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The Impact of Software Piracy on Inclusive Human Development: Evidence from Africa

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Abstract

The study examines the effect of software piracy on inclusive human development in 11 African countries for which software piracy data is available for the period 2000-2010. The empirical evidence is based on instrumental variable panel Fixed Effects (FE) and Tobit models in order to control for the unobserved heterogeneity and limited range in the dependent variable. The modeling exercise is based on the inequality adjusted human development (IHDI) and its constituents. The following main findings are established. First, from the FE regressions, software piracy consistently improves the IHDI and its constituents. Within this framework, the positive relationship between inclusive human development and software piracy is driven by all its constituents. Second, for Tobit regressions, the positive relationship between software piracy and inclusive human development is confirmed exclusively in the IHDI and literacy specifications. Within the latter framework, the positive relationship between software piracy and inclusive human is driven fundamentally by the literacy rate. Policy implications are discussed.

JEL Classification: K42; O34; O38; O47; O57
Keywords: Software piracy; Human development; Intellectual property rights; Panel data, Instrumental variables.

1. Introduction

In recent years, there has been a wide consensus on the key role that Intellectual Property Rights (IPRs) protection play on promoting innovation processes and economic growth. Recent technological advancements have not only resulted in an increased availability of information and technology related products but also in the proliferation of technology used to copy or pirate such goods (Andrés & Asongu, 2013a). Thus, efforts are being placed on increasing and harmonizing the standards and enforcement of IPRs protection worldwide (Asongu, 2013a). Since the concern of solidifying IPRs and curtailing the proliferation of pirated goods is particularly pronounced in developing countries, the concern over how this will affect economic growth has been widely debated.

While some scholars postulate that increased protection of IPRs stimulates economic growth and development via the positive impact on factor productivity (see for example, Gould & Gruben, 1996; Falvey et al., 2006; Ramello, 2005), some skeptics are of the stance that IPRs protection and adherence to international treaties (laws) may impede, rather than encourage economic growth in developing countries (Ramello, 2011; Nicita & Ramello, 2007)[1]. A great chunk of the opposition to stronger IPRs asserts that because the existing technology in developing countries is more imitative and/or adaptive in nature (rather than suitable for creation of new innovations) developing countries will be greatly hampered by such changes in policy (Asongu, 2014a, p. 527). Moreover, it is disputed that weaker IPRs are necessary (at least on a temporal basis) for developing countries to obtain knowledge spillovers essential for growth and development (Asongu, 2014a, p. 527).

In light of the current debate, there is growing importance in the impact of IPRs protection on technological advancements, promotion of innovation and economic development. Still, whereas the theoretical literature has attempted to tackle this concern, little scholarly attention has been paid to the empirical literature. Accordingly, the bulk of empirical studies have examined the socio-economic determinants of piracy in several copyright industries (Andrés, 2006a; Banerjee et al., 2005; Bezmen & Depken, 2006; Goel & Nelson, 2009; Peitz & Waelbroeck, 2006).

[1] "*The article agrees with the enounced thesis and tries to provide an explanation of it that relates to the fact that in specific circumstances property-rights can produce distinct market failures that affect the social cost and can consequently prevent attainment of social welfare*" (Ramello, 2011, p. 123). Even religious institutions with the supreme mission of spreading the Gospel have resorted to copyright for intellectual rents (Carla & Ramello, 2011). "*While property rules reduce transaction costs in the standard case of bilateral monopoly over the exchange of information goods, they might increase transaction costs*" (Nicita & Ramello, 2007, p. 767). This evolution may be in part be traceable to the phenomenon of 'causal economic thinking', highlighted by Fleury & Marciano (2013).

Recent studies on software piracy can be classified into four main strands, inter alia: nexuses with some factors, its determinants, surveys and others. First, the relationship between software piracy and the following have been investigated: socio-economic development (Banerjee, 2005); influences on software piracy (Bezmen & Depken, 2006); technological output (Charoensukmongkol & Elkassabgi, 2011); inequality (Asongu, 2014a; Andrés, 2016b); shadow economy (Goel & Nelson, 2012); taxation (Gomes et al., 2014a); intellectual rights protection (Hamister & Braunscheidel, 2013; Asongu, 2015a); scientific publications (Asongu, 2014b); implications for users and software companies (Jamil & Zaki, 2011); economic wealth and natural culture (Moores, 2008; 2010); Kuznets curves either through per GDP (El Harbi et al., 2011) or extended to other determinants of industrialisation (Panas & Ninni, 2011); trade liberalisation and corruption (Robertson et al., 2008); per capita Gross National Income (Reinig & Plice, 2011) and the decision to adopt a video game console (Goode & Kartas, 2012).

Second, the determinants of software piracy in: the Far East countries (Chen et al., 2010); worldwide (Gomes et al., 2013); European countries (Sonmez et al., 2010) as well as corrective measures (Theng et al., 2010). Third, surveys of: theoretical and empirical literature (Gomes et al., 2014b) and literature around the world (Kariithi, 2011). Fourth, a strand on varying other investigations: major trends in software piracy over the past decade (Yang et al., 2013); comparative studies between Asian and Non-Asian industrialised economies (Ding & Liu, 2009) and the use of new methods like neuro-computational models to assess if they outperform statistical techniques of a traditional dimension (Mostafa, 2011).

In light of the above, there is scanty empirical literature on the effect of software on software piracy on economic growth (Asongu, 2013a, 2015a; Andrés & Asongu, 2013ab; Bezmen and Depken, 2004; Goel and Andrés, 2012). Moreover, research on the influence of software piracy on an expanded conception of socioeconomic progress such as human development is clearly missing. Hence, the aim of this paper is to contribute to existing literature on software piracy by assessing the effect of software piracy on human development and its constituents at the macro level. As far as we know, the rate of piracy can be seen more generally to proxy for piracy of other goods (books, sound recording, and motion pictures). In the process, we also examine which components of the inequality adjusted human development (IHDI) later in the investigated relationship.

The remainder of the paper is organized as follows. Section 2 provides existing theory and empirical evidence. Data and methodology are discussed and outlined respectively in Section 3. The empirical analysis is covered in Section 4. Section 5 concludes.

2. Theory and empirical evidence

2.1 Piracy and development

In line with Bezmen & Depken (2004), there are two main avenues along which IP and the strength of IPRs regimes are thought to influence the level of economic growth and development. The first captures the extent to which IPRs influence the creation of new knowledge and information within individual nations, as well as the diffusion of existing knowledge across countries. The second is the indirect effect of a nation's IPR regime on international transactions[2] that provide factors imperative to the growth process.

2.1.1 Creation and dissemination of information

IPRs protection could be traced to the foundation of endogenous theories of economic growth in which investment in research and development (R&D) results in profit (returns) to individual investors and also increases society's stock of knowledge. By lowering the cost of future innovation, the accumulation of knowledge fosters economic growth (Romer, 1990; Grossman & Helpman, 1991). Fundamentally, the wisdom of tighter and more restrictive IPRs is premised on the notion that protection of IPRs serves as a stimulus to growth by encouraging innovations and inventions. It is only natural that individuals engage in innovative activities in response to expected payments for their efforts. As claimed by Bezmen & Depken (2004) from Baumol (1993), "*this expectation is the primary motivation for entrepreneurial activity, increasing total factor productivity, and culminating in increased levels of output*" (p. 5).

Patent holdings and R& D expenditures are more concentrated in the industrialized world and enforcement costs are positively associated with the tightening of IPRs. Hence stronger IPRs may increase gains (in the form of royalties) to developed countries (and the creators of technological advancements) at the expense of developing countries. In the same line of argumentation, some authors argue that net consumers of technological innovation have an incentive to enforce IPRs only when the innovation they consume differs from the type of innovation they supply to foreign markets (Diwan & Rodrick, 1991). It follows that the effectiveness of IPRs may be greatly dependent on the country's present stage of development. Strict IPRs regimes may restrict diffusion of knowledge and technological

[2] For example international trade flows, technology transfers and foreign direct investment.

development in ‘technology followers’ while at the same time stimulating innovation in ‘technology leaders’ (Bezmen & Depken, 2004).

Traditionally, industrialized nations have depended fairly heavily on the protection offered by IPRs. In contrast, less developed countries have often preferred rapid dissemination of knowledge at the cost of protecting the IPRs of foreigners. Recently, many newly industrialized countries have pushed for stronger IPRs through bilateral, multilateral and regional arrangements. This difference in approach might be attributed to the desire of developing countries to specialize in labor intensive production of agricultural industries. These industries until very recently have largely been supported by public expenditures on research and technology and have greatly benefited from shared knowledge spillovers. One application of this argument gaining widespread attention is the access to and affordability of life-saving drugs, especially with regard to the treatment of HIV/AIDS in developing countries. Immense pressure is being placed on pharmaceutical companies to ‘loosen’ their patent rights in order to allow poor countries the opportunity of better managing the AIDS pandemic.

2.1.2 International effects

Borrowing from Bezmen & Depken (2004), IPRs may also affect a nation’s growth and development process through their influence on a nation’s ability to engage in international transactions (e.g. trade, FDI flows and technology transfers). The potential growth rewards resulting from increased participation in international trade are well understood. It is generally accepted for instance that international trade can be an important stimulus to economic prosperity because access to world markets could spur greater utilization of idle human capital resources (Todaro & Smith, 2003). The endogenous growth theories argue that openness facilitates transmission of technology by providing contact with foreign counterparts and, directs domestic resources towards more research intensive sectors and increases market size knowledge (see Rivera Batiz & Romer, 1991). Nevertheless, these models do not necessarily predict that openness leads to economic growth for all countries and all circumstances. The theoretical prediction depends on country specific conditions. A stronger IPRs regime may also prove to be a crucial factor in attracting inflows of FDI and technological transfers. More so, individual (investors and firms) perceptions regarding the strength of a nation’s IPRs regime positively affects such nations’ receipts of FDI and the willingness of foreigners to transfer newer technologies (Lee & Mansfield, 1996). Smith (2001) also finds a positive correlation between the sales of US affiliates and the strength of

intellectual property rights protection in a host country. Moreover some authors have argued that a weak system of IPRs protection deters FDI in high technology sectors where IPRs play a key role (Smarzynska, 2004). It has also been established that stronger IPRs have a positive incidence on a nation's level of exports (Maskus & Penubarti, 1995; Smarzynska, 2004) and increases the likelihood of investment undertaken by multinational enterprises (Mansfield, 1994; Seyoum, 1996). One the other hand, stronger IPRs protection could also reduce the need for FDI (Yang & Maskus, 2001).

Like in the arguments in favor of lowered IPRs in certain pharmaceutical cases, access to productive computer software might have significant public good effects (Bezmen & Depken, 2004). As recently shown by Asongu (2014a, p. 526), software piracy could be good for the poor by mitigating inequality; hence positively contributing to inequality adjusted human development. Whether a piracy-instrumented[3] impact on the IHDI and its constituents could yield similar trends remains an empirical question this paper seeks to address.

2.2 Linkages between software piracy and inclusive development

In this section, we first discuss linkages between inclusive human development and software piracy before narrowing down the perspective to specific components of the inequality adjusted human development index, namely: income, literacy and life expectancy.

Asongu (2014a) has concluded that software piracy is good for the poor because it is associated with a positive income redistributive effect. According to the author, this linkage is fairly simple to understand because of the high cost of computer software in developing countries. Accordingly, a substantial bulk of the population within the low income category does not usually have the financial means to purchase original software. Therefore, counterfeiting, unauthorized downloading and illegal copying become more feasible options to possessing software. It follows that by using cheap software from pirated origins, money can be saved that would be subsequently used for other purposes. Hence, indulging in pirated products indirectly increases the purchasing power of the population in the low income strata. This narrative is also in accordance with Moores and Esichaikul (2011) who have found that economic wealth is negatively linked to software piracy, given that higher software piracy levels are more apparent in countries with lower economic wealth.

On the connection between literacy and software piracy, Asongu (2014b) has recently concluded that software piracy increases scientific publications. The author has recommended

[3] Using IPR laws (treaties) as instrumental variables.

less stringent property right regimes on software piracy (at least in the short run) in order to increase contribution to knowledge from low income countries. The positive nexus between software piracy and literacy builds on the intuition that more availability of usable computers by means of pirated software increases the diffusion of knowledge in society. This increased diffusion could be the result of the connection between the computers and other means of information and technology like mobile phones, the internet, *inter alia*.

The high cost of software has often been cited as the main factor motivating the use of pirated software. Hence, there is also a fundamental ethical dimension in the linkage between piracy and inclusive human development. Accordingly, citizens in poor nations are more likely to engage in piracy because they do not have the money to buy the 'correct thing'. This narrative is consistent with the equity theory by Glass and Wood (1996) and empirical evidence from Douglas et al. (2007) which contend that individuals are less likely to use software of pirated origin if they view such usage to be unfair.

In the light of the above, it is reasonable to postulate that a state of income deprivation could induce fairness in the use of pirated software (Glass & Wood, 1996). Within this framework, constructs of equity used by Douglas et al. (2007) are traceable to concepts of pro-poor growth and income-inequality. Therefore, the saved income can be used to increase average income and other positive externalities associated with 'increased income' like living standards and life expectancy.

3. Data and Methodology

3.1 Data

3.1.1 Measuring piracy

Consistent with previous empirical studies (Asongu (2015a) among others from SIIA (2000), software piracy is defined as *"the unauthorized copying of computer software which constitutes copyright infringement for either commercial or personal use*" (p.12). Due to software piracy potentially taking place in many avenues – e.g., organized copiers, piracy by individuals and commercial or business piracy– obtaining an accurate measure of the prevalence of software piracy remains a challenge. There are many types of piracy. According to the Business Software Alliance (BSA), we can distinguish among: 1) end user copying; 2) downloading; and 3) counterfeiting. The level of piracy is computed as the difference in demand for new software applications (estimated from PC shipments) and the legal supply of software. In our paper, the measure of piracy employed is the percentage of software

(primarily business software) in a country that is illegally installed (without a license) annually and is taken to capture the level of software piracy. This variable is reported in percentages, ranging from zero % (no piracy) to 100 % (i.e., all software installed is pirated). Piracy rates are obtained from the Business Software Alliance, (BSA), (2007), (refer to Business Software Alliance (2009) for measurement details).[4] BSA is an industry group; nevertheless its data on software piracy, is the best cross-country measure currently available, though subject to some inherent upward bias.[5] The data on software piracy may be seen more broadly as proxying for the extent of digital piracy. The mean level of piracy rate in the sample was 60.5 percent, with the minimum piracy rate of 21 percent and a maximum piracy rate of 94.3 percent.

Borrowing from recent African development literature (Asongu, 2013b), the paper uses the HDI (adjusted for inequality) as a proxy for human development. In a bid to obtain more robust results and capture specific human development channels of piracy, the IHDI is decomposed into its constituents of literacy; life expectancy and per capita economic prosperity. Therefore four endogenous variables will be used in the analysis. These indicators are from the World Bank Development (WBD) Indicators. It should be noted that while the IHDI was first published in 2010; the algorithm for its calculation has been used to adjust historical data up to the year 1970.

The human development index shows the national average of achievements in three principal areas: health and long life, knowledge and decent standards of living. The inequality adjusted human development index does not only control for the average level of achievements with respect to health, education and income, but it also accounts for the manner in which the distribution of these achievements are realized among the population by computing the average value with regard to its inequality level.

Control variables are obtained from recent inclusive human development literature, namely: (i) GDP per capita growth, private domestic credit, foreign direct investment (FDI) and remittances (from Asongu & Nwachukwu, 2016a) and (ii) mobile phones, government expenditure, trade openness and secondary school enrolment (Asongu et al., 2015). To these variables we add foreign aid, health expenditure and political stability in order to further control for 'variable omission bias' in specific components of the human development index.

[4] The BSA data primarily measures the piracy of commercial software. We are unaware of any publicly available cross-national data on end-user software piracy. See Png (2010) for a discussion about the reliability of piracy data. Also see Traphagan & Griffith (1998).

[5] Among the many researchers that have used this data are Andrés (2006a), Banerjee et al. (2005), Goel & Nelson (2009) and Marron & Steel (2000).

GDP per capita growth, health expenditure and secondary school enrolments are used in the distinct specifications of the IHDI, life expectancy and literacy. For the most part, we anticipate positive nexuses between selected covariates and inclusive human development as in recent inclusive growth literature (Anand et al., 2012; Mishra et al., 2011; Seneviratne & Sun, 2013; Mlachila et al., 2014). Accordingly, credit facilities, FDI, trade and health expenditure are required for social spending that improve human development (see Mlachila et al., 2014) and remittances which have been documented to be used substantially for consumption purposes (see Mlachila et al., 2014; Ssozi & Asongu, 2015) are very likely to enhance human development. It is also important to note that some of the covariates (e.g. foreign aid and health expenditure) can also negatively affect the inclusive outcomes because their allocation may be associated with corruption and mismanagement. Whereas Asongu (2014c) has recently shown that foreign aid is perilous to inclusive human development, Asongu and Nwachukwu (2016b) have clarified the findings by establishing that the effect could both be positive and negative, contingent on specifications and types of aid.

Due to constraints in data availability, the data include a panel of annual observations from 11 African countries for the years 2000-2010. The sample is limited because the software piracy data is only available for this number of countries on annual basis. Details about the variable definitions and data sources (Appendix 1), summary statistics with presentation of countries (Appendix 2) and correlation analysis showing the basic correlations between key variables used in this paper (Appendix 3) are presented in the appendices. From the summary statistics, it is apparent that the variables are comparable. Moreover the substantial degree of variation from corresponding standard deviations is an indication that reasonable estimated relationships should be anticipated. The purpose of the correlation matrix is to control for concerns in multicollinearity. From a preliminary assessment, such issues are apparent between political stability, government effectiveness and trade openness. Hence, we do not employ all three variables in the same specification.

3.2 Methodology

While piracy could be exogenous to human development, the reverse effect cannot be ruled-out, as human development engenders more respect for IPRs. As sustained by Bezmen & Depken (2004), studies investigating the piracy-development nexus are subject to potential endogeneity problems, because it is likely that a nation's level of development is a crucial factor in its choice of or adherence to a particular IPR regime. This confirms an earlier study by Ginarte & Park (1997) who found strong evidence that the level of economic development

explains the strength of patent protection provided by individual countries. We are therefore confronted here with an issue of endogeneity owing to reverse-causality since the piracy indicators are correlated with the error term in the equation of interest. Beside the reverse-causality, the human development indicator (adjusted for inequality) is subject to omitted variables that also cause endogeneity. The HDI consists of three components: life expectancy, income and literacy. However we know from reality that human development is a multidimensional and complex phenomenon, with quantitative and qualitative aspects. To tackle this endogeneity concern, we instrument the independent variable of interest (or software piracy) with their first lags.

In accordance with recent inclusive human development literature (Asongu & Nwachukwu, 2016a) we adopt fixed effects (FE) and Tobit regressions in order to respectively control for the unobserved heterogeneity and limited range in the dependent variables. Therefore, instrumental variable (IV) FE and Tobit estimations are used. Contrary to the underlying study that has also employed the Generalized Method of Moments (GMM) to control for persistence in inclusive human development, we cannot employ the GMM because T(11)=N(11). It is important to note that a basic requirement for the application of GMM is T<N.

Software piracy is instrumented in Eq. (1).

$$SP_{i,t} = \alpha + \delta_j\left(SP_{i,t-1}\right) + \varepsilon_{i,t} \qquad (1)$$

Where: $SP_{i,t}$, is the software piracy indicator of country i at period t, while $SP_{i,t-1}$ denotes software piracy indicator of country i at period $t-1$, , α is a constant, $\varepsilon_{i,t}$ the error term.

The panel FE model is presented as follows in Eq. (2)

$$IHD_{i,t} = \partial_0 + \partial_1 IVSP_{i,t} + \sum_{h=1}^{9} \omega_h W_{h,i,t-\tau} + \eta_i + \varepsilon_{i,t} \qquad (2)$$

Where: $IHD_{i,t}$ is inclusive human development of country i at period t; ∂ is a constant; $IVSP$, instrumented software piracy; W is the vector of control variables (*domestic credit, mobile phones, political stability, GDP per capita growth, remittances, foreign investment, secondary school enrolment, foreign aid* and *health expenditure*); η_i is the country-specific effect and $\varepsilon_{i,t}$ the error term.

Given that the range of the IHDI is theoretically between 0 and 1 (0.374 to 0.748), Ordinary Least Squares (OLS) may be inappropriate. Tobit models have been employed in the literature in order to control for such limited range in the dependent variable (Kumbhakar & Lovell, 2000; Koetter et al., 2008; Coccorese & Pellecchia, 2010; Ariss, 2010). Consistent

with McDonald (2009) and Coccorese and Pellecchia (2010), if there are no observations of either 0 or 1 for the IHDI (which is the case here), estimating by a double-censored Tobit model is the same as estimating by a linear regressions model since the two likelihood functions coincide. Therefore, the logistic regression associated with the Tobit model is as follows:

$$IHD_{it} = \frac{\exp\left(x_{it}^{'}\beta\right)}{1+\exp\left(x_{it}^{'}\beta\right)} + \phi_{it} \qquad (3)$$

where x_{it} is the same vector of regressors used in the Tobit model, β is the vector of parameters and ϕ_{it} is independently and identically distributed (iid) with mean zero and variance $\sigma_{\phi}{}^{2}$ variance.

The standard Tobit model (Tobin, 1958; Carsun & Sun, 2007) is as follows:

$$y_{i,t}^{*} = \alpha_0 + \beta X_{i,t} + \varepsilon_{i,t} \quad (4)$$

where $y_{i,t}^{*}$ is a latent response variable, $X_{i,t}$ is an observed $1\times k$ vector of explanatory variables and $\varepsilon_{i,t} \approx$ i.i.d. N(0, σ2) and is independent variable of $X_{i,t}$. Instead of observing $y_{i,t}^{*}$, we observe $y_{i,t}$:

$$y_{i,t} = \begin{cases} y_{i,t,}^{*} \, if \; y_{i,t}^{*} > \gamma \\ 0, \; if \; y_{i,t}^{*} \le \gamma, \end{cases} \qquad (5)$$

where γ is a non stochastic constant. In other words, the value of $y_{i,t}^{*}$ is missing when it is less than or equal to γ.

4. Empirical analysis

4.1 Presentation of results

Table 1 presents IV FE for inclusive human development and its components. Two main specifications are used for each dependent variable: the first with limited conditioning information set and the second with a broader conditioning information set. Moreover, some covariates in the conditioning information set are tailored to specific dependent variables. For example, GDP per capita growth is used for the IHDI, health expenditure for life expectancy and secondary school enrolment for literacy.

The following can be established. First, software piracy consistently improves the IHDI and its constituents. It follows that the positive relationship between inclusive human development and software piracy is driven by all its constituents. Second, with the exception of political stability, most of the significant control variables have expected signs. As recently

shown by Asongu and Nwachukwu (2016c) in the prediction of the Arab Spring, the political stability variable is negatively skewed in African countries. Hence, a negatively-skewed oriented political stability variable can have a negative effect on inclusive human development.

Table 1: Instrumental Variable Panel Fixed Effects

	Inclusive development		**Income (log)**		**Life Expectancy (log)**		**Literacy rate (log)**	
	IHDI	IHDI	GDPp	GDPp	LifeExp.	LifeExp.	Literacy	Literacy
Constant	**1.014*** **	**1.014*** **	**3.475*** **	**3.469*** **	**1.748*** **	**1.754*** **	**1.758*** **	**1.637*** **
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Piracy IV	**0.002*** **	**0.001*** **	**0.004** **	**0.003***	**0.002*** **	**0.002*** **	**0.004** **	-0.001
	(0.001)	**(0.006)**	**(0.028)**	**(0.050)**	**(0.002)**	**(0.0003)**	**(0.016)**	(0.588)
Domestic credit	0.0001	**0.0001***	0.0004	**0.0004***	-0.0001	**-0.0001***	**0.001*** **	0.0003
	(0.255)	**(0.060)**	(0.138)	**(0.083)**	(0.249)	**(0.091)**	**(0.000)**	(0.167)
Mobile phones	**0.0004*** **	**0.0004*** **	**0.001*** **	**0.0009*** **	**0.0002*** **	**0.0002*** **	0.00008	-0.0001
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	(0.339)	(0.120)
Political Stability	-0.002	-0.0006	-0.016	**-0.021***	-0.006	**-0.014*** **	-0.016	0.003
	(0.608)	(0.889)	(0.183)	**(0.079)**	(0.193)	**(0.002)**	(0.151)	(0.743)
GDPpcg	---	**0.0009*** **	---	---	---	---	---	---
		(0.002)						
Remittances	---	**0.001*** **	---	**0.002** **	---	**0.0008** **	---	**0.003*** **
		(0.002)		**(0.018)**		**(0.033)**		**(0.001)**
Foreign Investment	---	0.000	---	**0.002** **	---	---	---	---
		(0.978)		**(0.046)**				
Education (SSE)	---	---	---	---	---	---	---	**0.002*** **
								(0.000)
Foreign Aid	---	---	---	**-0.001***	---	**-0.001*** **	---	**-0.001***
				(0.062)		**(0.000)**		**(0.099)**
Health Expenditure	---	---	---	---	---	-0.0008	---	---
						(0.443)		
Adjusted R^2(within)	0.849	0.884	0.729	0.780	0.473	0.614	0.404	0.692
Fisher	**106.99*** **	**78.51*** **	**56.72*** **	**40.54*** **	**16.40*** **	**15.72*** **	**12.89*** **	**15.45*** **
Countries	11	11	11	11	11	11	10	9
Observations	91	90	99	98	88	87	90	64

*, **, ***: significance levels of 10%, 5% and 1% respectively. GDPpcg: Gross Domestic Product Per Capital Growth Rata. LifeExp: Life Expectancy. Literacy: Adult literacy rate. GDPpc: Gross Domestic Product per capita. SSE: Secondary School Enrolment. G: Government. IV: Instrumental Variable.

In Table 2 on IV Tobit regressions, the positive relationship between software piracy and inclusive human development is confirmed exclusively in IHDI and literacy regressions. The negative effect of software piracy on GDP per capita is not consistent across specifications while that on life expectancy is consistent across specifications. It follows from the findings that the positive relationship between software piracy and inclusive human is driven fundamentally by the literacy rate. Most of the significant control variables display expected signs. The negative relationship between health expenditure and life expectancy may be traceable to corruption and mismanagement of such health expenditure.

Table 2: Instrumental Variable Panel Tobit Model

	Inclusive development		**Income (log)**		**Life Expectancy (log)**		**Literacy rate (log)**	
	IHDI	IHDI	GDPp	GDPp	LifeExp.	LifeExp.	Literacy	Literacy
Constant	**-3.058***	**-3.539***	**3.467*****	**3.764*****	**1.767*****	**1.940*****	**1.781*****	**1.731*****
	(0.066)	**(0.080)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Piracy IV	0.548	**0.700***	**-0.044****	-0.018	**-0.015****	**-0.007***	0.003	**0.012****
	(0.149)	**(0.071)**	**(0.049)**	(0.258)	**(0.015)**	**(0.092)**	(0.614)	**(0.013)**
Domestic credit	**0.118*****	**0.144*****	0.001	0.00009	-0.0003	0.0001	**0.0006****	0.0003
	(0.000)	**(0.000)**	(0.247)	(0.901)	(0.285)	(0.469)	**(0.038)**	(0.141)
Mobile phones	**-0.038****	**-0.042****	**0.005*****	**0.002*****	**0.001*****	**0.0009*****	0.0005	-0.0001
	(0.036)	**(0.015)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	(0.137)	(0.680)
Political Stability	-0.207	-1.004	**0.123*****	**0.169*****	-0.015	**0.015****	**0.038*****	0.011
	(0.693)	(0.101)	**(0.000)**	**(0.000)**	(0.107)	**(0.035)**	**(0.000)**	(0.145)
GDPpcg	---	-0.137	---	---	---	---	---	---
		(0.518)						
Remittances	---	**-0.328****	---	**-0.011****	---	**0.004*****	---	**-0.010*****
		(0.011)		**(0.032)**		**(0.002)**		**(0.000)**
Foreign Investment	---	0.181	---	0.002	---	---	---	---
		(0.341)		(0.737)				
Education (SSE)	---	---	---	---	---	---	---	**0.001*****
								(0.000)
Foreign Aid	---	---	---	**-0.051*****	---	**-0.006*****	---	**-0.005****
				(0.000)		**(0.000)**		**(0.048)**
Health Expenditure	---	---	---	---	---	**-0.032*****	---	---
						(0.000)		
LR Chi-Square	**23.81*****	**31.02*****	**72.97*****	**148.81******	**19.19*****	**88.28*****	**33.38*****	**107.48*****
Pseudo R^2	0.044	0.058	0.843	1.759	-0.100	-0.461	-0.211	-1.061
Log Likelihood	-256.104	-250.011	-6.780	32.110	105.324	139.794	95.506	104.3772
Observations	91	90	99	98	88	87	90	64

*, **, ***: significance levels of 10%, 5% and 1% respectively. *, **, ***: significance levels of 10%, 5% and 1% respectively. GDPpcg: Gross Domestic Product Per Capital Growth Rata. LifeExp: Life Expectancy. Literacy: Adult literacy rate. GDPpc: Gross Domestic Product per capita. SSE: Secondary School Enrolment. G: Government. IV: Instrumental Variable.

4.2.2 Further discussion of results and policy implications

We discuss the: (i) positive relationship between software piracy and inclusive development; (ii) fact that the established relationship could be driven for the most part by the literacy rate and (iii) conflicting findings on the role of piracy on life expectancy.

First, the positive nexus between software piracy and inclusive human development is consistent with Asongu (2014a) who has established software piracy to be good for the poor. Software piracy may be inclusive because of the high cost of computer software. Hence, the population within the lower income echelons of society may not afford to purchase original packages of software. Therefore, resorting to counterfeiting, unauthorized downloading and illegal copying could be the feasible alternative to saving income for other expenses in basic needs, health and education. A direct result of such savings is an increase in purchasing power. This interpretation accords with Moores and Esichaikul, (2011, pp. 1-2) who have established that there is a negative nexus between economic wealth and software piracy, such that countries with higher income are comparatively less linked to software piracy. It is therefore not surprising that the same authors have documented that the high cost of software

motivates resort to software piracy. When the assumption is translated from a macroeconomic perspective to a microeconomic view, it becomes apparent that the poor stand to benefit more from software piracy because when compared with the rich, the corresponding saved-income is comparatively higher relative to their total household income.

Considering the African-specific context of the inquiry, it is important to elicit the cultural dimension of the relationship. In essence, culture can play a fundamental role in the established relationship because software piracy tend to be more prevalent in collectivist societies (Moores & Esichaikul, 2011, p. 2) and such collectivism is more likely to be apparent among the poor compared to among the rich. Therefore, it is only natural that software piracy engenders higher inclusiveness in human development. In the light of these narratives, our findings are in line with the substantial bulk of literature that has focused on examining the determining factors behind software piracy. This includes literature that is consistent with the position that lower rates of software piracy are associated with greater individualism (see Rushing & Thompson, 1996, 1999; Gould & Gruben, 1996; Maskus & Penubarti, 1995;Park & Ginarte, 1997; Marron & Steel, 2000; Husted, 2000; Depken & Simmons, 2004; Kim, 2004; Kranenburg & Hogenbirk, 2003).

Within a broader framework of the literature, our results contribute to the debate on levels of intellectual property rights (IPRs) protection. Notably, it is consistent with the stream of literature documenting that very stringent IPRs could limit growth and inclusive development prospects in poor countries (Yang & Maskus, 2001), thus counteracting the strand of literature with the position that higher levels of IPRs protection stimulates factor productivity and development (Falvey et al., 2006; Gould & Gruben, 1996). Our findings conform to the first school in the perspective that, less stringent IPRs are essential (at least in the short-term) for poor countries in order to enable spillovers in knowledge that are essential for economic growth and inclusive development. Hence, the results reconcile both schools on the view that less stringent IPRs regimes are imperative at least in the short-run in less developed countries in order to boost knowledge spillovers. Conversely, as inclusiveness increases and sampled countries begin to experience higher levels in the IHDI, the adoption of more stringent IPR regimes would increase the probability of investment from multinationals (Seyoum, 1996; Mansfield, 1994); facilitate exports (Maskus & Penubarti, 1995) and ease technological transfers (Lee & Mansfield, 1996).

The fact that the positive relationship between software piracy and inclusive human development could be driven by the literacy rate is broadly in accordance with Asongu (2014b) who has concluded that software piracy boosts scientific publications in Africa.

Among components of the IHDI, the role of literacy as the principal driving factor fundamentally builds on the fact the software is intrinsically linked to other instruments of knowledge diffusion like mobile phones, personal computers and internet penetration. This is consistent with the bulk of literature on the positive role of information and communication technologies in the diffusion of knowledge for economic wellbeing and inclusive development (Ureta, 2008; Smith & Seward, 2009; Sen, 2010; Asongu, 2015b; Kwan & Chiu, 2015).

Third, the conflicting nature of the effect of software piracy on life expectancy to some extend aptly translates the debate on the role of IPRs on health and pharmaceutical products. A case in point is the debate on HIV/AIDS drugs which is a fundamental cause of mortality in the sampled countries. In essence, the high cost of these drugs is motivating some proponents to advocate for less tight IPRs and so that 'permission' should be granted to enable 'copying' the life-saving pharmaceuticals; especially those used in the management of HIV/AIDS in developing countries most affected and least likely to afford such treatments. The thesis of these proponents is premised on the reality that existing technology in African countries is more imitative and adaptive in nature, rather than suitable for creation of new innovations.

5. Conclusion and further research directions

The study examines the effect of software piracy on inclusive human development in 11 African countries for which software piracy data is available for the period 2000-2010. The empirical evidence is based on instrumental variable panel Fixed Effects (FE) and Tobit models in order to control for the unobserved heterogeneity and limited range in the dependent variable. The modeling exercise is based on the inequality adjusted human development (IHDI) and its constituents. The following main findings are established. First, from the FE regressions, software piracy consistently improves the IHDI and its constituents. Within this framework, the positive relationship between inclusive human development and software piracy is driven by all its constituents. Second, for Tobit regressions, the positive relationship between software piracy and inclusive human development is confirmed exclusively in IHDI and literacy specifications. Within the latter framework, the positive relationship between software piracy and inclusive human is driven fundamentally by the literacy rate. Policy implications have been discussed.

It is also important to acknowledge that ethical concerns may surround the established relationship, notably: (i) the seller of software that is pirated could think that he/she has the right to continue doing his/her business because the company incurs more expenses in taking

the matter to court; (ii) users of pirated software could also think it is fair to use pirated software because they are poor and cannot afford the high cost of purchasing the 'correct thing'; (iii) illegal copying could derive from interpersonal trust because those who either share or copy software with others have some degree of trust that such software is not contaminated with viruses and (iv) individuals that engage in the distribution of pirated software must also trust that persons to whom they are distributed are unlikely to report to the police.

Future inquiries can improve extant literature by assessing the established linkages throughout the conditional distribution of inclusive human development. This is essentially because the established relationships may differ across countries with low, intermediate and high initial levels of inclusive human development.

Appendices

Appendix 1: Definitions of variables

Variables	Signs	Definitions of variables	Sources
Human Development	IHDI	Inequality adjusted Human Development Index	World Bank(WDI)
GDP per capita	GDPpc	Log of GDPpc, PPP(International constant dollar 2005)	World Bank(WDI)
Life Expectancy	LifeExp	Log of Life Expectancy at birth(Total years)	World Bank(WDI)
Literacy Rate	Literacy	Log Adult literacy rate(annual % of population aged 15+)	World Bank(WDI)
Piracy	Piracy	Piracy rate (annual %)	BSA
Piracy (IV)	PiracyIV	Instrumented Piracy rate	Authors' calculation
Mobile phone	Mobile	Mobile phone subscriptions (per 100 people)	
Political Stability	PolS	"Political stability/no violence (estimate): measured as the perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional and violent means, including domestic violence and terrorism".	World Bank(WGI)
Government Effectiveness	Gov.E	"Government effectiveness (estimate): measures the quality of public services, the quality and degree of independence from political pressures of the civil service, the quality of policy formulation and implementation, and the credibility of governments' commitments to such policies"	World Bank(WGI)
GDP per capita growth	GDPpcg	GDP per capita growth (% of annual)	
	Pcrbof	Private credit by deposit banks and other financial institutions (% of GDP)	FDSD
Remittances	Remit	Remittance inflows (% of GDP)	World Bank(WDI)
Foreign Investment	FDI	Foreign Direct Investment Inflows (% of GDP)	World Bank(WDI)
Education	SSE	Secondary School Enrolment (% of Gross)	World Bank(WDI)
Foreign Aid	Aid	Total Net Official Development Assistance (% of GDP)	World Bank(WDI)
Trade Openness	Trade	Imports plus Exports of Commodities (% of GDP)	World Bank(WDI)
Health Expenses	HealthExp	Health Expenditure (% of GDP)	World Bank(WDI)

WDI: World Bank Development Indicators. FDSD: Financial Development and Structure Database. BSA: Business Software Alliance. GDP: Gross Domestic Product. Log: Logarithm. PPP: Purchasing Power Parity. WGI: World Governance Indicators.

Appendix 2: Summary statistics and presentation of countries

Panel A: Summary Statistics

		Mean	S.D	Min	Max	Obser.
Dependent Variables	Human Development	0.547	0.113	0.376	0.748	113
	GDP per capita (log)	3.543	0.362	3.012	4.106	121
	Life Expectancy (log)	1.758	0.076	1.622	1.862	110
	Literacy ratio (log)	1.826	0.097	1.572	1.956	110
Independent & Control Variables	Piracy	2.745	1.857	0.000	5.250	121
	Piracy IV	2.932	1.522	0.749	4.989	110
	Private domestic credit	38.221	36.917	0.010	149.775	121
	Mobile phone penetration	34.649	30.437	0.024	117.761	121
	Political stability	-0.382	0.840	-2.084	1.069	110
	Government effectiveness	-0.164	0.583	-1.038	0.804	100
	GDP per capita growth	2.452	2.189	-5.069	7.967	121
	Remittances	3.286	3.482	0.006	13.042	118
	Foreign Direct Investment inflows	2.851	2.685	-1.156	12.013	121
	Secondary School Enrolment	59.980	24.320	16.468	95.699	90
	Foreign-aid	3.572	4.844	-0.251	24.424	121
	Trade	70.038	19.711	39.017	134.522	120
	Health Expenditure	5.561	1.437	3.489	10.251	110

Panel B: Presentation of Countries

Algeria, Botswana, Cameroon, Egypt, Kenya, Mauritius, Morocco, Nigeria, Senegal, South Africa, Zambia

S.D: Standard Deviation. Min: Minimum. Max: Maximum. Obser: Observations.

Appendix 3: Correlation Matrix

Dependent variables				Independent variables		Control variables											
IHDI	GDPp	LifeExp.	Literacy	Piracy	PiracyIV	Pcrbof	Mobile	PolS	Gov.E	GDPpcg	Remit	FDI	SSE	Aid	Trade	HealthExp	
1.000	0.106	-0.152	0.161	-0.219	-0.173	0.484	-0.043	-0.020	0.168	-0.006	-0.149	-0.095	0.168	-0.104	-0.084	0.358	IHDI
	1.000	0.158	0.816	-0.198	-0.168	0.278	0.448	0.543	0.741	0.272	-0.599	0.424	0.899	-0.677	0.614	0.261	GDPp
		1.000	-0.054	-0.490	-0.353	0.535	0.256	-0.245	-0.017	0.229	0.270	-0.466	0.367	-0.372	0.332	-0.543	LifeExp.
			1.000	-0.035	-0.079	0.169	0.289	0.429	0.460	0.088	-0.868	0.230	0.784	-0.640	0.447	0.179	Literacy
				1.000	0.749	-0.679	-0.094	-0.147	-0.335	-0.144	-0.116	0.055	-0.264	0.287	-0.342	0.139	Piracy
					1.000	-0.475	0.138	-0.0008	-0.201	-0.314	0.005	-0.020	-0.211	0.251	-0.142	0.232	PiracyIV
						1.000	0.352	0.272	0.454	0.181	0.101	-0.228	0.370	-0.349	0.456	0.031	Pcrbof
							1.000	0.389	0.429	-0.075	-0.145	0.253	0.405	-0.254	0.543	0.300	Mobile
								1.000	**0.880**	0.026	-0.242	0.488	0.261	-0.078	**0.695**	0.432	PolS
									1.000	0.201	-0.229	0.493	0.513	-0.248	**0.747**	0.442	Gov.E
										1.000	0.026	0.249	0.209	-0.311	0.179	-0.314	GDPpcg
											1.000	-0.210	-0.576	0.437	-0.191	-0.184	Remit
												1.000	0.197	-0.108	0.130	0.531	FDI
													1.000	-0.728	0.467	0.163	SSE
														1.000	-0.271	0.068	Aid
															1.000	-0.064	Trade
																1.000	HealthExp

IHDI : Inequality adjusted Human Development Index. GDPp: GDP per capita. LifeExp: Life Expectancy. Literacy: Literacy Rate. Piracy: Piracy rate. PiracyIV: Instrumented Piracy rate. Pcrbof: Private Domestic credit. Mobile: Mobile phone penetration. PolS: Political Stability. Gov.E: Government Effectiveness. GDPpcg: GDP per capita growth. Remit: Remittances. FDI: Foreign Direct Investment. SSE: Secondary School Enrolment. Aid: Foreign Aid. Trade: Trade Openness. HealthExp: Health Expenditure.

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