotheses must be formulated: (i) FDI positively influences the level of human capital in the countries of the WAEMU area; (ii) Public spending on education has a positive impact on human capital.

In contrast to the existing literature, the results show that foreign direct investment have a positive significant impact on human capital, which, in terms of economic policy implications means that FDI are means of improving the accumulation of human capital in WAEMU.

The remainder of this paper is organized into three sections. The first section is devoted to the literature review. The second section discusses the materials and methods adopted in this research. The third section presents the results and discussion, before concluding this paper.

Literature Review

The literature regarding the impact of FDI on the accumulation of human capital through education is not very abundant, whether theoretical or empirical.

According to Miyamoto (2003), FDI has an important role to play in human resource development through its ability to enhance new skills, information and technologies in multinational enterprises. FDI thus becomes a determining factor in education and training through the link it establishes between the immediate reality based on creation, the introduction of new skills, new technologies and the provision of a wide range of information and orientation of initial training. The complementary effects that contributed to the interdependence of the two main factors of economic growth in host countries generate an increase in FDI flows while continuing to improve the qualification in national, multinational and pre-existing companies (Miyamoto, 2003). Through technology transfer by foreign investors, they and multinational companies are always willing to allocate their assets in such an environment where there is already human capital of educated and skilled workers. The role of host countries, which must help in the mobilization of received foreign investors to engage in the strengthening and development of human resources, or in the training process, becomes important after completing the education formal. Indeed, in many types of research it has been confirmed that in addition to attracting foreign investors, it is essential that the country provides basic education to all its citizens, as a start of the transfer process, acceptance and diffusion of foreign technology. According to Xu (2000), South Korea and Taiwan are the best examples of implementing this practice, since they only started attracting foreign capital after developing highly qualified human resources. In addition to foreign trade, foreign investors are the only channel through which foreign technology is transferred to a developing or transition country. Therefore, foreign investor training programs are the right choice to begin employee training in an economy. Foreign investors are not only financially able to provide training, but they are also able to provide innovative forms of training that include information technology, organizational skills, and management, to which the host country typically has very limited access. There are different types of training that can be implemented in any economy. When we talk about employee training, it is generally accepted that there is a low level of investment in training (Batra and Tan, 2002; Ocde, 2013; Ocde, 2014). In countries that went through a transition period at the end of the last century, there are obvious reasons for the unsatisfactory level of training. It also turned out that the situation for large companies is much better, because the opportunity cost for many employees is lower than in small companies and they are more willing to take risks. Many studies have shown that companies where the majority of shareholding is in the hands of foreign investors and international organizations, there is a greater volume of investment in training (Miyamoto and Todo, 2008; Tan and Lopez-Acevedo, 2003; Ritchie, 2001; Gershenberg, 1987). In most cases, foreign investors have less difficulty in providing the necessary funds for training through loans, because they have easier access to foreign capital and they also have much easier access to information on techniques and the organization of training at the global level. It is necessary to emphasize that foreign investors, when taking on domestic companies, often take into account the level of training of employees, choosing companies that have a higher percentage of university graduates. The main goal in this regard is that the effect of increasing the productivity of educated employees is much higher, and therefore companies with a greater share of highly qualified employees are more likely to provide good training (Tan and Lopez-Acevedo, 2003). In studies conducted by Ritchie (2001), Tan and Batra (1995) and the World Bank (1997), it is confirmed that the level of training of employees is much higher for better-trained employees.

Training is the main source of human resources development and it is naturally of great interest to investors. Additionally, in many cases, foreign investors are interested in getting involved in supporting the country's formal education system. The activities of international organizations are important because they enable advanced transfer of skills and technologies to local companies, which otherwise would not have been able to import. Knowledge spillovers are considered one of the most important channels through which a country can transfer technology.

From an empirical point of view, the conclusions of existing analyses are mixed, but most studies support the idea that in the long term, FDI would have a positive impact on human capital accumulation. Using cross-sectional data for 87 countries over the period 1960 to 2000, Egger et al. (2005) examine the link between capital market integration (measured by net FDI inflows), higher education and growth. They show that net inward FDI increases individual incentives to acquire higher education, thereby increasing the relative marginal productivity of skilled versus unskilled workers and ultimately leading to higher economic growth. Zhuang (2008), with data from 29 Chinese provinces from 1978 to 1999, asserts that FDI contributes to the training of skilled labour and promotes schooling at a primary education level. The increase in the share of the population with primary education and vocational and technical education is greater in provinces with economic and technological development zones than in other provinces. Furthermore, the effects of FDI on the development of human capital are greater in the 1990s, even if they are negative with regard to the success rate in secondary education. Beugelsdijk et al. (2008), for their part, show that FDI should have different impacts on the accumulation of human capital, and therefore on education, depending on the type of FDI. Vertical FDI seeking low production costs wishes to exploit above all the low cost of low-skilled labour, which cannot significantly promote the accumulation of human capital in the economy. On the contrary; they can lead to specialization in low value-added production, which does not significantly motivate the local population to acquire higher education. Horizontal FDI seeking larger markets in host countries causes investing foreign companies to enter into direct competition with each other and at the same time with local companies. This is generally synonymous with technology transfer, thus contributing to the technological catch-up of host countries and the accumulation of human capital. Consequently, multinational corporations, which are the main private investors in developing countries, account for a large share of human capital-intensive research and development (R&D) activities (UNCTAD, 2004). Furthermore, recent data show that the majority of greenfield investments attracted to developing countries in recent years have been in R&D activities, thus suggesting a greater demand for skilled labor and, therefore, an increase in enrolment in higher education. However, Mughal and Vechiu (2015) find evidence of short-term negative effects of FDI on tertiary education measured by school enrolment in his study on developing countries from 2008-2018. The negative effect of FDI is confirmed for both secondary and tertiary education when measured in terms of adult educated population. However, the hetoregeneity problem not take into account can justify this result. To solve this problem, we use small sample and robust estimation approach.

Some conclusions regarding the impact of FDI on human capital accumulation could be drawn from the extensive literature on the role of FDI and human capital in economic growth. Several studies deal with the FDI-human capital-economic growth trilogy. Borensztein et al. (1998), in their study of 69 developing countries during the period from 1970 to 1989, find that the benefits of FDI depend on the technological absorption capacity of the host countries, and therefore on a minimum level of human capital. They estimate that 0.45 years of secondary education is necessary to benefit from foreign technology transfer. Stijns (2005, 2006), in his analysis of the role of natural resource endowments in human capital accumulation in various developed and developing countries, suggests that FDI can have a lasting effect on a country's per capita income thanks to a considerable stock of human capital. Butkiewicz and Yanikkaya (2007) empirically analyze the relationship between capital account openness, international trade and economic growth for a sample of more than 100 countries for the period 1967 to 1997 and find a positive impact of human capital on the economy, whatever the level of development of the countries. According to them, "in the long run, capital flows increase growth through several channels, including technological

diffusion, the accumulation of human and physical capital, a higher level of financial development and the strengthening of external sectors in host countries". Their results challenge the idea that countries need a certain level of development or human capital to benefit from the inflow of foreign capital. Ultimately, all these studies suggest a virtuous circle through which FDI, human capital and growth reinforce each other. It would therefore seem that the importance of human capital in an economy is twofold: on the one hand, as one of the main drivers of FDI and, on the other hand, as an important determinant of the impact of FDI on growth. The higher the human capital endowment, the greater the FDI inflows and the stronger their impact on growth. This leads to the indirect conclusion that an increase in inward FDI flows should be a source of a stronger incentive to acquire higher education, the latter being a means of accumulating human capital. However, there is no consensus in the literature on the direction and strength of the links that could be established between FDI and human capital. One of the main reasons for these divergent and contradictory results lies in the difficulty of defining and calculating human capital. However, Mughal and Vechiu (2015) have used alternative variables to capture human capital and chow that the conclusion remains the same, FDI have a negative effect on education. Often, the average number of years of education or initial schooling is used to report returns to education. These measures are calculated using the perpetual inventory method (PIM), interpolation, extrapolation or subjective estimation (de la Fuente and Domenech, 2006). Portela et al. (2004) estimate that on average the MIP underestimates the results observed by about a fifth of each school year every five years.

Other significant flaws concern missing data, differences in the classification of different levels of data between different countries and difficulties in data collection. Furthermore, these formal education measures do not take into account training on the job, experience accumulated through work and learning by doing (Baldacci et al., 2008). The unavailability of data (especially in the case of low-income developing countries), the use of different econometric techniques, different periods and the choice of variables have also led to divergent econometric results.

Methods

3.1. Choice of variables

The following table presents the variables retained, their definitions and their expected signs.

Table 1. Dictionaries of variables

Variables	Definition	Expected signs
KHM	Human capital indicator chosen in the literature is generally primary or secondary schooling rate (Mankiw et al., 1992; Levine and Renelt, 1992; Borensztein et al., 1998; Nunnenkamp, 2002). However, we find that higher education is more relevant human capital indicator in developing countries for three reasons: first, primary and secondary education is becoming compulsory in more and more developing countries, therefore an increase in the level or size of population with primary or secondary education cannot reflect incentives from FDI. Second, primary and secondary education is most often the responsibility of the public sector and responds more to public policy preferences than to individual choices and market forces. Third, today's foreign investments increasingly require high skills i.e professional, technical and managerial skills which require a level of education beyond primary or secondary. Finally, without an adequate measure of learning by doing, increasing the number of people enrolled in tertiary education seems to be the best alternative measure.	
FDI	Three measurements of FDI are used in this study. FDI measured in current dollars (FDI), FDI measured as a percentage of GDP (FDIratio) and furthermore, we consider it more appropriate to use FDI flows rather than stocks, given that we focus on short-term effects. As noted in the literature review, it is well known in descriptive analysis of statistics that the link between FDI and education is not well understood and the results can be contradictory depending the factors that intervene, such as the level of development of countries or their wealth.	+/-
GDP	GDP is standard variable in empirical studies of human capital, due to its two-way correlation with education. Thes relationship is generally considered positive and significant	+

	(Barro, 1996; Bils and Klanow, 2000; Baldacci et al., 2008). We therefore include total GDP (GDP) and GDP per capita (GDPBT) to take into account the level of development of WAEMU countries.	
PSS_{GDP}	Particular attention is paid to public education spending (PSS), the positive and significant impact of which on schooling has already been highlighted (Egger et al., 2005; Baldacci et al., 2003), at all levels of education. Education, particularly primary and secondary. An interesting case study is that of Sri Lanka, often cited for its great achievements in education, mainly through public welfare programs (Anand and Ravallion, 1993): especially through public spending on education. Education, Sri Lanka shows an adult literacy rate of more than 90% in 2011 compared to 84% in 1990 (UNDP, 1993; UNDP 2011). We use public education spending as a percentage of GDP (PSS_{GDP}) and total public spending (PSS_{GOUV}).	+
POP	We therefore introduce the population growth rate (Pop) to take into account the effect of recent demographic changes in our model. Previous studies have highlighted the negative impact of population growth on education (Simon and Pilarski, 1979; UN, 2003), particularly in LDCs and sub-Saharan Africa, given that poor countries have large difficulties in investing in education, in the context of a continuous increase in the population of school age.	-
INFL	Finally, inflation (INFL) measured by the evolution of the consumer price index is considered as an indicator of the economic and socio-political stability of countries. Certain health-related indicators, such as fertility rate, life expectancy, medical care, etc., are sometimes used in human capital analyzes (Pitt and Rosenzweig, 1990). However, theoretical and empirical evidence regarding the role of these variables is quite vague. For this reason and in order to avoid model misspecification, these variables are not included in the study.	+/-
Agr	We alternately use the added value created by industry (Ind), agriculture (Agr) and services (Serv) as a percentage of GDP to analyze its importance in the accumulation of human capital. These variables take into account the changing sectoral composition of the economy, given that each of these sectors requires a different set of skills. Since the 1970s, the industrial sector and particularly services have gained importance in developing countries, which could lead to a relative increase in demand for highly skilled labor.	+
Open	The degree of openness of the economy (Open), measured by the sum of imports and exports as a percentage of GDP, reflects the trade policy and the entire economic system prevailing in the countries. We expect a positive sign for this variable, given the presumed benefits of trade openness on the well-being and economic progress of developing countries (Beugelsdijk et al., 2008).	+

Sources: Authors

3.2. Model specification

We define our econometric model based on the theoretical model developed by Egger et al. (2005) which, to our knowledge, represents the only major theoretical contribution to this subject. According to Egger et al. (2005), the relationship between inward FDI and human capital accumulation can be positive or negative, depending on the level of development of developing countries and their level of integration into the world economy. Our basic equation is written:

$$Y_{it} = \alpha + \beta_k X_{it} + \varepsilon_{it} \quad (1)$$

Y represents the endogenous variable; α is a constant; β_k are the coefficients of the k exogenous variables; X represents the explanatory variables; i designates the country; t indicates time; ε is the error term. By applying this model in our context which is that of the relationship between foreign direct investments and human capital in the countries of the WAEMU zone, we obtain the log-linear models which are described by the equations:

$$\text{Ln}\, KHM_{it} = \beta + \alpha_1 \text{Ln}\, FDI_{it} + \alpha_2 GDPT_{it} + \alpha_3 PSSGDP_{it} + \alpha_4 Open_{it} + \alpha_5 Pop_{it} + \alpha_6 LnINFL_{it} + \varepsilon_{it} \quad (2)$$

Where the subscript t indicates the year, the subscript i indicates the country, β is a constant and ε represents the error term. KHM and FDI are successively replaced by PopTer, FDIratio, respectively. Given the quality and availability of data on education, our estimates will be based on panel data concerning the eight (08) countries in the WAEMU zone over 10 years (2010-2020).

Data for all variables except enrolment in tertiary education come from the World Bank online database. Data on numbers enrolled in tertiary and secondary education come from the education database put online by UNESCO. Table 1 above summarizes the variables used and their sources.

The stationarity tests of the variables made it possible to examine the stationary nature or not of the variables so as not to carry out misleading econometric regressions. Unit root tests in panel data have been recently developed by Levin and Lin (1992), Im, Pesaran and Shin (1997), Maddala and Wu (1999), Choi (1999), Choi (2007) and Hadri (1999). The variable cointegration test makes it possible to establish a link between the dependent variable and the independent variables. The use of cointegration techniques in panel data makes it possible to test the presence of long-term relationships between integrated variables. So, authors such as Pedroni (1999), Kao (1999) and Westerlund (2007) have proposed panel cointegration tests. In a first step, fixed and random effects panel regression methods are used. These estimation techniques, which are otherwise useful, do not make it possible to deal with the endogeneity problem prevalent in any empirical economic study.

Table 2. Data and sources

Name	Data	Sources
$Scol_{Sec}$	Number of students enrolled in secondary education	UNESCO
$Scol_{Ter}$	Number of students enrolled in tertiary education	UNESCO
Pop_{Sec}	Total population with secondary education	World Bank
Pop_{Ter}	Total population with tertiary education	World Bank
FDI	Inflows (current dollars)	World Bank
FDIratio	Inflows (% of GDP)	World Bank
GDP	Total GDP (current dollars)	World Bank
GDPT	GDP per capita (constant 2000 dollars)	World Bank
PSSGDP	Public spending on education (% of GDP)	World Bank
PSSGouv	Public spending on education (% of government spending)	World Bank
INFL	Change in the consumer price index	World Bank
Open	Trade openness rate (% of GDP)	World Bank
Pop	Population growth (annual %)	World Bank

Source: Authors

In our case, human capital has already been identified in the empirical literature as a determinant of FDI and economic growth (Borenzstein et al., 1998; Noorbakhsh et al., 2001; Nunnenkamp, 2002; Miyamoto, 2003). Therefore, an important source of endogeneity in our empirical analysis is this reverse causality between FDI and human capital. Given the number of observations in our samples, non-parametric or dynamic panel estimation techniques cannot be used because they require a much larger number of observations. Therefore, we use two-stage least squares with country fixed effects (dmcEF). All variables are used in logarithmic form, which allows their estimated coefficients to be interpreted in terms of elasticity. After having studied stationarity and cointegration, we will make the estimations with the three panel models namely: the OLS, the fixed effect model (within) and the variable effect model.

Results and discussion

This section first briefly presents stylized facts, then discusses descriptive statistics and deals with tests and estimations before developing the estimation results and their discussion.

4.1. Some stylized facts

The evolution of FDI inflows into the WAEMU zone does not show an upward trend regular despite the different attractiveness policies undertaken by the different authorities since the 2000s. It then presents periods of massive inflow and periods of significant outflows as illustrated by Fig. 1.

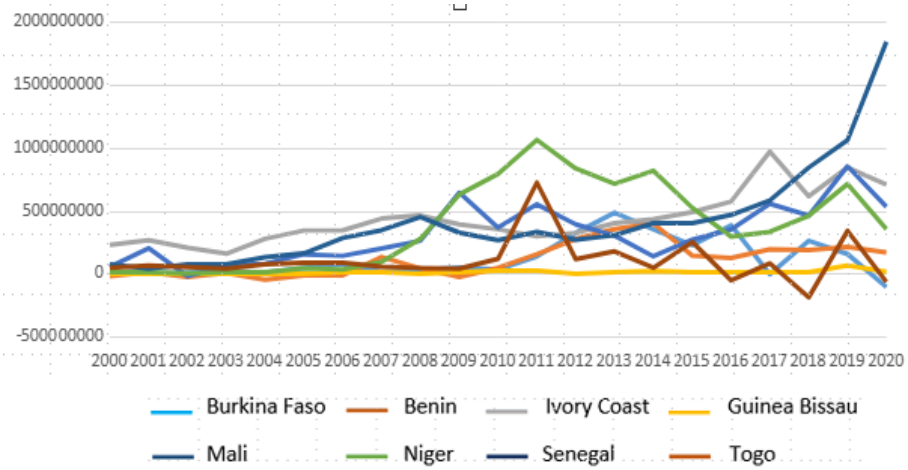


Figure 1. Evolution of net FDI flows in WAEMU countries (in current US dollars)
Source: Authors based on World Bank data (WDI, 2022)

The main trend in FDI flows to the WAEMU is a seesaw trend. Furthermore, the cyclical variations are almost identical for all the countries of the Union. This massive influx is interrupted by significant outflows even taking negative values in 2016 to 2018. This phenomenon reflects a flight of private capital from the Union and a gloomy economic situation in a climate of adjustment. However, this trend was affected by the economic and financial crisis that hit the region in 2016-2017, leading to a decline in inward FDI in 2016. FDI then returned to its pre-crisis level in 2017, but experienced a further decline in 2018 before rebounding in 2019 to $15.8 billion. Indeed, the largest outflows are observed in Togo and Burkina, where FDI takes negative values of the order of -180972715 and -98777856 dollars respectively. However, a significant increase was recorded following the devaluation of the FCFA from 2019 to 2020, which was quickly stifled by political instabilities (terrorism and multiple strikes). Thus, the countries of the Union have not constituted a destination of choice despite the historic record of global FDI inflows in 2000. However, since 2003, FDI inflows have resulted in a spectacular increase, particularly at the beginning of the international financial crisis of 2007 to reach 1.6 billion dollars, for an overall growth rate of 29.3% per year over the period 2003-2008. These follow the privatization operation of the National Telecommunications Office of Burkina Faso for an amount of 140 billion FCFA. This increase is also explained by the resumption of global investments following mergers and acquisitions operations and strong economic growth.

Ultimately, the evolution of FDI in the WAEMU area does not reveal a continued increase which would indicate the potential attractiveness of the WAEMU zone for foreign investors. Fluctuations could be due to factors affecting the macroeconomic environment and the legal and regulatory framework for investments. The main destination for FDI flows towards WAEMU remains Ivory Coast. Indeed, the distribution of FDI within the Union indicates that Ivory Coast remains the most attractive country, with 34.9% of FDI over the period 2004-2007, followed by Senegal (16.0%) and Mali (15.4%). This predominance of Ivory Coast is nevertheless tending to be reduced with the devastating effects of the crisis. In fact, the country had received, over the period 1996-2004, almost half of FDI in WAEMU (49.0%) (Banque de France, 2007). By elsewhere, highlighting the weight of foreign direct investments and domestic investments in GDP would make it possible to better understand FDI flows in WAEMU. In terms of geographical distribution, Ivory Coast attracted the largest share of inward FDI during the period 2000-2020, followed by Senegal and Benin.

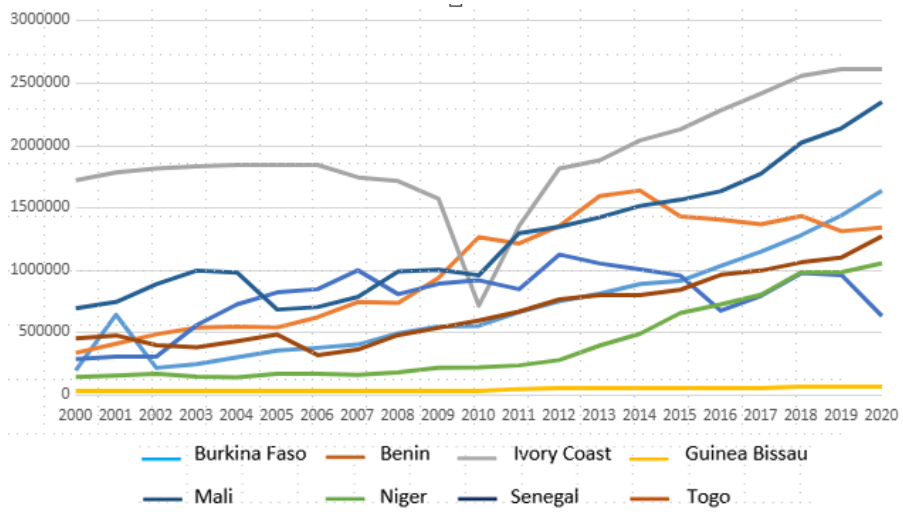


Figure 2. Evolution of human capital in WAEMU countries

Source: Authors based on World Bank data (WDI, 2022)

However, other countries in the region also experienced significant growth in FDI during this period, notably Burkina Faso and Togo. In summary, although the general trend of FDI in WAEMU countries has been increasing during the period 2000-2020, this trend has been affected by economic and political fluctuations in the region, with uneven growth between the different countries in the area.This graph shows us the evolution of human capital (PopTer) over the period 2000 to 2020. According to the graph, human capital in the WAEMU countries has experienced a general upward trend. The Ivory Coast is the country which stands out with high human capital. After experiencing a decline in 2011 with the political crisis, human capital experienced an increase from 2012 until 2020. Benin is the country whose human capital is almost linear. It tends to show a slight increase from 2010 to 2020 Overall, the human capital of WAEMU countries has little attractiveness for FDI compared to other countries. Thus, the highest human capital is 2614876 (Ivory Coast) and the lowest is 34967 (Benin). The ranking of WAEMU member states in the 2019 UNDP HDI report indicates that all belong to the category of “Countries with low human development”. Benin (0.520) comes first in the Union, followed respectively by Ivory Coast (0.516), Senegal (0.514), Togo (0.513), Guinea-Bissau (0.461), Burkina Faso (0.434), Mali (0.426) and Niger (0.377). The average for the WAEMU area is 0.470 compared to 0.541 for Sub-Saharan Africa.

Data descriptive statistics

To conduct an econometric study, it is important to take a look at descriptive statistics in order to synthetically decipher the information contained in the data.

Table 3. Descriptive statistics of variables

Variables	Obs.	Mean Std.	Dev.	Min	Max
PopTer	168	848098	624313.1	34967	2614876
FDI	168	2.42e+08	2.81e+08	-1.81e+08	1.85e+09
GDPT	168	906.637	443.3487	389.0775	2325.724
INFL	168	2.009382	2.603564	-3.502586	11.30511
Open	168	55.37382	14.69828	30.36824	112.761
Pop	168	2.852933	.4345849	2.000212	3.867091
PSS_{GDP}	168	18.14643	3.810622	8.009793	30.70003

Source: Authors

Table 3 shows the results of the discriminant validity test using the Fornell-Larcker criterion. Based on the results obtained, it appears that the root square of the AVE of the constructs is significantly higher than the correlations of this construct with the other constructs.

We can notice that the variables do not have the same degree of dispersion. In aggregate, the average human capital (PopTer) is 848098 with a minimum capital of 34967 observed in Benin and a maximum of 2614876 observed in Ivory Coast. For this variable, the standard deviation recorded is 624313.1 which means that the values are not grouped around the mean. The average FDI is 2.42e+08 with a minimum of -1.81e+08 observed in Togo, which reflects a recession and a maximum of 1.85e+09 observed in Senegal. As for the average in gross domestic product per capital (GDP), the average is 906.637 with a minimum of 389.0775 for Guinea Biseau and 2325.724 for Senegal. Population growth (POP) has an overall average of 2.857258 with a minimum of 2.000212 observed in Ivory Coast (2012) and a maximum of 3.867091 in Niger (2016). The standard deviation is relatively low near .4345849. This means that the values are grouped around the mean and it means that the population is homogeneous. The variables, GDP expenditure on education (PSSGDP), inflation (INFL) and the commercial openness rate (Ouv) have a successive average 18.14643; 2.603564 and 14.69828. The standard deviation of its variables (PSSGDP: 3.810622; INFL: 2.603564 and Open: 14.69828) shows that the values are grouped around the mean. The correlation matrix is a statistical tool used to measure the linear relationship between different variables. It allows you to quantify the extent to which variables move together, indicating whether they are positively, negatively or not correlated at all.

The Table 4 above highlights the correlation between the endogenous variable and the different explanatory variables. Generally speaking, we see that foreign direct investment (FDI), gross domestic product per capita (GDP), public expenditure on education (DepGDP) in education and the openness rate are positively correlated with human capital. Inflation (INFL) and population growth rate (Pop) are negatively correlated with human capital.

Table 4. Correlation matrix

Variables	PopTer	IDE	PIBT	Pop	INFL	Ouv	DepPIB
PopTer	1.0000						
FDI	0.5346***	1.0000					
	(0.0000)						
GDPT	0.8560***	0.4089***	1.0000				
	(0.0000)	(0.0000)					
Pop	0.2766***	0.1707**	0.5018***	1.0000			
	(0.0003)	(0.0270)	(0.0000)				
INFL	-0.1416**	-0.1273*	-0.0830	-0.0230	1.0000		
	(0.0671)	(0.1000)	(0.2848)	(0.7677)			
Open	0.0830	0.0552	-0.0290	-0.1793**	-0.0007	1.0000	
	(0.2850)	(0.4770)	(0.7094)	(0.0201)	(0.9926)		
DepPIB	0.5175***	0.2273***	0.4132***	-0.0964	-0.0377	0.1875**	1.0000
	(0.0000)	(0.0031)	(0.0000)	(0.2138)	(0.6279)	(0.0149)	

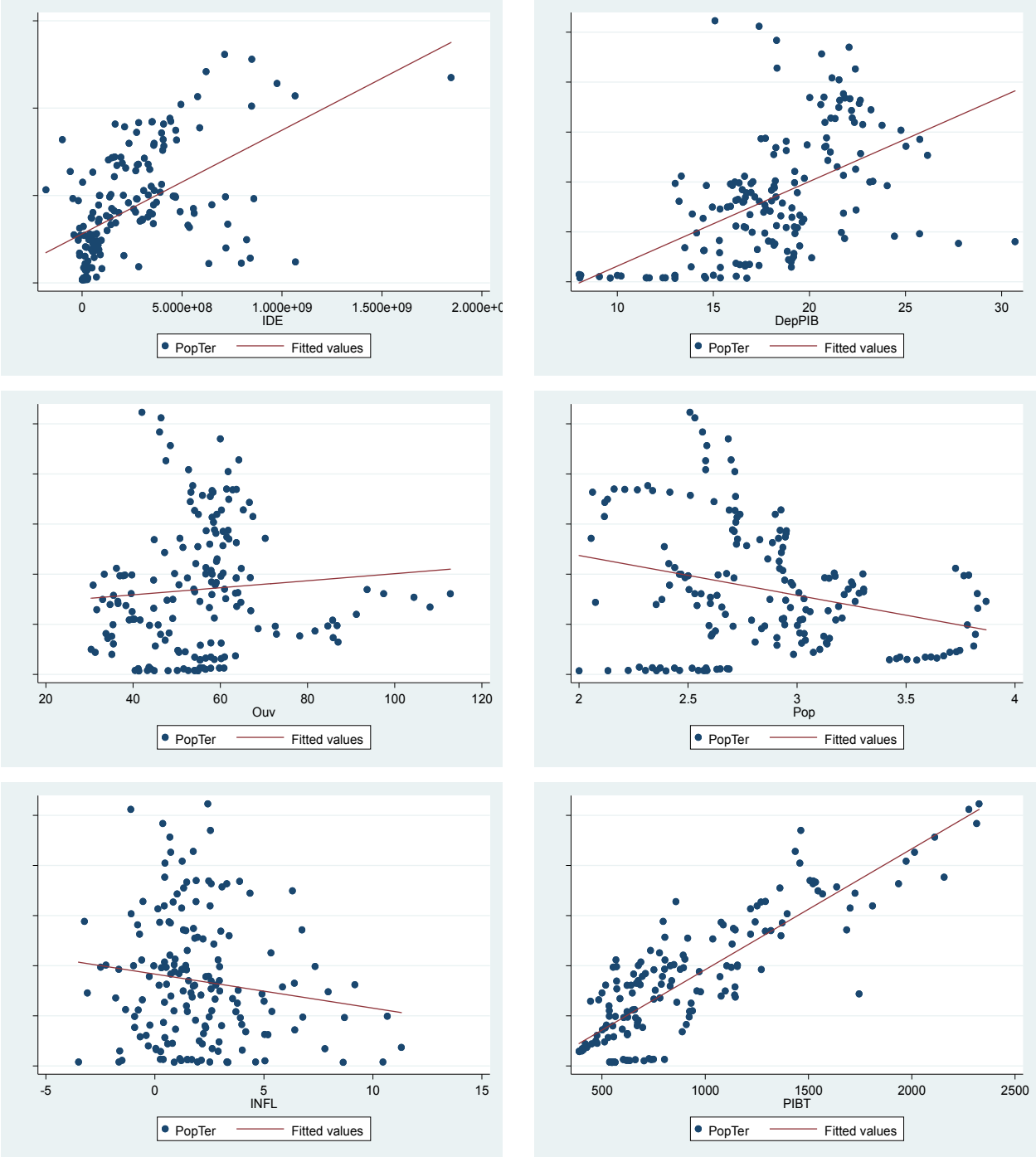
*Note: ***, ** and * respectively indicate the significance threshold at 1%, 5% and 10%. P-value in parentheses.*

Source: Authors based on World Bank data (WDI, 2022)

The positive correlation between (FDI, GDPT, PSSGDP, Ouv) and human capital (PopTer) means that when the value of the variables (FDI, GDP, DepPIB and Ouv) increases, human capital also tends to increase. As for the negative correlation between variables (INFL and Pop) and human capital indicates that when the value of INFL or Pop increases, human capital tends to decrease. The variables IDE, GDPT and PSSGDP are positively correlated and significant at the 1% threshold. Pop is negatively correlated and significant at the 1% level. This means that there is a strong correlation between (FDI, GDP, PSSGDP and Pop) and human capital. The variable Ouv is

positively correlated but not significant. It is the same for INFL which is negatively correlated and not significant. This implies that there is a weak correlation between the variables (Ouv and INFL) and human capital. The scatterplots below and the regression lines are a sort of graphical representation of the correlation between the endogenous variable and the explanatory variables. In other words, these lines provide an overview of the nature of the relationship (positive or negative) between human capital and each exogenous variable.

Table 5. Scatter plots



Source: Authors

4.3. Hypothesis testing and estimations

4.3.1. Hypothesis testing

The residual normality test: We use the Jarque-Bera test (1987) to find out if our residuals follow a normal law. In statistics, this test is imperative to the extent that it is strongly

recommended to ensure normality before considering other tests. The null hypothesis (*H0*) of this test states that the errors follow a normal distribution against an alternative hypothesis (*H1*) which states that the errors do not follow a normal distribution. After implementation, the test results give Prob>chi2 equal to 0. 0.0764 which is greater than 5%. We cannot therefore reject the null hypothesis (*H0*) so the residuals follow a normal law.

The heteroscedasticity test seeks to determine the nature of the variance of the error term or residuals. Several possible sources explain heteroskedasticity: (i) The heterogeneity of the sample studied; (ii) The omission of an explanatory variable in the model and; (iii) A poor functional form of the model. We speak of heteroskedasticity when the variance of the error of the variables is not constant, in other words when the variance differs for each observation. In the presence of heteroskedasticity, classic estimators lose their reliability and remain unbiased but no longer have minimal variance. As for homoscedasticity, the variance of the stochastic errors is the same for each observation. In our case, we use the Breusch-Pagan test which is a powerful test based on the Lagrange multiplier (Araujo et al 2008). The null hypothesis (*H0*) of this test states that the model is homoskedastic and the alternative hypothesis (*H1*) states that the model is heteroscedastic. The result of the test gives Prob > chi2 = 0.1018 which is greater than 5%, which does not allow us to reject *H0*. We therefore conclude that the model is homoscedastic.

This part aims to test the panel stationarity of the explained and explanatory variables of the model. If the variables are stationary, we can ensure the reliability of the results of the regressions. Indeed, the stationarity test makes it possible to avoid the risk of spurious regressions between endogenous variables and exogenous variables. The various stationarity tests were carried out using the Stata software. The Pesaran and Levin-Lin-Chu (2003) tests were applied to all the model variables. All these tests reveal that the Pop and INFL variables are stationary at level while the variables PopTer, FDI, GDPT, Open and PSSGDP are stationary at first differences.

The cointegration test is used in econometrics to determine whether two or more time series exhibit a stable long-term relationship despite their short-term fluctuations. It is mainly used to analyze long-term relationships between variables that could move in tandem, even if they may exhibit temporary short-term differences.

Table 6. Stationarity tests of LLC (2002) and IPS (2003)

	Levin-Lin-Chu			Im-Pesaran-Shin		
	In level	**In first difference**	**Decision**	**In level**	**In first difference**	**Decision**
PopTer	4.4249	-3.6181 ***	I (1)	5.5190	-5.5566***	I (1)
	(1.000)	(0.001)		(1.000)	(0.0000)	
FDI	2.0115	-2.1731 **	I (1)	0.0591	-6.1606***	I (1)
	(0.9779)	(0.0149)		(0.5236)	(0.000)	
Pop	-1.5842 **	-3.5530***	I (0)	-1.1515*	-2.9167***	I (0)
	(0.0566)	(0.0002)		(0.1248)	(0.0018)	
GDPT	0.5654	-6.1380***	I (1)	2.5173	-6.4062***	I (1)
	(0.7141)	(0.0000)		(0.9941)	(0.000)	
INFL	-5.9934 ***	-16.1196***	I (0)	-6.2855***	-8.0739***	I (0)
	(0.000)	(0.0000)		(0.0000)	(0.000)	
Open	-0.2463	-2.2902**	I (1)	0.6839	-5.9398***	I (1)
	(0.4027)	(0.0110)		(0.7530)	(0.000)	
PSSGDP	-0.1404	-5.7202***	I (1)	-1.5971	-7.2734***	I (1)
	(0.4442)	(0.0000)		(0.0551)	(0.000)	

*Note: ***, ** and * respectively indicate the significance threshold at 1%, 5% and 10% for the rejection of the null*
Source: Authors based on World Bank data (WDI, 2022)

Table 7. Pedroni's Cointegration test

Pedroni	t-Statistic	Prob.
Panel v-statistic	-3.5658	0.0002
Panel rho-statistic	1.9826	0.0237
Panel PP-statistic	0.5198	0.3016
Panel ADF-statistic	1.8654	0.0311
Group rho-statistic	3.5997	0.0002
Group PP-statistic	0.3498	0.3632
Group ADF-statistic	0.2713	0.3931

*Note: *** p<0.01, ** p<0.05, * p<0.1 respectively indicate the significance threshold for rejecting the null hypothesis of non-cointegration*

Source: Authors based on World Bank data (WDI, 2022)

Pedroni presents seven (07) statistical tests, the first four (04) of which are based on the within dimension and the last three (03) on the between dimension. We see that the p-values of the individual tests or the Pedroni cointegration tests are different. For individual tests, this may indicate that some series are cointegrated while others are not, i.e. there are long-term relationships between some variables, but not all. Thus some variables have transient or short-term behaviours rather than long-term relationships. This could mean that these variables are more sensitive to short-term fluctuations. Thus, diagnostic tests results alone us to use an ARDL panel approached in this study.

4.3.2. Auto Regressive Distributed Lag (ARDL) Model in panel data specification and estimation

The ARDL specification in panel data is giving by the equation (3).

$$Y_{\text{it}} = \theta + \sum_{i=1}^{p} \alpha_{ij} Y_{i,t-i} + \sum_{j=0}^{q} b_j X_{i,t-j} + \mu_i + \varepsilon_{\text{it}} \quad (3)$$

$X_{i,t}$ is the matrix of explication variables, and $Y_{i,t}$ the vector of human capital.

The later specification takes into account the parametrical of equation in long term.

$$\Delta Y_{\text{it}} = \phi_i Y_{i,t-1} + \beta_i^{'} X_{\text{it}} + \sum_{i=1}^{p-1} \lambda_{ij}^{*} \Delta Y_{i,t-j} + \sum_{j=0}^{q-1} \delta_{ij}^{*'} \Delta X_{i,t-j} + \mu_i + \varepsilon_{\text{it}} \quad (4)$$

The estimation can make by Pooled Group (PG), Pooled Mean Group (PMG), fixed effect or random effect.

4.3.2.1. Auto Regression Distributed Lag (ARDL) estimated with Pooled Mean Group: short and Long-term relationship

After determining the existence of a cointegration relationship, it seems imperative for us to estimate this relationship. To do this we use the Pooled Mean Group (PMG) estimator developed by Pesaran et al. (1999) which highlights short and long terms effects to estimate our ARDL. This estimator allows the short-term parameters or coefficients to differ between groups and constrains the long-term parameters to be identical.

Table 8. Regression (PMG): Dependent variable: LPopTer

Variables	Coefficient	Std. Err.	P-Value
Long term			
LFDI	.0402548 **	.115788	0.261
PSSGDP	.5468779	.1324552	0.000
Pop	-10.14159	2.377007	0.000
GDPT	0.050731 ***	.002341	0.030
INFL	-.6933628	.1314993	0.000
Open	.1210629	.0345777	0.000

Short term			
ECT	.2224714	.1191458	0.062
D. LFDI	.0665267	.2035777	0.744
D.PSSGDP	-.0248168	.0679713	0.715
D.GDPT	.0000172	.0011239	0.988
D.INFL	-.0973621	.0589464	0.099
D.Open	-.0164802	.0142734	0.248
D.Pop	5.23848	5.779314	0.365
Constant	1.417304	.6049279	0.019
Observations	160	160	160
Pays	8	8	8
Log Likelihood	-85.6173	-85.6173	-85.6173

*Note: ***, ** and * respectively indicate the significance threshold at 1%, 5% and 10%.*

Source: Authors based on World Bank data (WDI, 2022)

This Table 8 presents the results of regression 2. The table is divided into two, an upper part the long-term effects and in the lower part the short-term effects. The main condition of validity of this estimate is the error correction term (ECT), it is positive (0.2224714), between 0 and 1 and statistically significant at 10% (0.062.) Our results confirm an equilibrium relationship long-term relationship between human capital and explanatory variables. This indicates that the adjustment speed is approximately 22.25% for a return to equilibrium.

4.3.2.1 Auto Regression Distributed Lag (ARDL) estimated with the fixed effects

The test hypotheses are as follows:

H0: Without of fixed effects

H1: With fixed effects

The calculated Fischer statistic follows a Fischer law under the hypothesis *H0*. To this end, the hypothesis of the presence of fixed effects will not be rejected when the calculated statistic is greater than the critical value read from the Fisher Table 9. The test results are as follows.

Table 9. Fixed effect model

Variables	**Dependent variable: LPopTer**			
	(1)	**(2)**	**(3)**	**(4)**
LFDI	0.239273***		0.0600711*	0.1684914**
	(0.000)		(0.079)	(0.000)
PSSGDP		.0125931***		.001641
		(0.362)		(0.875)
GDPT			0.0019165***	.0010737
			(0.000)	(0.000)
Open			.0047928*	.0012286
			(0.093)	(0.678)
INFL				-0.1016556
				(0.619)
Pop				-.0092111
				(0.393)
_cons	8.747379***	12.98464***	11.85691***	9.297707***
	(0.000)	(0.000)	(0.000)	(0.000)
Observation	157	168	157	157
Pays	8	8	8	8
R2	0.5642	0.3912	0.4311	0.5958

*Note: ***, ** and * respectively indicate the significance threshold at 1%, 5% and 10%. Std*

Source: Authors based on World Bank data (WDI, 2022)

This Table 9 presents the results of estimation 3 in which we highlighted four (04) scenarios. Scenario (1) alone measures the impact of foreign direct investment on human capital. Indeed for this variable, the probability of the calculated Fischer statistic is less than 1%. Therefore hypothesis H0 is rejected, and the fixed effects model is more appropriate. Scenario (2) measures the impact of public spending on human capital. On the other hand, the probability of the calculated Fischer statistic is greater than even the 10% threshold. In this case, hypothesis *H0* cannot be rejected, and then the fixed effects model is not appropriate. Scenario (3) measures the impact of FDI, GDPT and openness on human capital. The analysis of the three scenarios shows that FDI is significant at 10%, GDPT 1% and Open 10% significant. So in this scenario the fixed effect model is appropriate. Scenario (4) measures the impact of exogenous variables on human capital. The FDI and GDPT variables are significant at the 1% level. As for the others (DepPIB, Ouv, INFL and Pop) are not significant. In the presence of random effects, the coefficient of determination R2-between with a value of 0.6242 shows that 62.42% of the variation of the exogenous variables is explained by the explanatory variable of the model. The R2-within has a value of 0.4480, indicating that the random effects of exogenous variables introduced into the model contribute to explaining the model by 44.8%.

4.3.2.2. Auto Regression Distributed Lag (ARDL) estimated with the random effect model

Table 10 presents the results of the estimation 3 in which we highlighted four (04) scenarios. Scenario (1) alone measures the impact of foreign direct investment on human capital. Indeed for this variable, the probability of the calculated Fischer statistic is greater than even the 10% threshold. Therefore hypothesis *H0* is not rejected, and the random effects model is not appropriate. Scenario (2) measures the impact of public spending and FDI on human capital. On the other hand, the probability of the calculated Fischer statistic is less than 1%. In this case, hypothesis *H0* can be rejected, and then the random effects model is appropriate. Scenario (3) measures the impact of FDI, PSSGDP and GDPT on human capital.

Table 10. Random effect model

Variables	Dependent variable: LPopTer			
	(1)	(2)	(3)	(4)
LFDI	.0871269***	.1755982	.184342***	.3003656**
	(0.176)	(0.000)	(0.000)	(0.000)
PSS_{GDP}			.0101664	.0123813
			(0.638)	(0.258)
GDPT		.0011204***	.0011191*	.0009901
		(0.000)	(0.024)	(0.000)
INFL				-.0079917
				(0.486)
Open				.0020598
				(0.503)
Pop				.0686411
				(0.710)
_cons	11.15235***	8.942642***	8.594935***	8.338641*
	(0.000)	(0.000)	(0.000)	(0.000)
Observation	157	168	157	157
Pays	8	8	8	8
R2	0.2759	0.6129	0.6385	0.7801

*Note: robust standard errors in parentheses with significance thresholds ***p<0.01, **p<0.05, *p<0.1.*

Source: Authors based on World Bank data (WDI, 2022)

The analysis of the three shows that FDI is significant at 1%, GDPT 5% and PSSGDP is not significant. So in this scenario the random effect model is not appropriate. Scenario (4) measures

the impact of exogenous variables on human capital. The FDI and GDPT variables are significant at the 1% level. As for the others (PSSGDP, Open, INFL and Pop) are not significant. In the presence of random effects, the coefficient of determination R2-between with a value of 0.7107 shows that 71.07% of the variation of the exogenous variables is explained by the explanatory variable of the model. The R2-within has a value of 0.4417, indicating that the random effects of exogenous variables introduced into the model, contribute to explaining the model by 44.17%.

4.4. Results with PMG regression and discussions

In this section, we present the main results of our estimations for the impact of foreign direct investment on human capital used PMG regression method (Table 8). We see that FDI has a positive (0.0402548) and statistically significant effect on human capital in a long term. But in a short term, FDI has an insignificant effect on human capital. The later result is not in line with the funding of Mughal and Vechiu (2015). However, the positive effect of FDI on human capital in long term improve the results in this literature. Indeed, an increase in foreign direct investment of $1 in WAEMU countries translates into an increase of 4.02% in human capital in the long term, all things being equal. Our results therefore corroborate the theoretical assertions of Beugelsdijk et al. (2008): in the short term, the FDI windfall has adjustment costs that governments must not neglect. The very high FDI flows that entered developing countries during our period of analysis have not yet had time to show their beneficial effects on individuals' preferences in terms of higher education. At this point, it should be mentioned that the data available for public spending on education is scarce and the resulting sample halves the number of observations for the entire data set. However, estimates including this variable show a very significant (0.000) and positive (0.5468779) impact of public spending (as a % of GDP and total public spending) on human capital. This result shows that our *H1* (which states that public education spending has a positive impact on human capital) is verified. This strong link between GDP per capita (GDP) and tertiary education (5.07%) indicates that higher income can provide a stronger motivation to acquire higher education. This should particularly be the case when economic growth benefits all social classes. The middle class, increasingly important in developing countries following the economic boom, seems very interested in improving its level of education and skills. This is evident in the increasing enrollment rates at universities and technical colleges. Secondary education, being compulsory in many developing countries, no longer responds to personal or average household income in the same way as tertiary education. Among the other explanatory variables, trade openness shows a positive impact (0.1210629). However, the evidence that economies more open to foreign trade show a stronger incentive to acquire higher education seems rather weak. This paradoxical result reflects a presumption of a protectionist economy corresponding to an insufficient level of openness in the area. However, protectionist economies can attract significant FDI if the domestic market is well developed. In such a case, firms circumvent tariff barriers by relocating production chains to host countries. These are essentially horizontal investments. Furthermore, this paradoxical result could also be explained by the fact that the massive inflows of FDI recorded in the Union are the result of waves of privatization programs. This is the recent case of Burkina Faso in 2007, Ivory Coast and Senegal. Furthermore, this fact seems to reflect the perverse effects of exogenous openness; that is to say a sudden and increased opening, as is the case in Togo where the opening rates gravitate around unity. The population growth rate displays a negative sign (-0.6933628) and its impact is statistically significant at 1% in most regressions. The negative effects of high population growth on human development and well-being have been well established in the literature. With a high birth rate, households are forced to give up education and therefore work in order to support themselves. We chose inflation as a general proxy for the management of countries' economies and their socio-political stability. Our results most often show a significant impact of 10% on education measured in terms of flow. This suggests that inflation, as an indicator of monetary and economic stability, has a lot of effect on the decision to pursue higher education, at least as long as the inflation rate is not too high. It should be noted that, during the period 2000-2020, many developing countries experienced high inflation: the price level did not remain stable.

Conclusion

The main objective of this study was to assess the impact of foreign direct investments on the human capital of WAEMU countries over the period 2000-2020. Achieving this objective resulted firstly in an analysis of FDI flows towards the Union and then in an econometric evaluation of the interactions between FDI and human capital in the WAEMU zone over the said period. The data for the study comes mainly from the World Bank and UNCTAD reports, with the exception of data on education which comes from the UNESCO database. The residual, stationarity and cointegration tests made it possible to estimate, using the least squares method, the model of our equation on panel data in order to identify the impact of FDI on human capital. The equation estimates show a positive and statistically insignificant effect on. Our results therefore corroborate the theoretical assertions of Beugelsdijk et al. (2008): in the short term, the FDI windfall has adjustment costs that governments must not neglect. The very high FDI flows that entered developing countries during our period of analysis have not yet had time to show their beneficial effects on individuals' preferences in terms of higher education. We can therefore conclude that hypothesis 1 is verified. GDP expenditure on education shows a positive and significant link with human capital. This result shows that public education spending has a positive impact on human capital. This corroborates with Egger et al. who state that net inward FDI increases the incentives to acquire higher education. We also noticed that the other variables which have a positive correlation with capital are: GDP per capita, trade openness and significant at 1%. The results of inflation and population growth rate are significant but have a negative correlation with human capital. In view of these results, the following recommendations can be made to decision-makers and development practitioners in the WAEMU region. The increase in foreign capital inflows should be accompanied by an active policy aimed at improving human capital. The provision of higher education and incentives to pursue higher education need to be strengthened in order to counter the negative short-term effects of foreign investment. An important objective of an FDI-led growth strategy should also be the training of the workforce to equip it with better skills. It is thanks to a more qualified and more abundant workforce that developing countries can climb the ladder of development in the long term. To deepen the work presented in this article and that of our predecessors which show that the impact of FDI depends on the type and nature of investments, a next step would be to study the impact of FDI by sector. Likewise, studies by region and country could help developing countries better gauge labour and human capital endowments and better adapt their economic policies to incoming capital flows.

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