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Fighting Software Piracy: Which IPRs Laws Matter in Africa?

Simplice A. Asongu[a]

Abstract: *The proliferation of technology to produce pirated software has prompted key questions in policy decision making on how to tackle the situation. The paper will employ Dynamic panel Generalized Methods of Moments and Two Stage Least Squares to address this. IPRs (Intellectual Property Rights) laws are instrumented with government quality dynamics to assess their incidence on software piracy. In essence, government quality variables are used as instrumental variables in investigating the role of IPRs laws on software piracy. The following findings are established. (1) Government institutions are crucial in enforcing IPRs laws in the fight against software piracy. (2) Main IP laws enacted by the legislature and Multilateral IP laws are most effective in combating piracy. (3) IPRs laws, WIPO Treaties and Bilateral Treaties do not have significant negative incidences on software piracy. Policy implications are discussed.*

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1. Introduction

It has become a truism that any country, region or continent to advance in the global economy, it must be competitive. Competition derives from Intellectual Property Rights (IPRs) which protect intellectual capital. There has been a wide consensus on the key role IPRs protection play in promoting innovation processes and economic development. Technological progress has not only brought about an increased availability of information and technology-related products, but also the proliferations of technology used to copy or pirate such commodities. Thus, efforts are being made to harmonies the standards of IPRs protection worldwide. This harmonisation is particularly important in developing countries since the proliferation of pirated goods is more pronounced in low-income countries (Moores and Esichaikul, 2011: 2).

[a] Corresponding Author. African Governance and Development Institute, Yaoundé, Cameroon. *Email*: asongusimplice@yahoo.com

The debate that has centred on IPRs protection has been animated by two schools of thought. While some scholars postulate that increased protection of IPRs stimulate economic growth and development through a favourable impact on factor productivity (Gould and Gruben, 1996; Falvey *et al.,* 2006), some sceptics are of the position that IPRs protection and adherence to international treaties (laws) may seriously inhibit the growth prospects of developing countries (Yang and Maskus, 2001). This second school of thought believes that less stringent IPRs regimes are necessary (at least in the short-term) for developing countries; knowledge spillovers crucial for growth and development will assist the latter countries. Thus, the existing technology in developing countries is more imitative and/or adaptive in nature and not suitable for the creation of new innovations[1].

In light of the above debate, there is growing interest in the impact of IPRs protection on innovation, technological advancements and economic development. Though literature has focused on these concerns to some extent, little scholarly attention has been devoted to empirical research. The bulk of empirical studies have concentrated on the socio-economic determinants of piracy in several copyright industries (Bezmen and Depken, 2004; Banerjee *et al.,* 2005; Andrés, 2006; Bezmen and Depken, 2006; Peitz and Waelbroeck, 2006; Goel and Nelson, 2009; Andrés and Goel, 2012). However, with enhanced efforts on harmonising the standards of IPRs protection worldwide, policy makers should be eager to know which IPRs regimes are most effective especially in developing countries where the scourge of piracy is most acute[2].

While regions such as South America and Asia are responding with calculated steps that underscore the importance of IPRs in the current pursuit of national, regional and international initiatives, Africa appears to be lagging behind. In the current efforts towards harmonising IPRs laws (treaties), policy makers in the continent are most likely to ask the following questions. (1) Which IPRs treaties (laws) are effective in fighting software piracy? (2) Are government institutions really effective in upholding and enforcing IPRs treaties (laws)? (3) If so, which are the IPRs laws (treaties) that government institutions should uphold and enforce to achieve results? (4) How are government through IPRs laws (treaties) institutions instrumental in the fight against piracy? The object of this study is to provide answers to the above questions.

The first and second sections of the paper examine existing literature on IPRs. Methodology and data are discussed in Section 3. While Section 4 covers the empirical analysis and corresponding discussion, Section 5 summarises the main points and concludes the paper.

2. Literature Review

2.1 Institutional Quality, Software Piracy and IPRs Protection in Africa

International development experts agree that development requires above all, good governance (Kaliannan *et al.,* 2010; Rasiah, 2011; Katz and Iizuka, 2011). While the issue of institutional quality has been widely documented in literature on development (Asongu, 2011; Asongu, 2012, 2013ab), how it plays out in the fight against piracy (by upholding IPRs against software piracy) has received little or no scholarly attention. In fact, software piracy has reached an epidemic threshold in Africa (Hamade, 2006; El-Bialy, 2010). According to the Business Software Alliance Global Software Piracy Study (BSA, 2010)[3], software piracy in Africa is double the global rate. According to the report, the commercial value of unlicensed software installed on personal computers (PCs) in Eastern and Southern Africa (ESA), which excludes South Africa, was US$109 million in 2010 as 83% of the software was pirated. This is 3.6 points higher than the previous five-year average, and stands at almost double the global piracy rate for PC software (that is 42%). It is also double the global rate of piracy which is 42%. In effect, the role of governance and formal institutions have been substantially documented as a means of effectively tackling this disturbing trend (IDC, 2009; El-Bialy, 2010; Blakeney and Mengistie, 2011; Fripp, 2011; AFROL, 2012; Agabi, 2012). The discussion in this section will focus on two strands. The first examines software piracy in selected African countries in the dataset while the second focuses on institutional measures to combat the growing problem.

In Africa, software piracy is a huge problem especially in Egypt, Kenya and Nigeria. It is reported that software developers are losing millions of naira annually to software thefts which has adversely affected the Nigerian economy (Agabi, 2012). Agabi agrees with business experts that the problem of illegal software in the country is a serious one and finding a solution is likely to become even more urgent with the usage rate expected to increase over the coming years. The Kenya Copyright Board is currently increasing its efforts in the battle against software piracy. According to Fripp (2011), aggressive measures were taken to battle software piracy in order to increase investment potential and the Board revealed there have been ongoing raids on suspected resellers of counterfeit software to reduce the Information and Communication Technology (ICT) sector's losses (the latter is losing thousands of new jobs and millions of dollars as a result of piracy). The Executive Director of the Board said the nation has resolved to uphold (and strengthen) Kenya's IPRs laws/ treaties/regimes by firmly dealing with those engaged in software piracy[4]. A study by the International Data Corporation (IDC) on Global Software Piracy

indicates that Egypt is making substantial efforts to tackle the issue of piracy through improved collaboration with the USA on enforcement of IPRs cases (AFROL, 2012). The report added that Egypt was fully committed to further reduce its piracy rating and tackling the challenges facing the industry head-on with a number of measures - among others, IPRs training for the Egyptian legal community and promotion of the copyright law (to improve awareness of IPRs and its role in sustaining economic growth and attracting foreign direct investment (FDI)).

The second strand analyses the role of institutions in IPRs protection and reduction of software piracy. Firstly, with regard to IPRs protection, the World Trade Organisation (WTO) can be considered among the different multilateral organizations that emphasizes on the importance of legal reforms in African countries. These organisations impose minimum requirement standards that should be fulfilled by each member country in order to protect IPRs. However, a down side to this approach is that it promotes one size-fits-all institutions. Therefore, they seem to neglect (or ignore) alternative institutional arrangements that could be used to reach efficient outcomes for the conflicting parties (El-Bialy, 2010) and how institutions matter in upholding IPRs (as the paper seeks to address). Accordingly, El-Bialy asserts that the phenomenon of inefficient IPRs institutions is more likely to be significant in developing countries. This is because they may need "appropriate" IPRs enforcement strategies and, their institutions differ considerably from those that prevail in wealthier countries. For example, Rodrik (2008) has qualified them as 'second-best institutions' and described the institutional reforms promoted by multilateral organisations (the World Bank (WB), International Monetary Fund (IMF) or WTO) as being heavily skewed towards a best-practice approach.

Secondly (with regard to the role of institutions in software piracy), during the end of the 20th century, the world began tilting towards new IPR strategies, with much emphasis on the need for cooperative policies to reduce software piracy. Governments, together with software companies (the International Intellectual Property Alliance (IIPA) and the BSA), began a more vigorous approach to tackle piracy in Africa. The BSA started publishing an annual study (after the year 2000) to assess a detailed and diverse picture of global software piracy in order to analyse country- and regional-specific piracy trends (El-Bialy, 2010). It began to look for alternative ways of tackling piracy. In addition to conducting huge awareness campaigns among the public, the BSA and African governments signed MOUs to provide price cut-offs for original software products. Some satisfactory results were observed[5]. Over the past few years however, reforming "IPR enforcement organs" in developing countries has attracted much attention. Accordingly, the efficiency of the enforcement

authorities or the process of factual (de facto) enforcement is now acknowledged as an important orientation of modern IPRs policies (El-Bialy, 2010).

2.2 Intellectual Property Rights (IPRs) and Development

According to Bezmen and Depken (2004), there are two principal ways along which intellectual property (IP) and the strength of IPRs regimes are thought to affect the level of economic growth and development. In other words, IP and IPRs affect economic growth and development through two main mechanisms. The discussion focuses on two issues. First is an analysis of the extent to which IPRs influence the creation of new knowledge and information within nations, as well as the diffusion of existing knowledge across countries is made. Secondly, it will examine the indirect effects of a nation's IPRs regime on international transactions and trade and thus indirectly affecting growth.

On "creation and dissemination of information", IPRs protection could be traced to the foundation of endogenous theories of economic growth whereby investment in research and development (R&D) rewards individual investors with profit (returns) and also augment society's knowledge. Lowering the cost of future innovation improves the accumulation of knowledge for economic growth (Romer, 1990; Grossman and Helpman, 1991). The underlying wisdom of tighter and restrictive IPRs regimes is based on the notion that protection of IPRs serves as a stimulus to growth by encouraging inventions and innovations. Recently, many newly industrialised countries have campaigned for stronger IPRs via bilateral, multilateral and regional arrangements. This difference in approach could be traced to the desire of developing countries to specialise in labour intensive production in agricultural industries. Until much recently, these industries have largely been supported by public expenditures on research and technology and have greatly benefited from shared knowledge.

The IPRs may also influence a nation's growth and development process via their influence on the country's ability to engage in international transactions such as trade, Foreign Direct Investment (FDI) flows and technology transfers (Bezmen and Depken, 2004). The endogenous growth theories have presented international trade as an important stimulus to economic prosperity, since access to world markets could stimulate greater utilisation of human resources (Todaro and Smith, 2003), and ease the transmission of technology by providing contact with foreign counterparts and direction of domestic resources toward more research-intensive sectors. Nevertheless, these models do not necessarily predict that openness leads to economic growth for all countries and under all circumstances principally because theoretical prediction is contingent on country-specific conditions. It has been widely documented that a stronger IPRs regime is a crucial factor in attracting FDI and technological transfers (Lee and Mansfield, 1996), stimulate exports (Maskus and Penubarti, 1995) and

increasing investment by multinational enterprises (Mansfield, 1994; Seyoum, 1996). On the other hand, stronger IPRs protection may reduce the need for FDI (Yang and Maskus, 2001).

2.3 The Politics of Piracy and Intellectual Property Rights (IPRs) Protection

According to Shadlen et al. (2003), two important types or main areas of IPRs are copyrights and patents. Copyright protects form of expression (e.g. written material and artistic works), whereas patents protect underlying ideas used for industrial products or processes. Computer software is protected under an ordinary copyright law, though in recent years software developers (particularly in the USA) have also been granted patent protection. When the government fails to enforce copyrights and patents, the processes of artistic creation and invention may take on a character of public goods and hence, subject to traditional collective action. IPRs are designed to solve a 'collective action concern' by offering inventors and authors temporary monopolies or in the jargon of public choice theory, selective incentives, to pursue their vocations. Ultimately, patents and copyrights should be rewarding to producers of IP. However, a very strong IPRs regime maybe unappealing to consumers who are likely to pay exorbitant prices on protected commodities.

Managing the trade-offs between consumers and producers is particularly complex. IPRs are different from normal property rights as they are not tangible goods. Most importantly, an unlimited number of people can exploit the same idea simultaneously and repeated use does not deplete (diminish) the stock of the idea. Owing to these distinct characteristics, many of the standard rationales for giving property owners extensive rights to control the use of their commodities become irrelevant. Without proper motivations to producers, ideas, just like tangible goods, run the risk of being undersupplied. However, it is not necessary for example to endow owners with rights to control distribution and restrict use to prevent depletion of commodities that by their definition are non-excludable. Restricting use could freeze ideas and stifle innovation. Indeed, a substantial body of the literature warns of the dangers of over protecting IPRs (Yang and Maskus, 2001). For instance, stronger IPRs may stifle incentives to innovate and introduce new technologies (Helpman, 1993; Bessen and Maskin, 2000; Maskus, 2000; Shadlen *et al.,* 2003). As mentioned by Shadlen et al. (2003), over protection can result in the tragedy of the commons being substituted with the tragedy of the anti-commons (Heller and Eisenberg, 1998), since diminished access to upstream ideas can stifle downstream innovation. Hence, the challenge is to manage IPRs in such a way to create incentives for provision without deterring distribution.

IPRs have been historically curtailed to strike the delicate balance between provision and distribution. For example, private rights over ideas are not automatically conferred upon possession. Nor are rights indefinite - copyrights and patents expire, after which what is private property enters into the public domain. Private property rights are also limited in the view of being subject to a range of automatic exceptions. That is, third parties also have rights to use ideas and commodities protected by IPRs. In the case of copyrights, these rights fall under the doctrine of fair use which permits third parties to exploit copyrighted material regardless of the intent of the copyright owner. Before the 1980s, most governments throughout the world had porous and weak copyright protection precisely to motivate diffusion and use (Lessig, 2001, p. 249). IPRs protection systems introduced in 1980s offer fundamental avenues to overcome the limitations that traditionally distinguished the treatment of intellectual property with tangible property (May, 2000; Shadlen *et al.,* 2003). In addition to making copyrights easier to obtain by simplifying the process of registration, the current arrangement enables copyright owners to have significantly greater control and exclusion rights, implying third parties' rights to *fair use* have been significantly reduced (Shadlen *et al.,* 2003:9). This represents a substantial challenge for government to enforce international treaties (laws) on IPRs protection in a bid to curb the growing problem of piracy.

Shadlen et al. (2003) further postulated that by granting extensive periods of protection to patents and copyrights, IPRs are made effectively permanent. By the time most operating systems or applications fall into the public domain, it is unlikely that any machine on earth will be able to use them (Lessig, 2001, p. 252). The measures include introduction of software under copyright law, significantly greater scope of protection for copyright owners and longer protection periods. At the national level (besides the extraordinary trade-off between innovation and diminished diffusion of new commodities), a concern arises on how to enforce IPRs and fight piracy. This paper examines which IPRs treaties (laws) are crucial for the battle against piracy in Africa.

2.4 Scope

With recent developments in Information and Communication Technologies (ICTs), there has been mounting concern over software piracy which has gained scholarly attention. International organisations are currently advocating global convergence in IPRs as a prerequisite for successful innovation strategies. The difficulties of achieving such harmonisation are however evident from the attempts of several nations to develop divergent IPRs systems. Standard-setting is increasingly important in tackling software piracy as a means of reducing transaction cost. Standards also have a particularly important role of ensuring compatibility and interconnectivity of products and services.

Literature has examined the socio economic determinants of software piracy that drive this phenomenon. It has been concluded that nations with higher income and greater individualism have lower piracy rates (Maskus and Penubarti, 1995; Gould and Gruben, 1996; Rushing and Thompson, 1996, 1999; Park and Ginarte, 1997; Husted, 2000; Marron and Steel, 2000; Kranenberg and Hogenbirk, 2003; Kim, 2004; Depken and Simmons, 2004). Empirical studies have also concentrated on the socio-economic determinants of piracy rates in several copyright industries (Andrés, 2006; Banerjee *et al.,* 2005; Bezmen and Depken, 2006; Peitz and Waelbroeck, 2006; Goel and Nelson, 2009; Andrés and Goel, 2012). The focus of the above studies has been largely on developed countries and the emerging economies of Latin America and East Asia. This article examines software piracy in the African continent drawing lessons from the success of the "East Asian Miracle"[6].

Europe and North America have mastered the dynamics of IP which is inexorably driving developments in the global and international arena. Other regions such as Asia and South America are responding with calculated steps that underscore the role of IP in the current pursuit of national, regional and international initiatives. Thus, different nations have varying standards of protection of IPRs. Globalisation, strengthened by several multilateral and regional treaties, has led to creation of international minimum standards for IPRs protection. In Africa, IPRs issues are assuming central stage in discussions on development. In light of the growing role of IPRs in software piracy protection, it is a pressing policy concern today to know which IPRs matters in the fight against software piracy. The empirical section will provide some answers.

3. Methodology and Data

3.1 Methodology

3.1.1 Dynamic Panel Generalized Methods of Moments (GMM)

Estimation with dynamic panel data has some important advantages and disadvantages when compared with cross-country analysis (Demirgüç-Kunt and Levine, 2008). On the first positive note: (1) it makes use of both time-series and the cross sectional variations in the data; (2) in cross-country regressions, the unobserved effect is part of the error term, so that correlation between the error term and the exogenous variables results in biased estimated coefficients. More so, in cross-country regressions, if the lagged dependent variable is included among the explanatory variables, the country-specific effect is certainly correlated with the regressors. A means of controlling for the presence of unobserved country-specific effect is to first-difference the regression equation to eliminate the country-specific effect. And then employ instrumental variables

to control for endogeneity issues. In other words, by taking the first difference of the equation, the country-specific effect is eliminated. The endogeneity issue is the second edge of dynamic panel data analysis. Uncontrolled endogeneity can lead to bias estimates and misleading inferences. Dynamic panel data analysis takes care of this endogeneity issue by using lagged values of exogenous variables as instruments.

The principal concern associated with dynamic panel data analysis is using data-averages over shorter time spans. This implies the estimated results reveal short term impacts and not long-term effects, which should be kept in mind when interpreting and discussing results. In the context of the paper, this issue can be overcome by using both "full data" and "data averages".

The dynamic panel regression model is expressed as follows:

$$P_{i,t}=\sigma_0+\sigma_1 P_{i,t-1}+\sigma_2 MIP_{i,t}+\sigma_3 IPR_{i,t}+\sigma_4 WIPO_{i,t}+\sigma_5 Multi_{i,t}+\sigma_6 Bilat_{i,t}+\eta_i+\xi_t+\varepsilon_{i,t} \quad (1)$$

Where 't' stands for the period and 'i' represents a country. P is the piracy rate; *MIP*, Main Intellectual Property law; *IPR*, Intellectual Property Rights law; *WIPO*, World Intellectual Property Organization Treaties; *Multi*, Multilateral Treaties; *Bilat*, Bilateral Treaties, η_i is a country-specific effect, ξ_t is a time-specific constant and $\varepsilon_{i,t}$ an error term.

Estimates will be unbiased if and only if, the IPRs exogenous variables above are strictly exogenous. Unfortunately, this is not the case in the real world because: (1) while they have a substantial incidence on piracy, the reverse effect cannot be ruled out because the level of piracy could also affect the choice of IPRs regimes; (2) the regressors could be correlated with the error term ($\varepsilon_{i,t}$) and; (3) country- and time-specific effects could also be correlated with other variables in the model, which is often the case with lagged dependent variables included in the equations. Hence, an issue of endogeneity due to endogenous regressors. A way of dealing with the problem of the correlation between the individual specific-effect and the lagged endogenous variables involves eliminating the individual effect by first differencing. Thus, Eq. (1) becomes:

$$P_{i,t}-P_{i,t-1}=\sigma_1(P_{i,t-1}-P_{i,t-2})+\sigma_2(MIP_{i,t}-MIP_{i,t-1})+\sigma_3(IPR_{i,t}-IPR_{i,t-1})+\sigma_4(WIPO_{i,t}-WIPO_{i,t-1})$$

$$+\sigma_5(Multi_{i,t}-Multi_{i,t-1})+\sigma_6(Bilat_{i,t}-Bilat_{i,t-1})+(\xi_t-\xi_{t-1})+(\varepsilon_{i,t}-\varepsilon_{i,t-1}) \quad (2)$$

However Eq. (2) presents another issue; estimation by Ordinary Least Squares (OLS) is still biased because there remain a correlation between the lagged endogenous independent variable and the disturbance term. To address this concern, we estimate the regression in differences jointly with the regression in levels using the Generalized Method of Moments (GMM) estimation. The

procedure uses lagged levels of the regressors as instruments in the difference equation, and lagged differences of the regressors as instruments in the levels equation, thus exploiting all the orthogonality conditions between the lagged dependent variables and the error term. Between the difference GMM estimator (Arellano and Bond, 1991) and system GMM estimator (Arellano and Bover, 1995; Blundell and Bond, 1998), we chose the latter in line with Bond et al. (2001:3-4)[7].

In specifying the dynamic panel system estimation, we opt for the two-step GMM because it corrects the residuals for heteroscedasticity. In the first-step, the residuals are considered to be homoscedastic. The assumption of no auto-correlation in the residuals is crucial as past lagged variables are used as instruments for the endogenous variable. Also, the estimation depends on the hypothesis that the lagged values of the dependent variable and other independent variables are valid instruments in the regression. When the error terms of the level equation are not auto-correlated, the first-order auto-correlation of the differenced residuals should be significant while their second-order auto-correlation, *AR(2)* should not be. The validity of the instruments is assessed with the Sargan over-identifying restrictions (OIR) test. In summary, the main arguments for using the system GMM estimation are: it does not eliminate cross-country variation; it mitigates potential biases of the difference estimator in small samples; and it can control for potential endogeneity of all regressors.

3.1.2 Two-stage Least Squares

The paper adopts a Two-Stage Least Squares (2SLS) Instrumental Variable (IV) estimation technique based on recent literature on software piracy (Andrés and Goel, 2012). IV estimation solves the puzzle of endogeneity and hence, avoids the inconsistency of estimated coefficients by OLS when the exogenous variables are correlated with the error term in the main equation. The 2SLS estimation will entail the following steps:

First-stage regression:

$$P_{it} = \gamma_0 + \gamma_{1i}\ (Instruments)_{it} + \upsilon_{it} \qquad (3)$$

Second-stage regression:

$$Piracy_{it} = \lambda_0 + \lambda_1\ (IP)_{it} + \mu_{it} \qquad (4)$$

In the third and fourth equations, υ_{it} and μ_{it} respectively represent the error terms. Instrumental variables are: control of corruption, government

effectiveness, voice & accountability, rule of law, regulation quality and political stability. IP represents: Main Intellectual Property Law, Intellectual Property Rights Law, WIPO Treaties, Multilateral Treaties and Bilateral Treaties. Piracy is the software piracy rate.

We adopt the following steps in the IV analysis: (1) justify the choice of a 2SLS over an OLS estimation technique with the Hausman-test for endogeneity; (2) verify the instruments are exogenous to the endogenous components of the explaining variable (IPRs channels) and; (3) ensure the instruments are valid and not correlated with the error-term in the main equation with an Over-Identifying Restrictions (OIR) test.

3.1.3 Further Robustness Checks

Besides the control for endogeneity, further robustness of the models is ensured by the following: (1) use of "full data" and "average data" with non-overlapping intervals to capture both the long-term and short-run tendencies of estimated coefficients respectively; (2) employment of robust Heteroscedasticity and Autocorrelation Consistent (HAC) standard errors; (3) use of both system and difference GMM estimation, and; (4) employment of both GMM instruments (for dynamic panel regressions) and 2SLS with "government quality" instruments (based on common sense and discretion of the authors).

3.2 Data

3.2.1 Measuring Piracy

Software piracy is defined as "the unauthorized copying of computer software which constitutes copyright infringement for either commercial or personal use" (SIIA, 2000). It is multidimensional and could potentially take many forms and avenues – e.g., organised copiers, piracy by individuals, and commercial or business piracy. Based on the Business Software Alliance (BSA) study, we can distinguish three types of piracy: 1) end user copying; 2) downloading; and 3) counterfeiting. Hence, examining the literature to obtain an accurate measure of the prevalence of software piracy remains a challenge. The piracy level is computed as the difference in demand for new software applications (estimated from PC shipments) and the legal supply of software. The paper measures the level of software piracy as the percentage of software (primarily business software) that is illegally installed (without a license) on an annual basis. This variable is reported in percentages, scaling from 0 % (or no piracy) to 100 % (i.e., all software installed is of pirated origin). Piracy data is gleaned from the Business Software Alliance (BSA, 2007). Additional details on measurement can be obtained from BSA (2009)[8]. Though BSA is an industry

group, its data on software piracy is the best cross-country indicator currently used in the literature, despite having some inherent upward bias[9]. From a broader perspective, the data on software piracy could be seen as a "proxy" measuring the extent of digital piracy. The rate of software piracy is computed as: "logarithm of (piracy/(100-piracy))" to ensure comparability of the variables.

3.2.2 Intellectual Property Rights (IPRs) Variables

IPRs variables are obtained from the World Intellectual Property Organization (WIPO). The five exogenous variables include: Main IP laws, IPRs laws, WIPO Treaties, Multilateral Treaties and Bilateral Treaties. Main IP laws and IPRs laws are IP laws that are enacted by the legislature and enforced by the institutions. WIPO-administered treaties are enforced from the day they enter into an agreement with the contracting party. Relevant Bilateral and Multilateral Treaties are also enforced on the date they are formalised by the contracting parties. The primary purpose of these laws is to uphold IPRs. Hence, they are naturally exogenous to software piracy if properly instrumented with existing enforcement organs (government institutions).

3.2.3 Instrumental Variables

The following section will provide justification for the empirical validity of the instrumental variables. This justification is essential for the relevance of the empirical analysis because a theoretical basis for the instruments is crucial for sound and consistent interpretation of estimated coefficients. In other words, while the object of this paper is to assess the effect of IPRs laws (treaties) on piracy, it also indirectly examines how government institutions are instrumental in the incidence of IPRs laws (treaties) on piracy. The approach in the empirical section requires that the instruments be correlated with the main endogenous regressors. Logic and common sense have it that government institutions and IPRs regime move hand in hand. Save in utopia, we cannot discuss one while ignoring the other. Hence, only formal institutions set up by the governments to enforce IPRs laws (treaties) are relevant. Measures indicating the quality of government institutions include: the rule of law, quality of regulation , corruption-control, government effectiveness, political stability (no violence) and voice & accountability. We argue that these good governance indicators are instruments for the upholding and enforcement of IPRs laws (treaties). Details on the definitions of these variables are provided in Appendix 3. Quality indicators range from -2.5 to 2.5 and the negative values in Appendix 1 confirm the poor state of government institutions in the sampled African countries.

Owing to constraints in data availability (for piracy), the dataset includes annual observations for 11 African countries from 2000-2010. Details about the

variable definitions (with data sources), descriptive statistics (with presentation of countries) and correlation analysis (showing the basic correlations between key variables used in this paper) are reported in the appendices. The summary statistics (Appendix 1) of the variables used in the panel regressions show that there is a degree of variation in the data utilised so that one is confident that reasonable estimated relationships should emerge. The purpose of the correlation matrix (Appendix 2) is to mitigate issues resulting from "overparametisation" and "multicollinearity". Based on the correlation coefficients, there do not appear to be any serious issues in terms of the relationships to be estimated. The countries investigated are shown in Panel B of Appendix 1.

4. Empirical Analysis

4.1 Presentation of Results, Discussion and Policy Implications

This section addresses the four main issues highlighted in the introductory section[10]. While the GMM estimations address only the first issue, the 2SLS estimations assess all four concerns. However, the GMM estimations are necessary (from a comparative standpoint), to enable the 2SLS approach to address the second, third and fourth issues. This is because the validity of the government quality instruments in the 2SLS approach must be compared with other valid instruments.

From the results in Table 1, the difference GMM findings are substantially different from those of the system GMM. Hence, we shall give priority to system GMM estimators for reasons already discussed in the methodology section (Bond *et al.,* 2001). For both types of GMMs, all the null hypotheses of the AR(2) and Sargan-OIR tests for no autocorrelation and validity of instruments respectively are not rejected. For the 2SLS, we perform a Hausman test prior to the IV estimations. The null hypothesis of the test is that OLS estimates are consistent and efficient. Hence, a rejection of the null hypothesis points to the issue of endogeneity and lends credit to the choice of an IV approach and in corollary, justifies the GMM estimations. The null hypotheses of the Sargan-OIR tests are also rejected in all the 2SLS models confirming the validity of the government quality instrumental variables. The absence of a significant initial piracy coefficient (*Pit-1*) in "full data" is not an issue because the two-Year NOI have been used to mitigate short-term disturbances looming in 'full data'[11]. Two years average data with NOI captures only the short-run tendencies. Full data captures the long-term tendencies. Two justifications could be provided to account for this difference: (1) it is standard GMM estimation inference (as discussed in the methodology section) and; (2) it is consistent with recent methodological innovations in the convergence literature (Asongu, 2013c, 2013d, 2013e, 2014a, 2014b). Moreover, when "full data" is converted into

two-year averages, it is a means of mitigating short-term disturbances that may loom substantially large and may bias the estimated coefficients.

Based on the findings, the following could be established. (1) From GMM estimates, IPRs laws (treaties) are effective in reducing the incidences of piracy in the long-term (rather than short-term). Full data findings can be interpreted as long-run effects whereas data averages (two-year non-overlapping intervals) findings are interpreted as short-term effects. (2) On the first question of which IPRs treaties (laws) are effective in fighting software piracy, only Main IP laws and multilateral treaties are found to have a significant effect. (3) On the second concern of assessing if government institutions are instrumental in upholding and enforcing IPRs treaties, the answer is: *yes*, since government institutions are effective by virtue of the Sargan-OIR test. In other words, failure to reject the null hypothesis of the Sargan-OIR test suggests that the government instruments do not control piracy beyond IPRs laws (treaties) channels. Simply put, these IPRs mechanisms are the only channels by which the government policies (related to corruption-control, rule of law, regulation quality, government effectiveness, political stability (no violence), voice & accountability) fight piracy. (4) As regards which IPRs laws (treaties) are instrumental in upholding and enforcing the anti-piracy laws, the results are similar to question 1. This is because there are no additional significant IPRs channels estimates in the 2SLS compared with the GMM. (5) On the question of how government institutions are instrumental, two interpretations are necessary. On the one hand, in short-term (two-year NOI) and long-run (full data), formal institutions increase the efficacy of Main IP laws and Multilateral treaties[12]. On the other hand, in the absence of formal institutions, the efficacy of Main IP law seems to be greater than that of multilateral treaties[13]. (6) The remaining IPRs laws (treaties) overwhelmingly have the right negative signs but are not significant. In other words, WIPO and Bilateral treaties do not have significant negative effects. A possible explanation to these unexpected results could be the fact that these IP treaties do not directly target software piracy because they are either too general (WIPO Treaties) or too specific (Bilateral Treaties). Also, their variations in the summary statistics (in Appendix 1) that are significantly lower than those of other IP law variables could be the source. (7) A higher constant (autonomous) piracy rate in the 2SLS regressions (in comparison with GMM estimations) broadly indicates that other institutional organs need to be taken into account in the fight against piracy.

We have observed that government institutions are instrumental in upholding and enforcing IPRs treaties. There is reason to believe that improving good governance would: (1) reduce the widespread incidences of software piracy on the Nigerian economy and halt the corresponding millions of naira in annual loses to software theft (Agabi, 2012); slow down the Kenyan ICT

sector losses in thousands of new jobs and millions of dollars as well as improve the country's investment potential and climate (Fripp, 2011) and; (3) sustain economic growth and attract FDI in Egypt (AFROL, 2012).

An interesting finding based on GMM estimates shows that IPR laws (treaties) are more effective in reducing piracy in the long-term, not short term. It points to the time advantage of IP laws. This suggests that governments of sampled countries should begin working toward balanced and appropriate IPRs protection at industrial and individual levels if they are to reap the time-specific benefits of IPRs policies. Among others, it will be effective not only for governments to negotiate with one another, but also for interactions of government and organisations to be informed on the opinion of the software industry. The imperative for the inclusions of other organs is justified by the higher autonomous or constant piracy rate in the 2SLS regressions. The authors suggest the following to facilitate this harmonisation process. (1) The establishment of highly transparent international protection rules/regulations and greater efficiency in international rights acquisition among countries to enhance trade relations, foreign investment and technology transfer. (2) Adequate and global protection for patents is imperative for the use of technological innovation geared towards a new society that takes African networks into consideration. (3) Development of an attractive international business environment that respects IPRs, with the global development of a business marketplace (among African countries as well as the rest of the world) that ensures the efficient use of IPRs, licensing contracts subject to "African development oriented regulations" and, fair competition will improve investment and technology transfer to enhance the African economy.

Table 1: GMM and 2SLS Regressions

	Dependent variable: Piracy rate							
	GMM Estimations				Two-Stage Least Squares (2SLS)			
	Full Data		Two Year NOI		Full Data		Two Year NOI	
	Dif. GMM	Sys. GMM	Dif. GMM	Sys. GMM	Not HAC	HAC SE	Not HAC	HAC SE
Constant	0.008	0.791**	0.003	0.432*	1.88***	1.88**	1.971**	1.971*
	(0.529)	(2.505)	(0.089)	(1.701)	(2.871)	(1.982)	(2.093)	(1.883)
Initial Piracy	0.265	0.107	0.324**	0.491**	---	---	---	---
	(0.715)	(0.306)	(1.977)	(2.195)				
Main IP law	-0.035	-0.080***	0.222**	-0.045*	-0.09***	-0.09***	-0.097**	-0.097***
	(-0.745)	(-2.707)	(2.053)	(-1.959)	(-3.280)	(-3.044)	(-2.434)	(-2.694)
IPRs law	-0.0004	0.020	-0.034	0.010	-0.11*	-0.119	-0.124	-0.124
	(-0.011)	(1.453)	(-1.593)	(1.059)	(-1.760)	(-1.125)	(-1.187)	(-1.024)
WIPO Treaties	-0.041	-0.007	0.0004	0.014	-0.08	-0.089	-0.096	-0.096
	(-0.963)	(-0.145)	(0.005)	(0.448)	(-0.548)	(-0.422)	(-0.429)	(-0.429)
Multilat. Treaties	-0.014	-0.022*	-0.015	-0.017*	-0.09***	-0.099*	-0.107**	-0.107*
	(-1.030)	(-1.654)	(-0.570)	(-1.652)	(-3.01)	(-1.761)	(-2.179)	(-1.875)
Bilateral Treaties	-0.063	-0.012	-0.057	0.017	0.293*	0.293	0.313	0.313
	(-0.978)	(-0.200)	(-1.144)	(0.435)	(1.777)	(0.989)	(1.180)	(0.950)
Hausman test	---	---	---	---	235.67***	235.67***	135.79***	135.79***
AR(2)	-0.941	-1.501	1.092	0.834	---	---	---	---
	[0.346]	[0.133]	[0.274]	[0.404]				
Sargan OIR test	6.257	5.576	7.125	4.863	0.880	0.880	0.603	0.603
	[1.000]	[1.000]	[0.624]	[0.978]	[0.348]	[0.348]	[0.437]	[0.437]
Wald (joint) test	5.984	724.01***	50.939***	499.2***	---	---	---	---
Adjusted R^2	---	---	---	---	0.149	0.149	0.078	0.078
Fisher	---	---	---	---	4.561***	3.174**	2.236*	2.947**
Countries	11	11	11	11	11	11	11	11
Observations	84	95	34	45	90	90	50	50
Instruments	51	60	16	20	Constant; CC; GE; RL; RQ; PolS; V&A			

Note : *;**;***: significance levels of 10%, 5% and 1% respectively. Z-statistics in parentheses. [ ]:P-values. Initial piracy: estimated lagged endogenous variable (piracy rate). Dif: Difference. Sys: System. GMM: Generalized Methods of Moments. HAC: Heteroscedasticity and Autocorrelation Consistent. SE: Standard Errors. NOI: Non overlapping intervals. Main IP: Main Intellectual Property. IPRs: Intellectual Property Rights. WIPO: World Intellectual Property Organization. Multilat: Multilateral. OIR: Overidentifying restrictions. CC: Control of Corruption. GE: Government Effectiveness. RL: Rule of Law. RQ: Regulation Quality. PolS: Political Stability. V&A: Voice & Accountability.

4.2 Caveats and Future Research Direction

The caveat is on measuring software piracy from which three points are relevant. (1) "Piracy rate is computed as the difference in demand for new software applications (computed from PC shipments) and the legal supply of software" (Andrés and Asongu, 2013a, 2013b; Asongu, 2014c, 2014d). However, it should be noted that this defines piracy as the drop in demand of software products. Hence, all pirated copies constitute lost sales. (2) It has also been widely documented that those who buy pirated copies do not always have the money to buy the true commodity. Hence, to consider the use of pirated products as diminishing demand for originals is an overstatement. (3) Knowledge of the elasticity of demand for the original product is necessary before adopting this definition. Otherwise, there will be a comparison of pirated commodities that constitute loss in sales with ones that do not. Hence, there is some upward bias in the software piracy estimate.

An interesting future research direction would be to assess why some IPRs laws are not that significant in the battle against software piracy.

5. Conclusion

For any country, region or continent to be actively involved in the global economy, it must be competitive. Competition stems from intellectual property rights (IPRs) which protect intellectual capital. In the current efforts towards harmonising IPRs laws (treaties) in Africa, this paper has answered four key questions policy makers need to know. On the first question of which IPRs treaties (laws) are effective in fighting software piracy, only Main IP laws and multilateral treaties are found to have a significant negative effect. Concerning the second issue of assessing if government institutions are instrumental in upholding and enforcing IPRs treaties, the answer is: yes. As regards to which IPRs laws (treaties) are instrumental to piracy, the answer is similar to the question 1. On the fourth question of how are government institutions instrumental, two interpretations are necessary. On the one hand, in both short-term (two-year non-overlapping intervals) and long-run (full data), formal institutions increase the efficacy of Main IP laws and Multilateral treaties. On the other hand, in the absence of formal institutions, the Main IP laws are more efficacious than multilateral treaties.

Policy implications, caveats and a future research direction have been discussed.

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Notes

1 This school of thought has gained prominence in the debate over if "permission" should be granted to enable "copying" of life-saving pharmaceuticals, especially those used in the management of HIV/AIDS in developing countries and least likely to afford such treatments.

2 Many studies have concluded that nations with higher income and greater individualism have lower piracy rates (Maskus and Penubarti, 1995; Gould and Gruben, 1996; Park and Ginarte, 1997; Rushing and Thompson, 1996, 1999; Husted, 2000; Marron and Steel, 2000; Kranenberg and Hogenbirk, 2003; Kim, 2004; Depken and Simmons, 2004).

3 The BSA evaluates the state of software piracy around the world.

4 "*The Board remains ready and willing to support software copyright owners by intensifying enforcement efforts to reduce software piracy in our country and ensure that legitimate businesses reap the fruits of their labor as per the Kenya Copyright Board mandate*" (Fripp, 2011).

5 For instance, some considerable achievements were noticed as piracy trends started to decline in North Africa.

6 Additional evidence for the possibility that the changing strength of IPRs regimes is based on a nation's level of development or current technological ability could be traced to the rapid growth in Southeast Asia. There are suggestions that the 'East Asian Miracle' may have originated from weaker IPRs regimes at the early stages of their development. These nations' capacities to absorb, replicate and duplicate foreign innovations have contributed to their relatively high economic prosperity rates. Evidence suggests that as these countries became significant producers of new technologies and innovations, the IPRs regimes become stricter. While Nelson and Pack (1999) have postulated that the productive assimilation of existing (foreign) production techniques and technologies "was a critical component in the success of these countries", Maskus (2000) cautions that weaker protection of IPRs may not necessarily be beneficial for developing countries as it may cause them to remain subservient to less efficient and outdated technologies.

7 "*We also demonstrate that more plausible results can be achieved using a system GMM estimator suggested by Arellano* and *Bover (1995) and Blundell* and *Bond (1998). The system estimator exploits an assumption about the initial conditions to obtain moment conditions that remain informative even for persistent series, and it has been shown to perform well in simulations. The necessary restrictions on the initial conditions are potentially consistent with standard growth frameworks, and appear to be both valid and highly informative in our empirical application. Hence we recommend this system GMM estimator for consideration in subsequent empirical growth research*". Bond et al. (2001:3-4).

8 Data from the BSA primarily measures the piracy of commercial software. In-depth discussions on the reliability of piracy data could be obtained from Png (2008) and Traphagan and Griffith (1998).

9 This data has been extensively used in the piracy literature (Marron and Steel, 2000; Banerjee *et al.,* 2005; Andrés, 2006; Goel and Nelson, 2009).

10 Which IPRs treaties (laws) are effective in fighting software piracy? (2) Are government institutions really effective in upholding and enforcing IPRs treaties (laws)? (3) If so, which are the IPRs laws (treaties) that government institutions should uphold and enforce to achieve results?? (4) How are government institutions through IPRs laws (treaties) instrumental in the fight against piracy?

[11] The absence of significant initial piracy coefficients (*Pit-1*) is simply an indication that the process of convergence cannot be fully appreciated with "full data" because short-term disturbances are looming substantially large (See, Islam, 1995, p. 14). This is the reason why the two-year NOI have been used to mitigate such short-term disturbances.

[12] Note should be taken of the fact that government institutions are the instruments in the 2SLS approach.

[13] The efficacy of Main IP laws and Multilateral Treaties is almost equal in the 2SLS approach. However, this is not the case in the GMM.

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Appendixes

Appendix 1: Summary statistics and presentation of countries

Panel A: Summary Statistics						
		Mean	S.D	Min	Max	Obser.
Dependent Variable	Piracy rate	2.745	1.857	0.000	5.250	121
Independent Variables	Main IP law	2.256	2.835	0.000	11.000	121
	IPRs law	1.438	1.944	0.000	7.000	121
	WIPO Treaties	2.735	0.793	2.000	4.000	121
	Multilateral Treaties	9.628	3.304	4.000	17.00	121
	Bilateral Treaties	0.322	0.535	0.000	2.000	121
Instrumental Variables	Control of Corruption	-0.309	0.641	-1.236	1.086	110
	Rule of Law	-0.302	0.687	-1.657	1.053	110
	Regulation Quality	-0.180	0.547	-1.305	0.905	110
	Government Effectiveness	-0.164	0.583	-1.038	0.807	100
	Voice & Accountability	-0.277	0.69	-1.256	1.047	110
	Political Stability (No violence)	-0.393	0.842	-2.094	0.996	110

Panel B: Presentation of Countries
Algeria, Botswana, Cameroon, Egypt, Kenya, Mauritius, Morocco, Nigeria, Senegal, South Africa, Zambia.

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

Appendix 2: Correlation matrix

Piracy rate	IP Independent variables MIPL	IPRL	WIPO	Multi	Bilat	Government Quality Instrumental variables CC	RL	RQ	GE	VA	PolS	
1.000	-0.715	-0.017	0.320	0.026	0.015	-0.432	-0.508	-0.602	-0.609	-0.420	-0.291	Piracy
	1.000	0.103	-0.273	-0.221	-0.071	0.232	0.100	0.293	0.438	0.294	0.014	MIPL
		1.000	0.308	0.443	0.143	0.196	0.121	0.087	0.285	-0.025	0.016	IPRL
			1.000	0.311	-0.052	-0.094	-0.128	-0.094	-0.101	-0.098	-0.222	WIPO
				1.000	0.261	-0.263	-0.069	-0.154	-0.129	-0.201	-0.149	Multi
					1.000	-0.242	-0.145	-0.284	-0.328	-0.612	-0.180	Bilat
						1.000	0.902	0.867	0.942	0.796	0.779	CC
							1.000	0.871	0.886	0.727	0.828	RL
								1.000	0.931	0.846	0.764	RQ
									1.000	0.833	0.712	GE
										1.000	0.722	VA
											1.000	PolS

Notes : MIPL: Main Intellectual Property Rights. IPRL: Intellectual Property Rights Law. WIPO: WIPO Treaties. Multi: Multilateral Treaties. Bilat: Bilateral Treaties. CC: Control of Corruption. RL: Rule of Law. RQ: Regulation Quality. GE: Government Effectiveness. VA: Voice & Accountability. PolS: Political Stability.

Appendix 3: Variable definitions

Variables	Signs	Variable definitions	Sources
Piracy	Piracy	Logarithm Piracy rate (annual %)	BSA
Main IP law	MIPL	Main Intellectual Property Law	WIPO
IPRs law	IPRL	Intellectual Property Rights Law	WIPO
WIPO Treaties	WIPO	World Intellectual Property Organization Treaties	WIPO
Multilateral Treaties	Multi	Multilateral IP Treaties	WIPO
Bilateral Treaties	Bilat	Bilateral IP Treaties	WIPO
Control of Corruption	CC	Control of Corruption (estimate): Captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as 'capture' of the state by elites and private interests.	WDI (World Bank)
Rule of Law	RL	Rule of Law(estimate): Captures perceptions of the extent to which agents have confidence in and abide by the rules of society and in particular the quality of contract enforcement, property rights, the police, the courts, as well as the likelihood of crime and violence.	WDI (World Bank)
Regulation Quality	RQ	Regulation Quality (estimate): Measured as the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.	WDI (World Bank)
Government Effectiveness	GE	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 government commitment to such policies	WDI (World Bank)
Voice & Accountability	VA	Voice and Accountability (estimate): Measures the extent to which a country's citizens are able to participate in selecting their government and to enjoy freedom of expression, freedom of association, and a free media.	WDI (World Bank)

Political Stability	PolS	Political Stability/ No Violence (estimate): Measured as the perceptions of the likelihood that the government will be destabilised or overthrown by unconstitutional and violent means, including domestic violence and terrorism.	WDI (World Bank)

Notes : WDI: World Bank Development Indicators. BSA: Business Software Alliance. Log: Logarithm. WIPO: World Intellectual Property Organization. IP: Intellectual Property.