Children Affected By HIV/AIDS And Human Capital Development In West Africa: A Panel Data Analysis

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ABSTRACT
This study investigates how the number of children infected with HIV/AIDS and AIDS-induced orphans affect human capital development in West Africa. Two panel data models were estimated, using the Fixed Effects estimation technique supported by the Hausman specification test result. The findings overwhelmingly suggest that number of children living with HIV/AIDS and AIDS-induced orphans have negative and significant effects on human capital development in West Africa. Therefore, efforts should be geared towards hurting and reversing the spread of the disease as well as eradicating it in West Africa. Care should also be provided for the education, health, nutrition, shelter and psychological needs of the affected children.

Key Words: HIV/AIDS, Human capital, children living with HIV/AIDS, AIDS-Induced orphans, West Africa
JEL Classification: I19, I29, J13

INTRODUCTION
The high prevalence of HIV/AIDS among different age groups in countries hardest hit has led to upsurge in the number of children living with the disease (HIV positive children) and AIDS-induced orphans[1] (children whose one or both parents have died from AIDS related diseases). Although the pandemic affects almost all classes and age groups in society, children and the working population are the most affected. Out of the estimated 34.0 million persons living with HIV/AIDS globally as at the end of 2010, about 3.4 million were children under 15 years (out of which 3.1 million were in sub-Saharan Africa, SSA) while approximately 17.1 million children under age 18 have lost one or both parents to the virus worldwide [1, 2].[2]

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[1] The Framework for the Protection, Care and Support of Orphans and Vulnerable Children Living in a World with HIV and AIDS as cited in UNICEF (2006, p.4) defines an orphan as a child under 18 years of age whose mother, father or both parents have died from any cause. AIDS-Orphan therefore, implies any child under age 18 who has lost either or both parents to AIDS.

[2] U.S. Global Health Policy (2012) affirms that around 16.6 million AIDS-orphans were recorded globally as at the end of 2009, with 89% of them living in sub-Saharan Africa.

UNAIDS (2013a, 2013b) indicate that SSA alone accounts for more than 90% of the children suffering from the scourge of HIV/AIDS while about 71% of 35.3 million people living with the disease globally, reside in the region. Also found in the region include approximately 70% of new infections among both children and adults, 67% of AIDS-induced deaths as well as above 14 million AIDS-orphans. In a recent report by UNAIDS (2015), it was revealed that out of the nearly 36.9 million people living with the disease globally as at the end of 2014, around 2.6 million were children below age 15 with 88% of them being in SSA. The report further indicated that new infections among children same year stood at 220,000 while daily infection among children was 600. In addition, out of the 36.7 million persons living with the virus as at the end of 2015 1.8 million of them were children with just 49% of them having access to antiretroviral treatment (UNAIDS, 2016). Worldwide, around 150 000 children were infected with HIV in 2015 alone with 66 000 of them in west and central Africa, which was about 31% decline from the 2010 figure (UNAIDS, 2016). Moreover, as at the end of 2014, 13.3 million children were orphaned by AIDS. The situation may take some time to ameliorate, particularly as a new HIV strain, which is able to develop faster into a full-blown AIDS within five years than the parent strains has been discovered in Guinea-Bissau while coverage of infected persons with antiretroviral drugs in the affected countries has been very low (USAIDS 2011; UNAIDS, 2013c; and Palm *et al.*, 2014). Bennell (2005, p. 469) has argued that in the absence of medical intervention, about 33% of pregnant women living with HIV/AIDS still pass the virus to their babies while "over 90% of these children die before they are old enough to attend school."

The continued influence of HIV/ADIS on the child has a lot of negative implications for human capital formation and other developmental activities in Africa. UNICEF (2011) reiterates that the disease has contributed to high rate of poverty, homelessness, number of children dropping out of school, discrimination and loss of life opportunities among children in countries mostly affected. Furthermore, HIV/AIDS could reduce "the stock of human capital and the capacity to maintain the required turnover of many sought after skills and training like engineers, doctors, teachers, artisans and others" (Pennap, Chaanda & Ezirike, 2011, p. 164). The virus is a "brutal escalator of other cruelties which children endure" because the bulk of poverty stricken persons today are actually women and children, and about 75 per cent of the 24,000 daily deaths caused by hunger fall within children under age five (Lyons, 2008, p. 2).[3]

Although the number of literature examining the impact of the HIV/AIDS pandemic on children in recent times appears to be rising (see Bicego, Rutstein & Johnson, 2003; Case, Paxson & Bleidinger, 2004; Ainsworth & Filmer, 2006; Kürzinger *et al.*, 2008; and Guo Li & Sherr, 2012), none of them has been able to explore how the increased number of children living with the disease and AIDS-induced orphans affect human capital development activities using panel data technique of analysis. Most of the available studies carried out in West Africa (Hilhorst *et al.,* 2006; Agboh-Noameshie *et al.*, 2007; Lowndes *et al.*, 2008; and Hooks & Silue, 2011) and other sub-regions, such as Southern and East African countries (Ntozi, 1997; Nyambedha, Wandibba & Aagaard-Hansen, 2003; and Hosegood *et al.*, 2007) are country-specific, covering majorly households and firms, all of, which are diverged from the main crux of the present

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[3] Lyons (2008) has also argued that in many households affected by the menace of HIV/AIDS, the tasks performed by children have increased; while some of them have become decision makers in their various families (since the disease has led to the demise of the head of the households), others have to work for longer "hours doing household tasks, supervising younger children and engaging in income-generating work in order to support the family." Gilborn (2002) pointed out that in the East and Southern African countries, children have become nurses to their "parents during prolonged illness and watch them suffer and die" including their guardians while most of them already lost their sisters, brothers, uncles, aunts, teachers and leaders.

study. This paper therefore, investigates how the increased number of children living with HIV/AIDS and the bloated AIDS-induced orphans affect human capital formation in West Africa, using panel data approach.

The remaining sections of the paper are structured as follows: section two presents stylized facts on HIV/AIDS as it relates to children and school enrolment in West Africa, section three briefly reviews the literature, section four focuses on the methodology adopted in the study, section five presents empirical results while section six gives conclusion and policy implications.

STYLIZED FACTS

West Africa constitutes about one third of the total population of SSA, with sixteen countries and an estimated population of 340 million people, which is growing at 2.54% according to World Bank (2015). The economic fortune of the sub-region depends majorly on agriculture, with the exception of Nigeria, a major producer and exporter of crude oil while Ghana in recent times discovered oil in commercial quantities. The situation of HIV/AIDS with respect to the number of infected children and AIDS-induced orphans poses threat to human capital formation activities in the sub-region. West Africa occupies the third position globally in terms of the burden of HIV/AIDS (World Bank, 2008; USAID, 2011; and UNAIDS, 2013b).

Children and HIV/AIDS in West Africa

In West Africa, the number of HIV/AIDS positive children and AIDS-orphans appear high. These facts are presented in Tables 1 and 2.

Table 1: Children Living with HIV/AIDS in West African Countries, 1990-2009

Country	Children Living with HIV/AIDS Per Hundred Thousand Population of Children ages 0-14 Years					Children Living with HIV/AIDS as a Percentage of Population of Children ages 0-14 Years				
	1990	1995	2000	2005	2009	1990	1995	2000	2005	2009
Benin	8.70	36.82	85.52	124.00	133.90	0.01	0.04	0.09	0.12	0.13
Burkina Faso	223.37	420.72	442.10	337.00	244.10	0.22	0.42	0.44	0.34	0.24
Côte d'Ivoire	90.87	425.88	809.90	924.00	807.20	0.09	0.43	0.81	0.92	0.81
Gambia	23.65	40.30	88.67	151.00	173.60	0.02	0.04	0.09	0.15	0.17
Ghana	15.60	76.84	205.20	279.00	290.90	0.02	0.08	0.21	0.28	0.29
Guinea	53.08	138.79	205.20	223.00	197.50	0.05	0.14	0.21	0.22	0.20
Guinea-Bissau	22.19	98.61	180.40	263.00	321.70	0.02	0.10	0.18	0.26	0.32
Mali	13.55	98.82	181.80	199.00	156.50	0.01	0.10	0.18	0.20	0.16
Mauritania	11.08	19.53	43.14	38.20	69.82	0.01	0.02	0.04	0.04	0.07
Niger	5.40	22.94	70.24	97.50	101.20	0.01	0.02	0.07	0.10	0.10
Nigeria	34.96	271.66	467.70	559.00	527.50	0.04	0.27	0.47	0.56	0.53
Senegal	14.13	24.94	49.45	76.50	94.55	0.01	0.03	0.05	0.08	0.10
Sierra Leone	5.54	11.67	56.24	87.00	121.50	0.01	0.01	0.06	0.09	0.12
Togo	28.55	102.11	274.20	400.00	424.40	0.03	0.10	0.27	0.40	0.42

Source: Authors' Computation using data from World Bank (2013). World Development Indicators.

The data in Table 1 suggest that the number of HIV/AIDS infected children in most West African countries continue to increase over the years. With the exception of Burkina Faso, all other countries experienced consistent upsurge in the figure from 1990 to 2005 before slight declines in few countries were recorded. In Benin, 8.7 per 100,000 population of children below 15 years lived with the pandemic in 1990 (about 0.01% of the entire population of children below 15 years). By 2000 it has increased to 85.52 (about 0.09 % of children below 15 years) while the 2009 figure stood at 133.90. In Côte d'Ivoire, approximately 90.87 per 100,000 population of children below 15 years lived with the virus in 1990. This figure however increased to 425.88 (about 0.43%) in 1995 and further to 809.90 (0.81%) in 2000 as well as 924.00 in 2005 (0.92%). In 2009, it declined to 807.20. Côte d'Ivoire has the highest burden of HIV in terms of the percentage of children below age 15 years who were living with HIV/AIDS in the entire region in 1995 to 2009. Sierra Leone recorded the lowest figure in 1995, with 0.01% while Mauritania had the lowest in 2005 and 2009.

AIDS-Induced Orphans in West Africa

AIDS is one of the main factors responsible for large number of orphans in West African. As indicated in Table 2, apart from Sierra Leone, none of the remaining countries has less than double digits of AIDS-induced orphans per 100,000 population of children below age 15 in 1990. In addition, nearly all the countries recorded increased number of AIDS-orphans for the period reported in this study.

Table 2: AIDS-Induced Orphan in Eleven West African Countries

Country	AIDS-Induced Orphans Per Hundred Thousand Population of Children ages 0-14 Years					AIDS-Induced Orphans Per Thousand Population of Children ages 0-14 Years					AIDS Orphans as Percentage of Total Orphans				
	1990	1995	2000	2005	2009	1990	1995	2000	2005	2009	1990	1995	2000	2005	2009
Benin	21.70	81.00	348.42	658.87	743.76	2.00	8.46	39.29	80.00	96.77	0.20	0.85	3.93	8.00	9.68
Burkina Faso	312.24	1452.00	2394.5	2563.8	2010.4	23.64	107.8	183.1	210.5	181.8	2.36	10.8	18.3	21.10	18.20
Côte d'Ivoire	135.38	933.70	3386.9	5434.3	5637.4	13.04	87.69	273.8	400.0	400.0	1.30	8.77	27.4	40.00	40.00
Gambia	23.42	100.60	177.17	227.03	373.83	2.02	9.24	16.65	22.39	38.89	0.20	0.92	1.67	2.24	3.89
Ghana	20.28	127.10	602.67	1396.2	1724.1	1.55	10.58	50.00	109.1	145.5	0.15	1.06	5.00	10.90	14.50
Guinea	94.78	375.90	934.93	1340.6	1294.8	6.58	30.95	80.00	124.4	134.1	0.66	3.10	8.00	12.40	13.40
Guinea-Bissau	44.16	197.00	396.77	1001.1	1485.8	2.24	11.48	23.91	61.00	88.18	0.22	1.15	2.39	6.10	8.82
Mali	13.52	132.60	613.09	1013.2	932.58	0.83	8.73	43.28	81.16	85.51	0.08	0.87	4.33	8.12	8.55
Mauritania	55.29	97.54	112.16	198.87	251.34	5.31	10.30	13.00	23.64	30.00	0.53	1.03	1.30	2.36	3.00
Niger	13.48	50.48	246.78	588.16	749.37	0.75	2.90	15.12	40.43	58.76	0.07	0.29	1.51	4.04	5.88
Nigeria	27.97	501.50	2057.8	3453.6	3663.4	1.58	27.27	110.0	190.9	208.3	0.16	2.73	11.00	19.10	20.8
Senegal	28.22	67.35	164.08	281.71	345.47	2.32	6.00	15.53	28.00	36.54	0.23	0.60	1.55	2.80	3.65
Sierra Leone	5.48	11.61	84.357	329.59	628.41	0.37	0.66	4.84	23.23	46.88	0.04	0.07	0.48	2.32	4.69
Togo	28.49	183.80	883.16	2022	2546.4	2.77	18.95	90.48	208.7	275.0	0.28	1.89	9.05	20.90	27.50

Source: Authors' Computation using data from UNAIDS (2010)

In Benin, 21.7 out of every 100,000 children under age 15 were AIDS-orphans in 1990. By 2000, the number had risen to 348.87, and further to 658.87 and 743.76 in 2005 and 2009 respectively. Burkina Faso had the worst case in 1990, with 312.24 orphans out of every 100,000 children ages 0-14. By 1995, Côte d'Ivoire had overtaken Burkina Faso as it recorded 933.7. The same high trend was observed for the remaining periods. Côte d'Ivoire has the highest figure of AIDS-orphans in the entire region, put at 5434.3 and 5637.4 per 100,000 population of children below 15 years in 2005 and 2009 respectively. Countries with the lowest figures were Sierra Leone in 1990, 1995 and 2000; Gambia in 2005; and Mauritania in 2009.

From the same Table 2, it is evident that AIDS-orphans as percentage of total orphans follow the same pattern as discussed above. This figure, which was 0.20% for Benin in 1990, increased to 3.93% in 2000 and further to 9.68% in 2009. Côte d'Ivoire recorded 40% in both 2005 and 2009, which was the highest in the entire region. Nigeria, which had 0.16% of total orphans caused by AIDS in 1990 recorded 11% in 2000 and 20.8% in 2009.

Apparently, the trend of HIV/AIDS infection as well as AIDS-orphans presented above portends grave danger for human capital development activities in West Africa.

School Enrolment

One of the main indicators of human capital is school enrolment. Primary school enrolment figures in West Africa are presented in Table 3. Countries in the sub-region on average appear to have recorded improvements in primary school enrolment over the years. As presented in the table, Ghana, Nigeria and Togo recorded enrolment rates above 70 in 1990. By 1995, Benin and Mauritania had joined this group. In 2005, apart from Burkina Faso and Niger, which had their enrolments as 55.42 and 49.30 respectively, others had theirs between 70 and 160. In 2009, Benin, Ghana, Guinea-Bissau, Mauritania, Sierra Leone and Togo recorded 100 and above. Overall, countries that appeared to have performed better in the area of primary school enrolment in West Africa are: Benin, Ghana, Guinea-Bissau, Nigeria and Togo.

Table 3: Primary School Enrolments in West Africa, 1990-2009

Country	Primary School Enrolment Rate					Log Primary School Enrolment Rate				
	1990	1995	2000	2005	2009	1990	1995	2000	2005	2009
Benin	53.04	73.51	86.43	105.38	123.9	3.97	4.30	4.46	4.66	4.82
Burkina Faso	30.14	36.47	42.28	55.42	74.69	3.41	3.60	3.74	4.02	4.31
Côte d'Ivoire	67.31	67.75	74.30	74.00	79.09	4.21	4.22	4.31	4.30	4.37
Gambia	53.25	61.10	84.47	86.07	87.33	3.97	4.11	4.44	4.46	4.47
Ghana	70.50	79.17	85.19	90.30	106.30	4.26	4.37	4.44	4.50	4.67
Guinea	35.95	47.25	59.65	84.80	91.94	3.58	3.86	4.09	4.44	4.52
Guinea-Bissau	53.01	56.50	78.70	119.80	104.00	3.97	4.03	4.37	4.79	4.64
Mali	26.13	37.31	55.19	71.06	79.40	3.26	3.62	4.01	4.26	4.37
Mauritania	46.85	72.12	84.41	94.27	100.4	3.85	4.28	4.44	4.55	4.61
Niger	27.03	28.80	32.61	49.30	62.01	3.30	3.36	3.48	3.90	4.13
Nigeria	84.84	87.91	97.85	101.83	83.09	4.44	4.48	4.58	4.62	4.42
Senegal	56.36	58.13	70.64	82.65	86.80	4.03	4.06	4.26	4.41	4.46
Sierra Leone	52.40	53.10	70.43	160.00	157.70	3.96	3.97	4.25	5.08	5.06
Togo	95.85	111.40	117.80	116.65	134.8	4.56	4.71	4.77	4.76	4.90

Source: Authors' Computation using data from World Bank (2013) World Development Indicators; and African Statistical Yearbook (ASY) (2010 & 2011).

THE LITERATURE

There is consensus in the literature that human capital in its various forms plays a critical role in every economy (Schultz, 1961; Becker, 1964; Nelson and Phelps, 1966; Grossman, 1972a, 1972b; Romer, 1986; Lucas, 1988; and Romer, 1990). Such role includes economic growth and development, employment generation, poverty alleviation, and women empowerment.

Various means of human capital investment have been identified in the literature; such as formal education, health, training, and so on (see Schultz, 1961). This study however, focuses exclusively on education as a form of human capital; which is not unconnected with the significant role of education in all aspects of society. Hamoudi & Birdsall (2004, p. 134) posit that education is a vital tool through which productivity could be increased, individual income level augmented and sustainable economic growth achieved. The authors argued that education would improve people's lives, boost poor people's capacity to participate in the political process, organize for other social and political rights, demand for better governance and help women in the area of "better family health and improved capacity to plan and time births."

The emergence of HIV/AIDS in the early 1980s however, has continued to erode human capital formation processes required for economic growth and development, particularly in SSA. Research has shown that countries hardest hit by the pandemic have had to contend with the ugly impact of the disease on school attendance/enrolment, number of teachers, health expenditure and health status of households (Gachuhi, 1999; Ennew, 2000; Carr-Hill *et al.*, 2002; Meyer, 2003; Pennap, Chaanda and Ezirike, 2011). The pandemic has also contributed to the bloated number of orphans in countries with high prevalence (Loening-Voysey & Wilson, 2001; UNAIDS, 2004; UNAIDS, UNICEF & USAIDS, 2004; Hosegood *et al.*, 2007; Beegle, de Weerdt & Dercon, 2010; Nsagha *et al.*, 2012). The literature reviewed for this study focuses on issues relating to how HIV/AIDS affects children and its implications for human capital development activities, particularly education.

There are existing studies on how HIV/AIDS affects the status of children, with many of these emphasizing on direct effects of the disease on school attendance, enrolment, completion, status and number of teachers. However, the findings appear mixed. While some report negative influence of the disease on education outcomes/inputs of both HIV/AIDS-infected children and AIDS-orphans, others did not find any significant impact of the pandemic on these variables.

Among studies which reported negative effect of HIV/AIDS on education outcomes/inputs of HIV/AIDS-infected children and AIDS-orphans are: Ennew (2000) who carried out a study in Kenya. The author discovered among other things that the disease has wide spread impact on children's learning experiences. Pupils' participation in classes,, attendance and performances were negatively affected. While some have dropped out of school, others were not regular due to inability of infected parents to pay for the children's schooling. Moreover, some of the pupils and their teachers were infected with the virus and some among them had died from AIDS-related causes.

In a cross-country study, using a descriptive analysis on a household surveys involving children below age 15 in 40 countries of SSA[4], Monasch & Boerma (2004) reported that HIV/AIDS has led to rapid increase in orphans statistics and as such, orphans were about 13% less likely to attend school than non-orphans while double orphans were more likely to be disadvantaged.

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[4] The data were collected in 37 countries between 1999 and 2002 by two "international survey programmes, the Multiple Indicator Cluster Surveys (MICS) supported by the United Nations Children's Fund (UNICEF), and the Demographic and Health Surveys (DHS) sponsored primarily by the United States Agency for International Development" (Monasch and Boerma, 2004, p. S56). The authors also included a 1997 DHS data for Mozambique, and 1998 data for both Ghana and South Africa.

Kobiané, Calvès and Marcoux (2005) carried out a study to determine how death of parents affects children's schooling in Burkina Faso and found that death of both parents, which has increased due to HIV/AIDS epidemic, has negative impact on children's chances of entering school particularly in rural areas. However, orphan-hood was discovered to be detrimental to school access only among the oldest cohorts and double orphans in rural areas. In addition, parental death was also detrimental to school access for girls than for boys.

Niang & van Ufford (2007) employed both secondary and primary data to determine the socioeconomic impact of HIV on children in Senegal. They found negative impact of the disease on school enrolment, class attendance and performance in school at individual and household levels. However, they reported insignificant nation-wide effects of the pandemic on the economy as a whole. This may not be unconnected with the low prevalence of the virus in the country. The data analysis was also more descriptive in nature, hence limited in terms of the determination of the causal relationship between HIV/AIDS and human capital and the impact of this relationship. Furthermore, the survey data used in the study was collected between June and September 2001, which may not give present situation of the disease as it relates to children human capital developmental activities. Finally, the most recent of the literature used in this study was 2004.

Oladokun *et al*. (2009) also used the data of HIV-positive orphans and non-orphans patients who attended the infectious disease clinic at the University College Hospital, Ibadan, Nigeria between July 2005 and December 2006 to study their socio-demographic and clinical characteristics. The authors employed Chi-square test, t-test and Z-scores for analysis. They however found that there was no significant difference between school enrolment of orphans and non-orphans who were HIV positive. The main objective of the study notwithstanding, attempt should have been made to include non-HIV positive children, which could have revealed any difference between their socio-demographic characteristics when compared with those children infected by the pandemic.

The study undertaken by Cluver *et al.* (2012) employed qualitative and quantitative methods, to examine educational impact of children living in AIDS-affected households and other households in South Africa, with a sample of 659 adolescents within the age bracket 10-20 years. Their findings showed significant negative association between household AIDS-sickness and adolescents' education than other homes whether affected by other sicknesses or not.

Studies showing no significant impact of the pandemic on human capital as they relate to education variables include:

Ainsworth, Beegle & Koda (2005) used a maximum likelihood probit regression model to examine the influence of adults' deaths and orphans'status on primary school attendance and the number of hours pupils spent in school. The study was carried out in the north-western Tanzania (an area with high incidence of HIV/AID), using household survey from the 1991-1994 Kagera Health and Development Survey (KHDS). One of their findings suggests that orphan status or adult deaths did not contribute to school drop-out among pupils; however, school hours reduced significantly for children months before parents' death but recovered after such death. This study was observed to have employed an out-dated data set while the technique of analysis adopted could be defective for time-invariant variables, which could have affected their findings.

Pufall *et al.* (2014) investigated how HIV affects education outcomes in Zimbabwe, using a 1998-2011 general population survey among youths aged 15–24 years and a 2009-2011 survey covering children aged 6-17. The authors employed multivariable logistic regression. They however, found no association between being HIV-positive and primary school completion, ordinary level passes, correct grade level among adolescents of age bracket 16-17 years. Furthermore, no significant impact of HIV status on education outcomes was reported among the same age group. However, lower secondary school attendance was found to exist among young caregivers in 2009-2011 data. Additionally, for the 2009-2011 and 1998-2011 periods, decreased odds of being in the correct grade level and the odds of primary school completion were reported for both periods respectively.

The mixed evidence reported by the various studies suggests the inconclusive nature of literature on the impact of HIV/AIDS on human capital. Furthermore, majority of the studies employed cross-sectional survey data. No doubt, this could have also influenced their findings. Additionally, a good number of data analysis techniques employed by the studies appear too simple, such as descriptive method of analysis. It is also observed that the bulk of the studies focus on East and Southern African countries, with few including one or two countries of West Africa. The exception is Monasch & Boerma (2004) which added thirteen West African countries; although, their methodology was not different from the others. Two country specific studies were also done in West African countries. These are: Oladokun *et al.*, which was done in Nigeria; and Kobiané, Calvès & Marcoux (2005) conducted in Burkina Faso. Finally, all the studies diverge from the present paper, which focuses on the impact of increased number of children living with HIV/AIDS and AIDS-induced orphans on human capital investment activities in West Africa.

METHODOLOGY

Human capital literature covering both micro and macro studies support the fact that investment in human capital could occur at individual and societal levels. Most human capital models used for macro studies have a background in micro frameworks. The model employed in this study benefits from the work of Ben-Porath (1967) as highlighted in Mincer (1997). Ben-Porath's human capital model is based on individual human capital production function, which as stated in Mincer (1997, p.S27) is given as

$$Q_t = f(K_t, S_t, X_t; B) \tag{1}$$

Where:
Q_t = an individual's gross investment in human capital in period *t*;
K_t = initial stock of human capital;
S_t = the proportion of time in period *t* set aside for the production of Q_t;
X_t = the goods and services procured by the individual for the production of Q_t; and
B = a parameter, which according to Mincer (1997) was included by Becker (1975). This parameter indicates "the limited individual physical and intellectual capacity that rationalizes Yoram's assumption of decreasing returns to scale" (1997, p.S27).

The implication of the function is that individuals produce some form of human capital using certain inputs into the production process, which all involve certain costs. Most of the inputs into the production could be classified as economic, social and environmental variables such as: income, education, health, and household. These variables are also applicable for macro study. For instance, Gross Domestic Product (GDP) can be used instead of household income while population size can also be used instead of household size.

The model employed in this paper assumes away initial stock of human capital, which is more appropriate for a dynamic panel data technique of analysis as against the static panel the work applied.

Our model derives from the human capital function specified below

$$h_{it} = f(x_{it}, d_{it})$$ (2)

Where h_{it} is human capital stock and x_{it} stands for inputs into human capital production activities. d_{it} is epidemiological variables under which HIV/AIDS is captured. Prevalence of diseases, such as HIV/AIDS, malaria, tuberculosis, etc. could have negative implication for human capital developmental activities. It should be noted that while variables that fall under **x** assist to boost human capital development activities, those that are captured under **d** erode human capital formation.

Empirical Model Specification

This study estimated two models. The main difference between the models is that both contain different variables of interest. The variable of interest in the first model was the number of children living with HIV/AIDS as a percentage of children ages 0-14 years while in the second model, AIDS-induced orphans as a percentage of total orphans was the variable of interest.

Model One

$$\ln PRY_{it} = \beta_0 + \beta_1 CHIV_{it} + \beta_2 \ln IFM_{it} + \beta_3 \ln DEP_{it} + \beta_4 \ln GDP_{it} + \epsilon_{it}$$ (3)

Where: *lnPRY* is the natural log of primary school enrolment; *CHIV* is the number of children living with HIV/AIDS as a percentage of children ages 0-14 years; *lnIFM* is the natural log of infant mortality; *lnDEP* is the natural log of age dependency ratio (% of working-age population) and *lnGDP* represents the natural log of GDP per capita {Purchasing Power Parity (PPP)}.

Model Two

$$\ln PRY_{it} = \beta_0 + \beta_1 AIDSO_{it} + \beta_2 \ln IFM_{it} + \beta_3 \ln DEP_{it} + \beta_4 \ln GDP_{it} + \epsilon_{it}$$ (4)

AIDSO is AIDS-orphans as a percentage of total orphans. All other variables remain as earlier defined. *i*=1,2,...,N stands for individual country, *t*=1,2,...,*t* indexes year, and ϵ_{it} is the composite error term.

$$\epsilon_{it} = \mu_i + v_{it}$$ (5)

μ_i stands for country specific effects while v_{it} is the remainder disturbance term. In the second model, we replace *CHIV* with *AIDSO*

Theoretically, β_1 and β_2 are < 0 while β_3 and β_4 are > 0.

Estimation Technique

Fixed effects (FE) panel data estimating technique was employed for analyses in this study. This was considered suitable after conducting the Hausman specification test. FE estimator helps to prevent the problem of heterogeneity bias and therefore, produces consistent and efficient estimates. Heterogeneity bias occurs when the country-specific characteristics influence the predictor variables, which makes the error term to correlate with the predictor

variables. What the FE estimator does is to "remove the effect of those time-invariant characteristics so we can assess the net effect of the predictors on the outcome variable" (Torres-Reyna, 2007, p. 9). It does this by transforming the model to eliminate the unobserved effects. Furthermore, dummy variables can also be employed to deal with this problem.

In carrying out our analysis, we first focused on all countries of interest in the sub-region and later excluded Nigeria because the country accounts for more than 50% of the entire size of the sub-region (see World Bank, 2015). The main justification for this was to eliminate the probable dominant effect of Nigeria.

Data Requirement and Sources

The study focuses on the impact of the growing number of children living with HIV/AIDS and increased AIDS-induced orphans on human capital formation in West Africa over 1990-2009, with focus on fourteen West African countries, namely: Benin, Burkina Faso, Cote d'Ivoire, Gambia, Ghana, Guinea, Guinea Bissau, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone and Togo. The selection of these countries was based on data availability. The data for the study were collected from sources indicated in Table 4

Table 4: Sources of Data

Variables	Sources
Number of Children Living with HIV/AIDS	World Bank (2013). World Development Indicators
AIDS Orphans	World Bank (2013). World Development Indicators
Gross Domestic Products Per Capita	World Bank (2013). World Development Indicators
Primary School Enrolment	World Bank (2013). World Development Indicators and African Statistical Yearbook (ASY) (2010 and 2011)
Age Dependency Data	World Bank (2013). World Development Indicators
AIDS Orphans	UNAIDS (2010)
Children Ages 0-14	World Bank (2013). World Development Indicators

Source: Prepared by the Authors.

Descriptive Statistics

These give the summary statistics of the variables employed for analysis in the study. As depicted in Table 5, primary school enrolment in West Africa remains on the average of 75.18% regardless of the age of the pupils. This is a high level of school participation at this level. However, this figure declines by 1.23% when Nigeria was excluded from the analysis. Percentage of children below age 15 living with HIV/AIDS is on the average of 0.19 (0.17 without Nigeria). However, this value ranges between a 0.01 (same when Nigeria was excluded) and 0.92 (same without Nigeria). Moreover, 6.55% of orphans in the region were caused by AIDS. This nevertheless hovers between 0.03% and 43% for the period 1990-2009. It reduced marginally to 6.28 %, and varied between 0.03% and 43.00% when Nigeria was exempted from the analysis. Infant mortality remains high, with a mean value of 94.43 (93.19 excluding Nigeria), which also varies between 49.30 (same without Nigeria) and 162.00 (same without Nigeria). The ratio of dependent population to the working population stood at 90.80 (91.03 when Nigeria was excluded) on the average while average value of per capita gross domestic products (purchasing power parity) in the sub-region was US$1075.56 (US$ 1047.60 without Nigeria) for the period under consideration.

Table 5: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
		Nigeria Inclusive					Nigeria Exclusive			
PRY	280	75.18	27.65	26.13	160.00	260	73.95	28.25	26.13	160.00
CHIV	280	0.19	0.20	0.01	0.92	260	0.17	0.19	0.01	0.92
AIDSO	280	6.55	8.59	0.03	43.00	260	6.28	8.59	0.03	43.00
IFM	280	94.43	24.45	49.3	162.00	260	93.19	24.60	49.30	162.00
DEP	280	90.80	7.03	74.56	109.54	260	91.03	7.23	74.56	109.54
GDP	280	1075.60	408.43	482.80	2327.40	260	1047.6	398.88	482.80	2327.36

Note: Obs implies observations
Source: Computed by the Authors

EMPIRICAL RESULTS AND DISCUSSION

Children Living with HIV/AIDS

Our results for the first model focus specifically on how the share of children living with HIV/AIDS affects human capital in West Africa. These are presented in Table 6. A peep into the table revealed negative and significant effect of children living with the disease on human capital in the entire region. Findings of estimations which excluded Nigeria were negative and highly significant. A fundamental observation about the result centered on the larger coefficient when Nigeria was excluded from the analysis. While the coefficient of children living with HIV/AIDS for the sub-region was -0.47, the exclusion of Nigeria from the analysis shot up the coefficient to -1.55, both coefficients being highly significant at 1% significance level. The import of this is that the inclusion of Nigeria reduced the impact of HIV/AIDS on human capital in the region, specifically on children's education. The findings above appear consistent with other studies conducted elsewhere by Gilborn *et al.* (2001); Niang & van Ufford (2007); Gow & Desmond (2007); Guo, Li & Sherr (2012); Cluver, Operario, Lane, & Kganakga (2012); and Pufall *et al.* (2014), which all reported significant declines in school enrolment, attendance and completion in countries severely affected by the disease. Although these studies did not focus attention on how number of HIV/AIDS infected children and AIDS orphans affects education outcomes, they however considered the effects of the disease itself on education variables as they affect children in society.

Table 6: Effects of Children Living with HIV/AIDS on Human Capital Development in West Africa
Dependent Variable = Log of Primary School Enrolment Rate

Variables	Nigeria Inclusive Coefficients	Nigeria Exclusive Coefficients
CHIV	-0.466***	-1.545***
	(0.000)	(0.000)
lnIFM	-1.521***	-0.282**
	(0.000)	(0.019)
LnDEP	-2.029***	-1.305***
	(0.000)	(0.002)
lnGDP	0.191**	0.322***
	(0.064)	(0.002)
Constant	19.024	14.896
	(0.000)	(0.000)
Observations	280	260
Group	14	13
R-squared	0.653	0.705
F-Stat.	123.15***	144.84***
	(0.000)	(0.000)
Hausman Test	67.80***	19.87***
	(0.000)	(0.001)

Note: * p<0.10; ** p<0.05; *** p<0.01
Source: Authors' Computation

AIDS Orphans and Human Capital in West Africa

Results of the second model are shown in this section. The main focus is the impact of AIDS-induced orphans on human capital in West Africa. Table 7 contains the results.

Table 7: Effects of AIDS-Orphans on Human Capital Development in West Africa
Dependent Variable = Log of Primary School Enrolment Rate

Variables	Nigeria Inclusive Coefficients	Nigeria Exclusive Coefficients
AIDSO	-0.011***	-0.008***
	(0.000)	(0.000)
lnIFM	-1.494***	-1.563***
	(0.000)	(0.000)
lnDEP	-1.937***	-1.384***
	(0.000)	(0.000)
lnGDP	0.300***	0.389***
	(0.003)	(0.000)
Constant	17.719	14.876
	(0.000)	(0.000)
Observations	280	260
Group	14	13
R-squared	0.663	0.715
F-Stat.	128.95 ***	152.58 ***
	(0.000)	(0.000)
Hausman	55.42 ***	-34.97
	(0.000)	NA

Note: * $p<0.10$; ** $p<0.05$; *** $p<0.01$.
Source: Authors' Computation

With respect to how AIDS-induced orphans affect human capital in West Africa, the findings shown in Table 7 suggest that orphans created by the pandemic associate negatively with human capital activities. The results were also statistically significant. It is also interesting to note that the coefficient returned by our analysis was slightly larger with analyses involving Nigeria than those that excluded Nigeria. This indicates that orphans created by the pandemic appear to exert greater negative influence on school enrolment in Nigeria than other countries in the region. However, with respect to number of children living with the disease, greater influence on human capital was observed with analyses involving other countries than those that left out Nigeria. Some of the findings consistent with negative effects of HIV/AIDS on orphans' education outcomes include: Case, Paxson & Ableidinger (2004); Monasch & Boerma (2004); Kasirye & Hisali (2008); Oladokun *et al.* (2009); and Pufall *et al.* (2014).

Apparently, the findings of the present study provide very strong evidence that the number of children living with HIV/AIDS and AIDS-induced orphans have negative and significant impact on human capital (measured with school enrolment) in West Africa, a region bearing the third heaviest burden of the disease globally. This outcome is not unexpected going by the growing statistics of orphans induced by AIDS and the number of children living with HIV/AIDS in a region battling with high level of poverty, insecurity (currently aggravated by terrorism) poor macroeconomic performance, low level of literacy, poor governance and high level of corruption. Literacy rate in all West African countries is very low. According to African Development Bank, AfDB (2011), more than 45% of West African adult population is not literate. In a report by United Nations Educational, Scientific and Cultural Organization, UNESCO (2012), which showed the SSA as having the lowest literacy rate globally, eight out of the eleven countries shown to have their adult literacy rate below 50% are found in West Africa. The lowest literacy rate in Africa and globally too is found in Burkina Faso, which is a West African country.

Other Variables Employed in the Study
Three control variables were included in each of the two models. These are: logs of infant mortality; age dependency ratio as percentage of working-age population; and GDP per capita {purchasing power parity (PPP)}. These are shown in Tables 6 and 7. Overwhelmingly, infant mortality and age dependency ratio exert negative and highly significant influence on human capital across all the estimations while per capital GDP has positive and significant impact on human capital all through.

Diagnostic Test, Post Estimation Test and Choice of Model
Our estimates are shown to be robust given the results of diagnostic and post estimation tests. The R-squared ranged between 0.513 and 0.715, which shows strong explanatory power of the model. Furthermore, the F-Statistic test was statistically significant, implying joint significance of the models. On the choice of model, the Chi-squared statistics of Hausman specification tests were significant, meaning that the fixed effects modeling and estimation technique were suitable and produced efficient and consistent results.

Summary results from both models estimated are presented in Table 8 covering solely, the two variables of interest. This was done for ease of understanding and enable proper visualization of results. As shown in the table, children living with HIV/AIDS and AIDS orphans have negative and significant impact on human capital within the region of West Africa. A percentage increase in the number of children living with the virus led to about 0.47% decline in school enrolment in the entire region. The exclusion of Nigeria from the analysis raises the magnitude of the coefficient to -1.55%. Furthermore, a percentage rise in AIDS-induced orphans in West Africa, reduced school enrolment by .011% while the same figure declined to -0.008% due to non-inclusion of Nigeria. It can be said categorically that the elimination of Nigeria, which accounts for more than 50% of the region's population from the analysis, did not change the results substantially. Both variables have negative and significant effects on enrolment figure in the region, whether with or without Nigeria. The only difference was observed in the magnitude of the coefficients.

Table 8: Summary Results Showing Effects of Children Living with HIV/AIDS and AIDS-Orphans on Human Capital Development in West Africa
Dependent Variable = Log of Primary School Enrolment Rate

Variables	Nigeria Inclusive Coefficients	Nigeria Exclusive Coefficients
CHIV	-0.466***	-1.545***
	(0.000)	(0.000)
AIDSO	-0.011***	-0.008***
	(0.000)	(0.000)

Note: * p<0.10; ** p<0.05; *** p<0.01.
Source: Author's Computation

CONCLUSION AND POLICY IMPLICATIONS

The study focuses on the impact of children living with HIV/AIDS and AIDS-induced orphans on human capital formation in West Africa, using panel data technique of analysis. It employed two models. The variables of interest in model one was the percentage of children age 0-14 who were living with HIV/AIDS while that of the second model was AIDS-induced orphans as a percentage of total orphans. The analysis was carried out firstly on all countries of interest and later without Nigeria (this was to eliminate the probable dominant effect of Nigeria since the nation accounts for more than 50% of the entire region's population). The findings suggest that

number of children living with HIV/AIDS and AIDS orphans have negative and significant effects on school enrolment in West Africa, which conforms with the a priori expectation. The persistent rise in the number of children infected by HIV/AIDS and AIDS-induced orphans could add to some of the problems already affecting West Africa and this may continue to depress human capital development activities. Most countries in West Africa are overburdened with high level of poverty, menace of other communicable diseases, including the Ebola virus, terrorism, and bad governance. These no doubt could strain the available resources and reduce care for these children.

The conclusion drawn from the above is that both AIDS-induced orphans and increased number of the children living with HIV/AIDS in West Africa exert negative pressure on the level of human capital formation in the sub-region. This implies that if policies are not put in place to reduce the number of children living with the pandemic and the number of orphans created by the disease, the level of human capital in the sub-region may continue to decrease and this could have negative implication for economic growth and development, and further compound poverty situation in the sub-region.

It is therefore, recommended that governments of West African countries should step-up efforts to check the spread of the disease and also endeavour to educate children on the existence of HIV/AIDS and its negative implication on their future. Children who are already infected with the disease should be given free treatment, counselled and also encouraged to attend school, which should be provided at no cost to them. More attention should also be paid to AIDS orphans by providing them with education, shelter, free medical services and if possible free meal.

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