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Intelligence, Human Capital and HIV/AIDS: Fresh Exploration

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Abstract

This study complements existing literature on the relationship between HIV/AIDS and human capital by introducing previously unexplored indicators as well as more robust empirical strategies. The overarching purpose is to assess whether previous findings on the relationship withstand empirical scrutiny when alternative indicators and methodologies are employed. Four main HIV/AIDS measurements are regressed on intelligence for a maximum of 195 cross-sectional averages over the past decade. The empirical evidence is based on OLS, IWLS and 2SLS. The following findings are established. First, human capital decreases HIV prevalence with the magnitude on 'Women's share of population ages 15+ living with HIV' substantially higher. This implies improving average human capital levels across communities would be more beneficial to girls above the age of 15 living with HIV. The relatively similar negative magnitudes across other dependent variables implies that increasing human capital decreases deaths from HIV/AIDS by almost the same rate as it reduces infections to the disease. Moreover, the HIV infection rate in children between the ages of 0 and 14 does not significantly change with human capital improvements. More policy implications are discussed.

JEL Classification: D60; I10; I20; J24; O15
Keywords: Health; Human capital; Intelligence

1. Introduction

The effect of intelligence on health has been recently documented in many studies. Barber (2005) has linked it to the example low birth weight; Lynn and Vanhanen (2006) to undernourishment and Lynn and Meisenberg (2012) to malnourishment. Many studies have also assessed the relationship with: (i) infant mortality (Barber, 2005; Lynn & Vanhanen, 2006 ; Kanazawa, 2006; Templer, 2008 ; Rushton & Templer, 2009; Reeve, 2009); (ii) maternal mortality (Lynn & Vanhanen, 2006 ; Reeve, 2009), la life expectancy (Lynn & Vanhanen, 2006 ; Kanazawa, 2006 ; Lynn et al., 2007; Ram, 2007 ; Templer, 2008; Rushton & Templer, 2009; Reeve, 2009) and (iii) HIV/AIDS[1] (Templer, 2008 ; Rindermann & Meisenberg, 2009; Rindermann et al., 2009; Rushton & Templer, 2009; Reeve, 2009).

The present line of inquiry complements the last strand by investigating the effect of intelligence on health, notably on: HIV/AIDS. Whereas theoretical underpinnings may be intuitive, to the best of our knowledge, empirical scrutiny on the nexus has not yet been firmly established. It is interesting to note that, in the strand closest to the present study, HIV/AIDS is measured in terms of the percentage of infected individuals. As far as we have reviewed, Reeve (2009) is the line of inquiry that has steered clear of existing literature by considering HIV/AIDS deaths. We go a step further by exploiting four different indicators related to HIV/AIDS, namely: 'Adults (ages 15+) living with HIV'; 'Adults (ages 15+) and children (0-14 years) living with HIV' ; 'Women's share of population ages 15+ living with HIV (%)' and 'AIDS estimated deaths'. Hence, usages of this plethora of variables enable us to investigate whether previous findings withstand empirical scrutiny.

As concerns human capital, economists have traditionally abundantly measured this economic indicator quantitatively and scantily with qualitative measurements of education (e.g Lutz, 2009). Traditional indicators in growth regressions include: average years of schooling, life expectancy of the school, secondary and tertiary enrolment and lifelong learning (Barro, 1991; Benhabib & Spiegel, 1994; Barro & Lee, 1993, 2001; Caselli et al., 1996; Mankiw et al., 1992; Levine & Renelt, 1992; Sala-i-Martin et al , 2004; Asongu & Nwachukwu, 2015, 2016). Unfortunately, the use of these traditional indicators has not resulted in conclusive results. With regard to issues of data quality (Cohen & Soto, 2007; De la Fuente & Doménech, 2006), Weede and Kämpf (2002) have emphasised that these traditional indicators have for the most part focused on human capital inputs as opposed to

[1] Human immunodeficiency virus infection and acquired immune deficiency syndrome (HIV/AIDS).

outputs. In order to address this gap in the literature, Hanushek et al. (Hanushek & Kimko, 2000; Hanushek & Woessmann, 2008, 2009) have used international scholarly evaluation tests (Trends in International Mathematics and Science Study (TIMSS) and the Program of International StudentAssessment (PISA)).

The psychologist, Richard Lynn and political scientist, Tatu Vanhanen (2001, 2002, 2006) have also contributed to addressing the underlying issue by compiling intellectual quotient (IQ) data from many countries. This data has been employed in a substantial bulk of published works (Lynn & Vanhanen, 2012b). This data is also being increasingly employed by economists (e.g. Weede and Kämpf, 2002; Jones & Schneider, 2006; Ram, 2007 ; Potrafke, 2012; Kodila-Tedika & Kanyama-Kalonda, 2012 ; Kodila-Tedika, 2014 ; Rindermann et al., 2014 ; Kodila-Tedika & Mustacu, 2014 ; Kodila-Tedika & Bolito-Losembe, 2014; Kodila-Tedika & Asongu, 2015). The data of Hanushek and Lynn and Vanhanen are increasingly being improved (Rindermann, 2007a, b ; Meisenberg & Lynn, 2011). The last version from Meisenberg and Lynn (2011) has been recently employed by Meisenberg and Lynn, (2012). We follow this stream because there is an apparent advantage of combining traditional and new data. This is engaged in the data description section.

From a technical perspective, the plethora of studies on the relationship we examine have been authored by psychologists who recourse to simple correlations and path analysis (Templer, 2008 ; Rindermann & Meisenberg, 2009 ; Rindermann et al., 2009 ; Rushton & Templer, 2009 ; Reeve, 2009). We steer clear of this literature by using more classical empirical approaches by economists, namely: Ordinary Least Squares (OLS), Iteratively Weighted Least Squares (IWLS) and Two Stage Least Squares (2SLS). Accordingly, by employing an alternative methodological approach, we also contribute to the literature by investigating if the established relationship in the literature can be viewed from a different angle.

We have established the following findings. First, human capital decreases HIV prevalence with the magnitude on 'Women's share of population ages 15+ living with HIV' substantially higher. This implies improving average human capital levels across communities would be more beneficial to girls above the age of 15 living with HIV. The relatively similar negative magnitudes across other dependent variables implies that increasing human capital decreases deaths from HIV/AIDS by almost the same rate as it reduces infections to the disease. Moreover, the HIV infection rate in children between the ages of 0 and 14 does not significantly change with human capital improvements.

The rest of the study is organised as follows. Section 2 discusses the data, preliminary analysis and methodology. Empirical results are presented in Section 3. Section 4 concludes with implications and future research directions.

2. Data, preliminary analysis and methodology

2.1 Data

The sample consists of a maximum of 195 cross-sectional averages over the past decade. Four indicators are used to measure the dependent variable or HIV/AIDS, namely: Adults (ages 15+) living with HIV; Adults (ages 15+) and children (0-14 years) living with HIV; Women's share of population ages 15+ living with HIV (%) and AIDS estimated deaths. For the first variable, AIDS deaths are the estimated number of adults and children who died due to AIDS-related causes. 'Adults and children living with HIV' refers to the number of people ages 0-49 (adult ages 15-49 and children ages 0-14) who are infected with HIV. 'Adults living with HIV' refers to the number of people ages 15-49 who are infected with HIV. Female rate is as a percentage of the total population ages 15+ who are living with HIV. Prevalence of HIV is the percentage of people who are infected with HIV. The data is sourced from the United Nations AIDS (UNAIDS) estimates.

Consistent with Kodila-Tedika and Asongu (2015), the data on intelligence is from Meisenberg and Lynn (2011): previous versions of this dataset can be found in Lynn and Vanhanen (2002, 2006). This dataset is a compilation of hundreds of average national IQ tests observed over the 20^{th} and the 21^{st} centuries using best practice methods. Average IQ is a measure of general-purpose human capital as well as a measure of the nation's labor quality (Hanushek & Kimko, 2000; Jones & Schneider, 2006). With regard to institutional quality, we consider IQ as a measure of the ability of a nation's human capital to cooperate in order to produce a nationally efficient outcome in terms of pro-market policies. The advantage of the recent dataset is that it includes more countries as well as a composite measure of intelligence in the form of human capital. Our measure of intelligence is therefore the IQ from Lynn and Vanhanen,

The measures of institutional quality are obtained from the dataset compiled by Daniel Kaufmann, Art Kraay and Massimo Mastruzzi at the World Bank (www.govindicators.org). This dataset aggregates indicators of six broad dimensions of governance: voice and

accountability, political stability and absence of violence/terrorism, government effectiveness, regulatory quality, rule of law and control of corruption. The six aggregate indicators are based on 30 underlying data sources reporting the perceptions of governance of a large number of survey respondents and expert assessments worldwide. We use only government effectiveness to avoid issues of multicollinearity and overparameterization because of the high degrees of substitution among underlying governance indicators (Andrés et al., 2013, pp.9-10).

The data on religious composition is taken from LLSV[2] (1999) to create the dummy variable 'Muslims Religion' which takes the value 1 if Muslims are the dominant religious group in the country, and 0 if the dominant religious group in the country is Protestantism or Catholicism or Other Religions.

The data on GDP per capita is from Pen World Tables 7.1, while that on population size from World Development Indicators of World Bank. Table 1 presents the summary descriptive statistics of the variables used in this study. The exhibited variations are quite substantial. Hence we can be confident that reasonable and significant linkages will emerge.

Table 1: Summary statistics

Variables	Obs	Mean	Std. Dev.	Min	Max
Women's share of population ages 15+ living with HIV (%)	151	38.24	16.02	8.9	68
AIDS estimated deaths (log)	98	7.86	2.01	4.61	12.82
Adults (ages 15+) and children (0-14 years) living with HIV (log)	101	10.68	2.11	4.61	15.59
Adults (ages 15+) living with HIV (log)	101	10.59	2.08	4.61	15.50
Human capital	175	84.21	10.85	61.2	106.9
Muslim	195	0.2	0.40	0	1
GDP per capita (log)	140	8.873	1.19	5.90	11.17
Government effectiveness	139	0.113	0.99	-1.75	2.22
Population	123	16.53	63.11	-13.54	612.36

[2] LLSV stands for La Porta, Lopez-de-Silanes, Shleifer and Vishny.

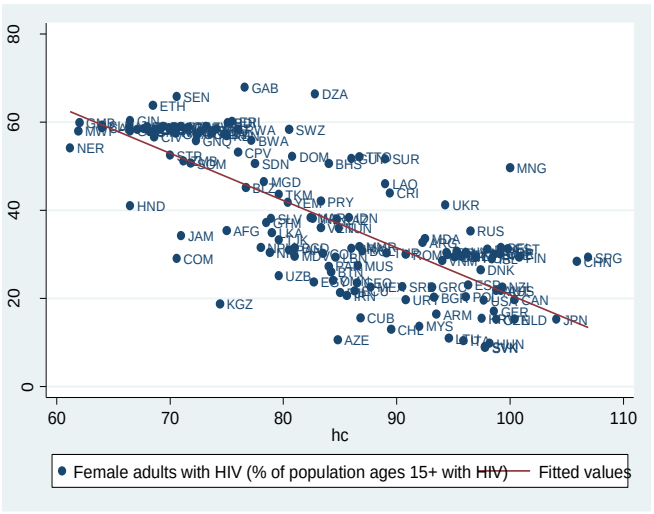
Africa	170	0.32	0.47	0	1

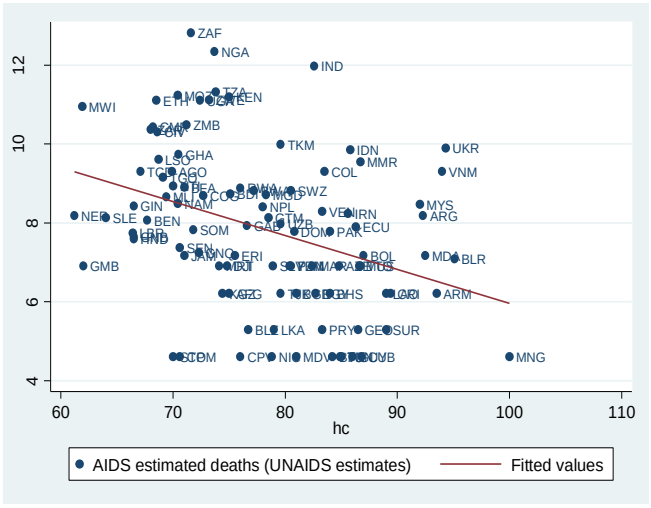
Obs: Observations. Std. Dev: Standard Deviation. Min: Minimum. Max: Maximum.

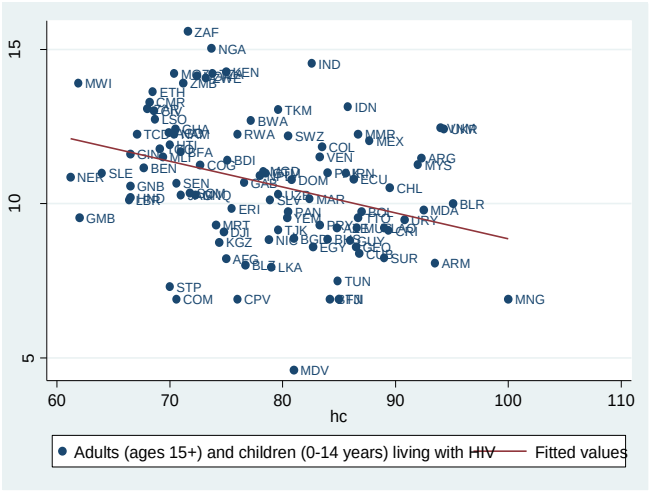
2.2 Preliminary Analysis

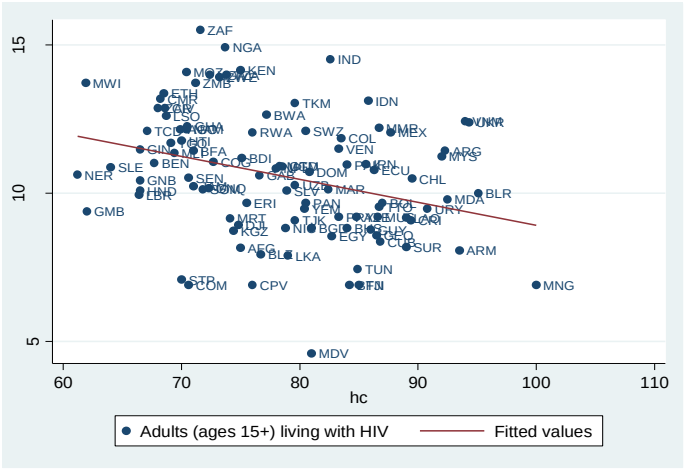
Figure 1 presents the scatter plot between HIV/AIDS (y-axis) and human capital (x-axis) for the countries included in our sample. The evidence clearly suggests a negative relationship between these two variables. The same conclusion is obtained when analyzing the relationship between each of the four measures of AIDS. The estimated coefficient of β from each of the simple linear regression models or OLS model is negative and strongly significant = -1.073 (at 1%) when the dependent variable is 'Women's share of population ages 15+ living with HIV (%)'; β = -0.085 (at 1%) when the dependent variable is 'AIDS estimated deaths (log)'; β= -0.083 (at 1%) when the dependent variable is 'Adults (ages 15+) and children (0-14 years) living with HIV (log)' ; β= -0.077 (at 1%) when the dependent variable is 'Adults (ages 15+) living with HIV (log)'. In each of the simple regression models, Human capital explains more than one-third of the variations in four indexes of AIDS: 57.7% of the variations in 'Women's share of population ages 15+ living with HIV (%)', 13.1% of the variations in 'AIDS estimated deaths (log)', 11.5% of the variations in 'Adults (ages 15+) and children (0-14 years) living with HIV (log) 'and 10.1% of the variations in 'Adults (ages 15+) living with HIV (log)'.

Figure 1. HIV/AIDS and Human capital









Considering that HIV/AIDS is a function of many different factors, these correlation figures must not be taken seriously unless further examination of the partial correlation of these other variables with HIV/AIDS on the one hand, and with human capital on the other hand, are undertaken. This is the objective of Tables 2-4.

2.3 Methodology

In accordance with recent human capital literature (Ang & Kumar, 2014; Kodila-Tedika & Asongu, 2015), the specification in Eq. (1) investigates the correlation between human capital and HIV/AIDS prevalence.

$$HIV/AIDS_i = \alpha_1 + \alpha_2 HC_i + \alpha_3 C_i + \varepsilon_i \qquad (1)$$

Where: $HIV / AIDS_i$ (HC_i) represents a HIV/AIDS prevalence (Human Capital) indicator for country i, α_1 is a constant, C is the vector of control variables, and ε_i the error term. *HIV/AIDS* includes four measures, namely: 'Adults (ages 15+) living with HIV'; 'Adults (ages 15+) and children (0-14 years) living with HIV'; 'Women's share of population ages 15+ living with HIV (%)' and AIDS estimated deaths. *HC* is the *Human Capital* variable while *C* entails: *Muslim, GDP per capita (log), Government effectiveness* and *Africa*. Consistent with the underlying human capital literature, the interest of Eq. (1) is to estimate if human capital affects 'HIV/AIDS prevalence' by Ordinary Least Squares (OLS) with standard errors that are corrected for heteroscedasticity.

3. Empirical Results

This section presents the empirical results. Baseline OLS findings are presented in Table 2. We then check for robustness by verifying if the established linkages withstand more empirical scrutiny by employing IWLS and 2SLS to control for outliers and have some bite on endogeneity respectively in Table 3 and Table 4. Each of the three tables has four specifications corresponding to the underlying four dependent variables.

The following findings can be established. First, human capital decreases HIV prevalence with the magnitude on 'Women's share of population ages 15+ living with HIV' substantially higher. This implies improving average human capital levels across communities would be more beneficial to girls above the age of 15 living with HIV. In addition, the relatively similar negative magnitudes across the last-three dependent variables implies that, increasing human capital decreases deaths from HIV/AIDS by almost the same rate as it reduces infections to the disease. Moreover, the broadly similar correlations between human capital and the last-two dependent variables implies, the HIV infection rate in children between the ages of 0 and 14 does not significantly change, with human capital improvements. Second, most of the control variables are significant with the expected signs: (1) Muslim-dominant countries have relatively lower levels of HIV/AID prevalence (Yamaguchi, 2012)[3] while being in Africa is positively correlated with prevalence of the disease (Asongu, 2014, p.1244); and (2) population size (like demography in Sub-Saharan

[3] "*The Muslim-majority countries long had been considered to be free of HIV/AIDS epidemic because of their strict religious and moral codes*"(p.3)

Africa) should be positively correlated with the dependent variable (Bariagaber, 2001, p. 168).

Table 2. OLS results

	Women's share of population ages 15+ living with HIV (%)	AIDS estimated deaths (log)	Adults (ages 15+) and children (0-14 years) living with HIV (log)	Adults (ages 15+) living with HIV (log)
Human capital	**-0.528****	**-0.069****	**-0.068***	**-0.066***
	(0.030)	**(0.027)**	**(0.067)**	**(0.076)**
Muslim	**-6.298****	**-1.150***	**-1.337****	**-1.324****
	(0.026)	**(0.050)**	**(0.027)**	**(0.028)**
GDP per capita (log)	-1.491	0.186	0.109	0.141
	(0.507)	(0.552)	(0.733)	(0.656)
Government effectiveness	-0.338	-0.195	-0.002	-0.009
	(0.865)	(0.663)	(0.994)	(0.982)
Population (log)	0.006	**0.021*****	**0.019*****	**0.019*****
	(0.441)	**(0.000)**	**(0.000)**	**(0.000)**
Africa	**14.32*****	**1.665*****	**1.527****	**1.485****
	(0.000)	**(0.003)**	**(0.010)**	**(0.012)**
Constant	**92.18*****	**11.04*****	**14.818*****	**14.272*****
	(0.000)	**(0.001)**	**(0.000)**	**(0.000)**
Adj. R^2	0.718	0.439	0.418	0.402
Observations	102	63	66	66

Notes: P value in brackets (). *,**, ***: significance levels of 10%, 5% and 1% respectively. GDP: Gross Domestic Product. Log: logarithm. OLS: Ordinary Least Squares. All regressions are corrected for heteroscedasticity in the White perspective.

Table 3 uses IWLS to control for outliers. The findings in terms of signs and significance are consistent with baseline OLS results. Compared to OLS, this alternative procedure has the advantage of delivering robust estimators because it simultaneously correct for issues arising due to the presence of outliers and/or heteroskedasticity (non-constant error variances).

Table 3. IWLS results

	Women's share of population ages 15+ living with HIV (%)	AIDS estimated deaths (log)	Adults (ages 15+) and children (0-14 years) living with HIV	Adults (ages 15+) living with HIV
Human capital	**-0.614*****	**-0.086****	**-0.087****	**-0.084****
	(0.000)	**(0.013)**	**(0.013)**	**(0.015)**
Muslim	**-6.45*****	**-1.96*****	**-2.14*****	**-2.12*****
	(0.007)	**(0.000)**	**(0.000)**	**(0.000)**
GDP per capita (log)	-0.441	0.208	0.141	0.174
	(0.783)	(0.519)	(0.665)	(0.591)
Government effectiveness	0.220	-0.168	0.141	0.138
	(0.897)	(0.682)	(0.724)	(0.730)
Population (log)	0.013	**0.090*****	**0.092*****	**0.092*****
	(0.275)	**(0.000)**	**(0.000)**	**(0.000)**
Africa	**16.11*****	**1.82*****	**1.72*****	**1.683*****
	(0.000)	**(0.001)**	**(0.001)**	**(0.002)**
Constant	**88.83*****	**11.80*****	**15.62*****	**15.07*****
	(0.000)	**(0.001)**	**(0.000)**	**(0.000)**
Observations	102	62	65	65

Notes: P value in brackets (). *,**, ***: significance levels of 10%, 5% and 1% respectively. GDP: Gross Domestic Product. Log: logarithm. IWLS: Iteratively Weighted Least Squares.

The 2SLS findings in Table 4 are also consistent with baseline OLS and IWLS findings in the preceding two tables. We employ proteins and fat per capita daily macronutrients instruments for the period 2005-2007 (FAO Statistics Division, 2010) and Historic IQ (Lynn, 2012). The advantage of employing 2SLS is to have some bite on endogeneity by controlling for simultaneity. This instrumentation process is consistent with Kalonda-Kanyama and Kodila-Tedika (2012).

Table 4. TSLS results

	Women's share of population ages 15+ living with HIV (%)	AIDS estimated deaths (log)	Adults (ages 15+) and children (0-14 years) living with HIV	Adults (ages 15+) living with HIV
Human capital	-0.174	**-0.158*** **	**-0.162*** **	**-0.158*** **
	(0.588)	**(0.008)**	**(0.004)**	**(0.005)**
Muslim	**-6.48** **	**-1.083***	**-1.305**	**-1.296**
	(0.011)	**(0.070)**	**(0.029)**	**(0.031)**
GDP per capita (log)	-3.124	0.540	0.554	0.577
	(0.140)	(0.186)	(0.141)	(0.124)
Government effectiveness	-0.422	0.175	0.364	0.361
	(0.823)	(0.738)	(0.391)	(0.394)
Population (log)	0.002	**0.020**	**0.019*** **	**0.019*** **
	(0.860)	**(0.000)**	**(0.000)**	**(0.000)**
Africa	**20.142*** **	0.921	0.800	0.761
	(0.000)	(0.270)	(0.341)	(0.365)
Constant	**74.20*** **	**15.69*** **	**19.12*** **	**18.58*** **
	(0.001)	**(0.001)**	**(0.000)**	**(0.000)**
Adj. R^2	0.770	0.378	0.380	0.363
Sargan test (p-value)	0.400	0.202	0.248	0.239
Hausmann test(p-value)	0.420	0.232	0.279	0.270
Observations	89	53	56	56

Notes: P value in brackets (). *,**, ***: significance levels of 10%, 5% and 1% respectively. GDP: Gross Domestic Product. Log: logarithm. TSLS: Two Stage Least Squares. All regressions are corrected for heteroscedasticity in the White perspective. We employ proteins and fat per capital daily macronutrients instruments for the period 2005-2007 (FAO Statistics Division, 2010) and Historic IQ (Lynn, 2012).

4. Concluding implications and future directions

This study has complemented existing literature on the relationship between HIV/AIDS and human capital by introducing previously unexploited indicators as well as more robust empirical strategies. Its overarching purpose has to assess whether previous findings on the relationship withstand empirical scrutiny when alternative indicators and methodologies are employed. Four main HIV/AIDS measurements are used and the empirical evidence is based OLS, IWLS, and 2SLS. The following findings have been established. First, human capital decreases HIV prevalence with the magnitude on 'Women's share of population ages 15+ living with HIV' substantially higher. This implies improving average

human capital levels across communities would be more beneficial to girls above the age of 15 living with HIV. The relatively similar negative magnitudes across other dependent variables implies that increasing human capital decreases deaths from HIV/AIDS by almost the same rate as it reduces infections to the diseases. Moreover, the HIV infection rate in children between the ages of 0 and 14 does not significantly change with human capital improvements.

Infection rates in children between the ages of 0 to 14 are not significantly affected for at least a twofold reason: they are relatively less sexually active and also have access to less sexual education on the underlying health issues. On the other hand, the fact that HIV infection rates would significantly reduce in females above the age of 15 implies that educating girls should be a priority in HIV/AID prevention policies. Consistent with Kodila-Tedika and Asongu (2015), such programmes may include, inter alia: (i) educating the young below the ages of 14 so that they should be aware of the HIV/AIDS prevention mechanisms before they become sexually active; (ii) putting-in place counsels for scholarly orientation of girls; (iii) implementing measures that would end impunity from aggression towards girls as well as sexual violence; (iv) providing civics education in primary and secondary schools in order to reinforce personal image, so that girls can condemn and openly reject sexual molestation and violence and (v) promoting female health clubs and reinforcing medical counsel and treatment is schools girls.

We have provided a fresh exploration of the relationship between human capital and HIV/AIDS, in which we have: (i) confirmed on the one hand that previous findings on the nexus withstand empirical scrutiny and (ii) on the other hand, extended to established nexus from a simple measurement of HIV infection rates to four dependent variables that have improved a scholarly perspective on dynamics of the underlying relationship. Future lines of inquiry, devoted to extending what we know about the underlying nexus could focus on country-specific cases for more focused policy implications.

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