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Fighting Software Piracy: Which Governance Tools Matter in Africa?

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Abstract This article integrates previously missing components of government quality into the governance-piracy nexus in exploring governance mechanisms by which global obligations for the treatment of IPRs are effectively transmitted from international to the national level in the battle against piracy. It assesses the best governance tools in the fight against piracy and upholding of intellectual property rights (IPRs). The instrumentality of IPR laws (treaties) in tackling piracy through good governance mechanisms is also examined. Findings demonstrate that: (1) while all governance tools under consideration significantly decrease the incidence of piracy, corruption-control is the most effective weapon; (2) but for voice and accountability, political stability and democracy, IPR laws (treaties) are instrumental in tackling piracy through government quality dynamics of rule of law, regulation quality, government effectiveness, corruption-control, and press freedom. Hence, the need for a policy approach most conducive to expanding development is to implement an integrated system of both IPRs and corollary good governance policies. Moreover, our findings support the relevance of good governance measures in developing countries wishing to complement their emerging IPR regimes.

Keywords Software piracy · Governance tools · Intellectual property rights · Instrumental variables

Introduction

In legal terms, intellectual property covers three distinct sets of rights: copyrights, patents, and trademarks.[1] However, economics differentiates between copyright and patent on the one hand and trademark on the other based on the following rationale. Copyright refers to two types of commodity—information or intellectual property goods[2]—having certain characteristics. Information goods have two important public goods characteristics. First, their consumption is inherently non-rival. That is, the use that one person makes of a piece of information does not decrease the possibility of use by others. Furthermore, because reproduction costs are potentially very low for anybody else than the creator of the good, information goods might be non-excludable in the sense that the producer is often unable to prevent those who do not pay from consuming the good in question. That is, consumers might appropriate part of the surplus at the expense of producers. Intellectual property law responds to this non-excludability problem by giving producers certain exclusive rights that exclude non payers form certain uses of their intellectual property goods. Thus, the producers are able to reap the benefits from the production of information goods for a certain period of time. Nevertheless, the rights holder might charge a price above the marginal cost and this

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[1] For an excellent introduction to the economics of intellectual property rights (see Besen and Raskind 1991).

[2] Varian (1998) defines an information good as anything can be digitized. Books, records, and computer programs fall into this category. Computer software receives protection under copyright law, though in recent years software developers (particularly in the USA) have been granted patent protection as well. Copyright protects form of expression (e.g., written material and artistic works), while patents protect underlying ideas used for industrial products or processes.

together with the non-rivality feature of the information goods creates deadweight loss. Hence, the challenge for the IPRs system is to create incentives for provision that do not unnecessarily inhibit the distribution.[3]

As regards intellectual property protection, one serious concern for copyright holders is piracy, that is, the unauthorized use of copyrighted goods. Even though piracy occurs for all types of intellectual property and can take many forms depending on the access type and intellectual property mechanism (see Watt 2001). One of the most troubling areas is the piracy of business software applications.[4] Indeed, the emergence of new technologies poses a new threat for copyright publishers without question, because these new technologies provide the opportunity for copyright violation to a wide spectrum of end users (Gallegos 1999; Gopal and Sanders 2000). According to the Business Software Alliance Global Software Piracy Study (BSA 2010), which evaluates the state of software piracy around the world, the software piracy in Africa is double the global rate. The estimated global software piracy rate was of 43 % in 2009. For instance, the commercial value of unlicensed software installed on personal computers in Eastern and Southern Africa (ESA), which excludes South Africa reached $109 million in 2010 as 83 % of software deployed on PCs during the year was pirated.

The concern of how intellectual property rights (IPRs) affect the processes of economic development and growth is multidimensional and complex. The effectiveness of IPRs in this regard is contingent on particular circumstances of each country. Much has been covered about how stronger and more certain IPRs could well increase economic growth and foster beneficial technical change, thereby improving development aspects if they are structured in a manner that promote effective and dynamic competition (Maskus 2000).[5] Turning to the related literature, piracy studies broadly consist of three main strands: (i) investigating the effects of piracy (Banerjee 2006; Koboldt 1995), (ii) studying the determinants of piracy, and (iii) strategies against software piracy (Banerjee et al. 2005; Yang and Sonmez 2004; Asongu 2012a, b). Our study falls in the second strand. In particular, in the last few years, there have been a handful of studies on the socioeconomic determinants of piracy in several copyright industries from a macro perspective (Marron and Steel 2000; Holm 2003; Andrés 2006; Banerjee et al. 2005; Bezmen and Depken 2006; Peitz and Waelbroeck 2006; Goel and Nelson 2009). In general, the findings of these papers support the notion that economic and legal factors significantly influence piracy rates. In contrast, there is scanty empirical evidence to validate the basic premise of how government quality might impact software piracy. In fact, some researchers have explored the link between corruption and software piracy (Banerjee et al. 2005; Goel and Nelson 2009; Andrés and Goel 2012; Robertson et al. 2008). These studies have established a positive nexus between corruption and piracy rates, although the instrumentality of IP laws (treaties) in the corruption–piracy linkage has been ignored for the most part. These studies have also largely neglected the potential causality of corruption on piracy. More recently, Andrés and Goel (2012) have demonstrated that this empirical finding holds after accounting for the potential endogeneity of the corruption variable. Nonetheless, the mechanisms through which corruption influence piracy seem to be tentative and need more explanation. Furthermore, an analysis using within country and across time variation would be more compelling instead of using a cross-country estimation method.

By granting extensive periods of protection to patents and copyrights, IPRs are made effectively permanent (Shadlen et al. 2005). As Lessig (2001, p. 252) asserts, 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. In substance this implies, the sea of changes includes introduction of software under copyright law, significantly greater scope of protection for copyright

[3] However, it is not necessary for example to endow owners with strong rights to control distribution and restrict use so as to avoid depletion of goods that by their definition are non-excludable. On the contrary, restricting use can freeze ideas and stifle innovation. Indeed, a substantial body of the literature warns of the dangers of too much protection of IPRs. For instance, stronger IPRs may stifle incentives to innovate and introduce new technologies (Helpman 1993; Bessen and Maskin 2000; Maskus 2000; Shadlen et al. 2005). As sustained by Shadlen et al. (2005), with too much protection, the *tragedy of the commons* may be replaced by the *tragedy of the anti-commons* (Heller and Eisenberg 1998), since diminished access to upstream ideas can deter downstream innovation.

[4] Theoretically, there are several reasons why piracy will not be damaging to the copyright holders. As piracy enlarges the installed base of users (legal or illegal), it creates network effects that increase the consumers' willingness to pay for the software, thereby potentially increasing the producers' profits (Takeyama 1994; Shy and Thisse 1999). Another wave of papers assumes that copies can be made from originals so that producers of information goods can indirectly appropriate part of the consumer surplus (e.g., Johnson 1985; Liebowitz 1985; Besen and Kirby 1989; Varian 2000). Even in the absence of network effects, piracy may be profitable because of indirect appropriation.

[5] Another strand of the formal literature has focused on the fact that, stronger intellectual property rights protection should enhance economic growth by increasing returns to innovation and therefore, the incentives to innovate. At the aggregate level, a broader strand of the literature has investigated the intensity of the protection of the IPRs and its impact on economic growth. This empirical literature has largely documented that, IPRs protection has a positive effect on economic growth, often using cross section data (see for example, Falvey et al. 2006; Park and Ginarte 1997).

owners and longer periods of protection. At the national level, an issue arises on how to enforce IPRs and fight piracy, beside the extraordinary trade-off between innovation and diminished diffusion of new commodities.

A strand in the literature is of the view that developing countries in particular may have strong incentives to offer minimal protection of intellectual property (Maskus and Penubarti 1995; Kim 2004; Bezmen and Depken 2004). In the simplest terms, this implies countries may opt to offer low levels of protection to IPRs to favor users of IP over (usually non-local) producers, and to avoid the negative welfare effects of raising the price of potentially key inputs. The need for IPRs protection becomes essential to ameliorate the investment climate, stimulate innovation, and improve economic prosperity. It this therefore to this effect that governments in developing countries are signing into international treaties (laws) on IPRs protection.

Owing to increasing globalization and sophistication of Information and Communication Technologies (ICTs), today the paradigm has shifted towards political economics. Hence, governments, scholars, researchers and policy makers are more inclined today to ask: which government quality tools are best in the fight against software piracy (aka protection of IPRs)? This study only incorporates one dimension of the government, the quality dimension. It can be argued that a well develop legal system can contribute to a more efficient IPRs protection which in turn leads to a decrease in software piracy rates. In this study, we employ the governance indicators: rule of law, regulation quality, government effectiveness, political stability/no violence, corruption-control, press freedom, voice and accountability, and democracy.

With this background, this article has a number of innovative elements: (1) it assesses best governance tools in the fight against piracy and (2) tries to shed light on the ability to IPR laws (treaties) to fight software piracy through good governance mechanisms at macro level. In other words, we explore governance mechanisms by which global and regional obligations for the treatment of IPRs are effectively transmitted from the international to the national level in the fight against software piracy in a panel data set of 11 African countries over the period 2000–2010. In addition, this paper methodologically also controls for the potential endogeneity and random measurement error in the governance variables in the piracy equation by employing an instrumental variables estimation approach. The rate of software piracy can be seen more generally to proxy for piracy of other goods (books, sound recordings, and motion pictures). The empirical strategy that we adopt here is to draw from the empirical literature on piracy to identify the driving forces that are expected to influence cross-national piracy rates. The contribution of this article to the literature is therefore threefold: (1) it integrates previously missing government quality dynamics into the debate over how governance plays-out in the battle against piracy and protection of IPRs. While a substantial bulk of the literature has focused on the relation between corruption and piracy (Banerjee et al. 2005; Goel and Nelson 2009; Andrés and Goel 2011; Robertson et al. 2008), very little is known about how other governance tools play-out in the fight against piracy. (2) A corollary of the above contribution is the assessment of best governance tools in the fight against piracy. Hence, we shall be able to give policy makers the much needed guidance on which governance tools are best in the process of upholding IPRs and fighting piracy. (3) The seminal character of this article is buttressed by a further examination of the ability of IPR laws (treaties) to fight piracy through good governance mechanisms. In contextual terms, this third contribution aims to investigate the instrumentality of IPR laws (treaties) in the fight against piracy through government quality dynamics.

The primary finding suggests that corruption-control is the best governance tool in the battle against software piracy. Other findings reveal that, but for voice and accountability, political stability and democracy, IPR laws (treaties) are instrumental in the fight against piracy through government quality dynamics of the rule of law, regulation quality, government effectiveness, corruption-control and press freedom. Hence, the policy approach most conducive to expanding development is to implement an integrated system of both IPRs and corollary good governance policies that strike a balance of incentives in favor of rigorous and dynamic competition. More substantially, the findings support the relevance of good governance measures in developing countries wishing to complement their emerging IPRs regimes.

The rest of the paper is organized as follows. ""Software piracy, IPRs, and Governance in Africa" section" examines the current situation of the IPRs systems and its potential link with governance in Africa. Data and methodology are discussed and outlined, respectively, in the third section. The fourth section is devoted to empirical analysis. We conclude with the fifth section.

Software Piracy, IPRs, and Governance in Africa

Software piracy has reached an epidemic level in Africa (Hamade 2006; El-Bialy 2010). At this respect, the role of governance has been substantially documented as a means of effectively tackling the rising phenomenon (IDC 2009; El-Bialy 2010; Fripp 2011; Blakeney and Mengistie 2011; AFROL 2009; Agabi 2012). This section will be tackled in two strands, while the first will present glaring evidence on software piracy from selected African countries in the

dataset, the second will focus on institutional measures that are being implemented to combat the soaring phenomenon.

On the growing importance of software piracy in Africa; Kenya, Egypt, and Nigeria best illustrate the situation. Firstly, the Kenya Copyright Board is looking to increase its efforts in the fight against software piracy and it is said that, it battled piracy with vigor in 2012 in order to increase investment potential and crackdown on illegal use of software (Fripp 2011). Fripp reports that according to the board, there are sustained raids on suspected resellers of counterfeit software, in order to reduce the ICT sector's losses which they say is losing thousands of new jobs and millions of dollars as a result of the piracy. According to the Executive Director of the Board, there are clear signs that the Board has resolved to uphold Kenya's IPRs laws/treaties/regimes by dealing firmly with those engaging in software piracy.[6] Secondly, a study by the International Data Corporation (IDC) Global Software Piracy has revealed that Egypt is making considerable efforts to tackle the issue of piracy, highlighting how this is largely due to the increased collaboration between Egypt and the US on enforcement for IPRs cases (AFROL 2009). According to the AFROL report, Egypt is fully committed to further reducing its piracy rating and tackling the challenges facing the industry with a number of initiatives, including IPRs training for the Egyptian legal community and promotion of the copyright law (to increase awareness of IPRs and its role in sustaining economic growth and attracting foreign direct investment). Thirdly, Agabi (2012) reports that software developers are losing millions of naira annually to software thefts. Software piracy is negatively affecting Nigeria's economy. Agabi also confirms from business experts, the problem of illegal software usage in the country is a serious one and that finding a solution is likely to become ever more urgent with usage rate expected to soar over the coming years.

In the second strand, we discuss the role of institutions in IPRs protection and reduction of software piracy. Firstly, on IPRs protection, the World Trade Organization (WTO) can be counted among the different multilateral organizations that try to stress on the importance of legal reforms in African countries. They guard these countries to grant and protect IPRs, given minimum requirement standards that should be fulfilled by each member country. However their strategy is mainly based on promoting one-fits-all institutions. Hence, they seem to ignore alternative institutional arrangements that might be found to reach efficient outcomes for the conflicting parties for a long time (El-Bialy 2010) or the institutions that matter most in upholding IPRs (as the present paper seeks to address). Accordingly, El-Bialy (2010) asserts that the phenomena of inefficient IPRs institutions is more likely to be significant in developing countries, as they may require "appropriate" IPRs enforcement strategies and institutions differing from those prevailing in rich countries. For instance, Rodrik (2008) has called them second-best institutions and described the institutional reforms promoted by multilateral organization such the World Bank (WB) and International Monetary Fund (IMF) or WTO as being heavily biased towards a best-practice approach. Prior to Rodrik (2008), this position had been well documented in the IPRs literature.[7]

Secondly, on software, during the end of the twentieth century, the world began moving towards new IPR strategies, stressing on cooperative policies to reduce software piracy. Governments, together with software companies, the International Intellectual Property Alliance (IIPA) and the BSA started doing lots of cooperative efforts to combat piracy in Africa. After the year 2000, the BSA started publishing an annual study to assess a detailed and diverse picture of global software piracy in order to analyze piracy trends by region and by country (El-Bialy 2010). According to El-Bialy (2010), it started looking at alternative solutions to tackle piracy in which they have to work aside and guide the host governments. In addition to conducting huge awareness campaigns to the public, agreements between the BSA and African governments to provide price cut-offs of original software products were signed. To this effect, some satisfactory results were noticed[8]. However after a certain time (2003–2006), they also realized that this was only the beginning or the necessary condition of efficient enforcement, as it just has formed the starting point of the process (especially after noting the fluctuations of software piracy rates of a number of African countries). Accordingly, after reaching satisfactory results they tried to understand the reasons behind the sharp deteriorations of software piracy rates. Consistent with El-Bialy (2010), during the last few years, the tendency towards reforming

[6] "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).

[7] The model assumes the possibility to determine a unique set of appropriate institutional arrangements in advance and then expects convergence towards those arrangements is inherently desirable (El-Bialy 2010). Countries applying the same formal rules will have very different performance characteristics, due to the fact that they have different informal norms and enforcement characteristics (North 1995). Hence, it is very hard to determine a unique set of appropriate formal and external institutional arrangements that could be implemented in all countries without taking the already existing informal or internal institutional set-up of each country into consideration. According to North (1996), this fact can explain the failure of some formal rules from successful Western economies when applied to developing countries.

[8] For instance, some considerable achievements were observed as piracy trends started to decline in North Africa.

the judicial and prosecution system of IPR protection within countries has started becoming the focus of much attention. The efficiency of the enforcement authorities or the process of factual (de facto) enforcement is now considered an important target of modern IPRs policies (El-Bialy 2010). Hence, the need to assess which governance tools matter in the fight against piracy.

Data and Methodology

Sample and Data Sources

We have used data from 2000 to 2010 for 11 African countries to conduct our empirical analysis. The total number of observations is 64. Since we are combining different datasets, we have different number of observations for different variables, and model specifications. The list of countries included in this study is provided in Table 4 in Appendix (Panel B). The choice of countries and time series rests on the availability of data. The piracy rates were compiled from raw data published by the Business Software Alliance (BSA). GDP growth rate, population growth, savings, foreign direct investment and public investment are extracted from the World Bank's World Development Indicators (WDI). The press freedom quality indicator is taken from the Freedom House (2011). The governance variables are based on the database compiled by Kaufmann et al. (2006). The variables used in the robustness analysis are all from the World Intellectual Property Organization (WIPO) with the exception of the dummy variable for English common law countries taken from La Porta et al. (2008, p. 289).

Measuring Software Piracy

According to SIIA (2000), software piracy is defined as "the unauthorized copying of computer software which constitutes copyright infringement for either commercial or personal use". 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 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 personal computer 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 0 (no piracy) to 100 % (i.e., all software installed is pirated). From 2003 onwards, the BSA changed the methodology. Some scholars believe that this piracy measures is more appropriate because it ensures a consideration of the purchases on internet (Yang et al. 2009).[9] Piracy rates are obtained from the BSA (2007).[10] 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.[11] The data on software piracy may be seen more broadly as proxying for the extent of digital piracy. In our data, there is no distinction between commercial and end user piracy but our measure of piracy relates most likely to businesses. The mean level of piracy rate in the sample was 60.5 %, with the minimum piracy rate at 36.4 % in South Africa and a maximum piracy rate of 83.6 % in Algeria.

Variables of interest

Defining good governance is difficult. For instance, the UNDP (2002) defines good governance "as striving for rule of law, transparency, equity, effectiveness/efficiency, accountability, and strategic vision in the exercise of political, economic, and administrative authority". Borrowing from recent African institutional literature (Asongu 2012c, d) that is based on the IMF (2005) conception and definition of good governance, this paper employs six different indicators of good governance. In particular, (1) *voice and accountability*: the degree to which a country's citizens are able to participate in the political decision making process, (2) *political stability and absence of violence*: measures the stability of a government to political violence and terrorism, (3) *government effectiveness* measures the capability of a government to implement effective policies and maintain credibility, (4) *regulatory quality* is the ability of the government to formulate and implement sound policies that encourage private sector participation, (5) *rule of law* measures the existence of a good legal system including property rights and enforcement of contracts, (6) *control of corruption* measures the degree to which public power is diverted from private gain, (7) *press*

[9] Unfortunately, we are unable to include a dummy variable to capture the effect of the methodology change because of issues in degrees of freedom (owing to constraints in data availability).

[10] Refer to BSA (2009) for measurement details. 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 (2008) for a discussion about the reliability of piracy data. Also see Traphagan and Griffith (1998).

[11] Among the many researchers that have used this data are Andrés (2006), Banerjee et al. (2005), Goel and Nelson (2009), Andrés and Goel (2012), and Marron and Steel (2000).

freedom quality refers to the right to publish newspapers, magazines and other printed matter without government restriction and subject only to the laws of libel, obscenity, sedition, etc., (8) *democracy* is a form of government in which all eligible citizens have an equal say in the decisions that affect their lives. These indicators for the most part range from −2.5 (the weakest institution) to 2.5 (the strongest institution). The literature covered above also substantially justifies the choice of these institutional quality variables.[12]

Other variables

Control variables include: population growth, real GDP growth, gross domestic savings, foreign direct investment (FDI), and public investment. While the first two are annual growth rates, the last three are in annual percentage of GDP. The choice of only five control variables is contingent on constraints in the overidentifying restrictions (OIR) test for instrument validity.[13] The control variables have been documented as determinants of software piracy: population growth and real GDP growth (Chen et al. 2010)[14] and FDI (Haley 2000). IPRs in theft or infringement in recipient-emerging countries is positively associated with FDI inflows (Haley 2000, p. 1). Also, from intuition we expect economic conditions favoring investment (domestic savings and public investment) to increase software piracy.

Instrumental variables include: main intellectual property law, IPRs law, WIPO treaties, multilateral treaties, bilateral treaties, income-levels, legal-origin and, freedom.[15] Apart from the *IPR laws (treaties) instruments* which fall within the framework of an original contribution in this article, the other instrumental variables have been largely documented in the development (Beck et al. 2003; Stulz and Williamson 2003) and recent African growth (Agbor 2011) and governance (Asongu 2012c, d) literature. Bases for the choice of these instrumental variables have already been substantially covered above as well as in the literature section.[16] Accordingly, the fight against software piracy by government organs in Kenya, Nigeria and Egypt as we have seen in the stylized facts is aimed at enforcing existing IPR regimes (treaties). Besides the justifications from stylized facts presented above, we provide theoretical justification for the choice of legal-origin, income-levels and *freedom* as instruments. From an income-level perspective, high-income countries inherently have tighter IPR regimes and higher *governance quality* than their low-income counterparts (Maskus 2000). It has been substantially documented that legal-origins inherently differ in the emphasis they place on private property rights *vis-à-vis* the powers of the state (La Porta et al. 1998; Beck et al. 2003). The theoretical linkage between *freedom* and IPRs is somewhat mixed. Fundamentally, high-income countries with high *freedom* qualities have been linked with stringent IPR regimes. However, today with globalization, ICTs and the Chinese model, the paradigm is shifting as high growth could be associated with low *freedom*, less stringent IPR regimes, disrespect for human rights and limited attention to environmental impacts (Asche and Schüller 2008). From intuition, we expect institutional quality to negatively affect software piracy. However, the main interest of the study is to assess the magnitude of each institutional dynamic in order to give policy makers the much needed guidance on which governance tools matter most in the fight against piracy. Thus, from common sense, resources cannot be devoted to tackling software piracy without an underlying motive of enforcing IPRs in the software industry. It naturally follows that existing IPRs (treaties or laws) in place are instrumental in the decision to enforce software protection through government organs. This justification provides the basis for employing IPRs laws (treaties) as instrumental variables in the estimation specifications we shall outline below.

Details about the summary statistics (with presentation of countries), correlation analysis showing the basic correlations between key variables used in the article and variables definitions (with data sources) are presented in Tables 4, 5, and 6 in Appendix, respectively.

Methodology

To study the effect of governance on software piracy rates we specify a reduced regression form as follows:

$$\text{Piracy}_{it} = \beta_0 + \beta_1(\text{Governance})_{it} + \beta^* X_{it} + \varepsilon_{it} \quad (1)$$

[12] See first point on second strand in the "Software piracy, IPRs, and Governance in Africa" section. Also see, first strand depicting stylized facts from selected countries on how governments are fighting software piracy.

[13] An OIR test is only possible in the presence of overidentification. That is, the instruments must be higher than the endogenous explaining variables by at least one degree of freedom. In the cases of exact identification (instruments equal to endogenous explaining variables) and under identification (instruments less than endogenous explaining variables) an OIR test is by definition not possible.

[14] We expect both population growth and economic prosperity to be positively associated with software piracy.

[15] The *freedom* variable in the analysis is a time-dynamic dummy instrumental variable. It may take the values of 0 or 1 for the same country depending on the state of *quality of freedom* in a given period. Hence there is a substantial difference between *freedom* (an instrumental variable) and *press freedom quality* which an exogenous variable.

[16] See second point on second strand in the "Software piracy, IPRs, and Governance in Africa" section.

$$\text{Governance}_{it} = \gamma_0 + \gamma_1(\text{Piracy})_{it} + \gamma^*(\text{Instruments})_{it} + \upsilon_{it}, \quad (2)$$

where Piracy_{it} is the log of the software piracy rate in country i and year t, Governance_{it} represents our different measures of quality of governance. The vector X_{it} includes a set of explanatory variables that are expected to influence piracy rates. These are unknown parameters to be estimated and ε_{it} is the classical error term.

The focus of this paper will be on Eq. (1) which will be estimated using both Ordinary Least Squares (OLS) and two stage least squares (2SLS). In this model, there is a risk of endogeneity stemming from a reverse causality from software piracy and governance indicators. Software piracy could lead to bad governance practices. This feedback from piracy to governance is the reason for the presence of Eq. (2). In addition, these governance variables might be also subject to measurement error.[17] Governance indicators are perception-based measures which are subject to bias due to media propaganda. To tackle these methodological concerns, in this paper, we employ a 2SLS approach that avoids the inconsistency of estimated coefficients by OLS.

Our empirical analysis is carried out in three steps: (1) justify the choice of a 2SLS over an OLS estimation technique by employing a Hausman test for endogeneity; (2) verify the instruments are exogenous to the endogenous components of explaining variables (government quality channels) and; (3) ensure the instruments are valid and are uncorrelated with the error term in the main equation with an OIR test. In addition, further robustness check will be ensured with robust heteroscedasticity and autocorrelation consistent (HAC) standard errors.

Empirical Analysis

This section aims to examine three main issues: (1) the ability of the instruments to explain the endogenous components of government quality dynamics and control variable, (2) the capacity of the exogenous components of the government quality dynamics to explain piracy, and (3) the ability of the instruments to explain software piracy beyond government quality dynamic channels. While the first issue is addressed with first-stage regressions, the second and third concerns are looked at with the second-stage regressions. All estimations were carried out using *GRETL*.

First-Stage Regressions

Table 1 below summarizes the first-stage regressions in which government quality dynamics are regressed on the instrumental variables. This is the first condition for the 2SLS-IV estimation in which the potential instruments must be correlated with the government quality channels under consideration. The findings overwhelmingly demonstrate that the instruments jointly (taken together) enter significantly at the 1 % level (Fisher statistics). Hence the instruments are strong, indicating distinguishing sampled countries by IP laws (treaties), income-levels, legal-origins, and press freedom quality help explain cross-country differences in government quality channels and control variables. On a specific note, the following could be drawn from the signs and significance of the estimates. (1) IP laws (treaties) may either increase or decrease government quality dynamics. Discussing this to elaborate detail will be space consuming and out of scope, since the object of this section is simply to provide evidence of some correlation between the instruments and the dynamics of government quality. Hence dwelling on why IP laws' (treaties') estimates maybe positive or negative for some governance tools could be object of future research. (2) Good governance increases with income-levels; in line with recent African governance literature (Asongu 2011).

Presentation of Results

This section discusses the second and third issues: the ability of the exogenous components of the government quality channels to explain software piracy and the capacity of the instruments to explain piracy beyond good governance channels. To inspect these issues, we employ an IV approach with IP laws (treaties), income-levels, legal-origins, and press freedom quality as instrumental variables.

Whereas the second issue is addressed by the significance and signs of estimated coefficients, the third is solved with the OIR Sargan test. The null hypothesis of this test is the position that the instruments explain piracy only through the governance mechanisms. Hence a rejection of this null hypothesis is a rejection of the view that the instruments do not explain piracy beyond government quality channels. A Hausman test is performed before the 2SLS-IV approach is adopted. The null hypothesis of this test is the position that, estimated coefficients by OLS are efficient and consistent. Therefore a rejection of this null

[17] Note that measurement error in the dependent variable, the piracy rate, causes inefficiency in the regression analysis. This makes the standard errors in the coefficients on the explanatory variables large and they lose statistical significance. If the measurement error in the dependent variable is systematically related to one or more of the explanatory variables, OLS estimates will be biased. Taking the natural log of the dependent variable lets the bias move into the error term if measurement error is systematic and persistent.

Table 1 First-stage regressions (with HAC standard errors)

	Dependent variables: government quality dynamics							
	RL	RQ	GE	V&A	PolS	CC	Freedom	Demo
Constant	0.538 (1.344)	0.592 (1.193)	**0.898*** **(−1.958)**	**1.304*** ** **(2.747)**	1.001 (1.066)	**0.751*** ** **(2.795)**	**46.70*** ** **(13.92)**	**6.199*** ** **(8.816)**
Main _IP_Law	**−0.07*** ** **(−19.64)**	−0.002 (−0.372)	0.006 (1.531)	**−0.007*** ** **(−2.844)**	**−0.10*** ** **(−14.34)**	**−0.04*** ** **(−6.435)**	0.184 (1.205)	0.013 (0.742)
IP_rlaw	−0.033 (−1.302)	0.037 (0.918)	−0.0006 (−0.033)	−0.019 (−0.516)	0.031 (0.526)	0.019 (0.414)	**2.850*** ** **(5.273)**	**−0.48*** ** **(−11.16)**
Wipo_treaties	**−0.143** ** **(−2.517)**	0.045 (0.977)	**0.036** ** **(2.530)**	−0.005 (−0.299)	**−0.333** ** **(−2.501)**	−0.004 (−0.116)	0.502 (0.821)	**0.434*** ** **(2.732)**
Multilateral	0.016 (1.652)	0.012 (1.045)	0.007 (0.711)	0.012 (1.577)	−0.008 (−0.415)	**−0.05*** ** **(−2.699)**	**0.457*** **(1.847)**	**0.103*** ** **(3.902)**
Bilateral	**−1.21*** ** **(−7.426)**	−0.075 (−0.258)	**−0.53*** ** **(−2.780)**	−0.569 (−1.623)	**−1.43*** ** **(−4.120)**	**−0.85*** ** **(−6.004)**	**35.54*** ** **(16.33)**	**−6.524** ** **(−23.90)**
LM Income	**−1.93*** ** **(−16.58)**	**−1.46*** ** **(−8.077)**	**−0.89*** ** **(−8.289)**	**−0.83*** ** **(−4.370)**	**−2.97*** ** **(−9.820)**	**−1.24*** ** **(−6.555)**	**16.04*** ** **(5.813)**	**−4.18*** ** **(−19.93)**
M. Income	**1.576*** ** **(7.951)**	**0.640** ** **(2.015)**	**1.396*** ** **(6.041)**	0.382 (0.976)	**2.070*** ** **(4.601)**	**1.264*** ** **(8.336)**	**−35.5*** ** **(−14.81)**	**3.67*** ** **(19.34)**
English	**−1.02*** ** **(−17.51)**	**−0.62*** ** **(−6.970)**	–	**−0.40*** ** **(−3.860)**	**−1.90*** ** **(−13.77)**	**−0.70*** ** **(−9.232)**	**11.18*** ** **(6.586)**	**−2.70*** ** **(−22.54)**
Freedom	0.001 (0.327)	−0.009 (−1.139)	−0.0003 (−0.055)	**−0.021** ** **(−2.161)**	**0.024** ** **(2.041)**	−0.005 (−1.601)	**−5.306** ** **(−2.206)**	**0.767*** ** **(3.281)**
Adjusted R^2	0.972	0.942	0.978	0.974	0.898	0.954	0.968	0.881
Fisher	**250.9*** **	**116.6*** **	**307.8*** **	**269.6*** **	**63.11*** **	**148.4*** **	**247.3*** **	**59.41*** **
Observations	64	64	64	64	64	64	64	64

RL rule of law, *RQ* regulation quality, *GE* government effectiveness, *V&A* voice and accountability, *PolS* political stability, *Freedom* press freedom, *Demo* democracy, *HAC* heteroscedasticity and autocorrelation consistent, *Main _IP_Law* main intellectual property law, *IP_rlaw* intellectual property rights law, *Wipo_treaties* World Intellectual Property Organization treaties, LM lower middle, M middle, *English* English common law countries. *, **, and *** Significance levels of 10, 5, and 1 %, respectively. *t* statistics in brackets

hypothesis points to the concern of endogeneity due to inconsistent estimates and hence lends credit to the choice of the IV estimation technique. For all models under consideration we find overwhelming evidence of endogeneity and proceed with the IV estimation. While Table 2 presents results without HAC standard errors, estimates pertaining to Table 3 have robust standard errors that are HAC consistent.

As concerns the second issue, the following findings could be established. (1) All government quality dynamics are significant with the expected signs. In interpreting the sign of the press freedom estimate, note should be taken of the fact that, Freedom House from where the data is sourced presents *freedom of the press* in decreasing magnitudes (such that countries enjoying the highest press freedom qualities have the least values). (2) Findings in Table 2 are robust to HAC standard errors (Table 3). (3) The relevance of governance tools in the fight against piracy (in increasing order) are as follows: press freedom (0.030), democracy (−0.123), voice and accountability (−0.65), government effectiveness (−0.71), regulation quality (−0.74), rule of law (−0.83), political stability (−0.91), and corruption-control (−0.98). Thus, corruption-control appears to be the most important government tool for the fight against software piracy and upholding of IPRs.

Looking at the third concern, but for regressions entailing voice and accountability, political stability and democracy, the null hypothesis of the Sargan test is not overwhelmingly rejected. Hence two interpretations result from this observation. (1) The instruments explain piracy through other mechanisms beyond government quality channels of: voice and accountability, political stability and democracy. Therefore, the instruments are not strictly exogenous and are invalid because they suffer from the same problem as the endogenous explaining variables (endogeneity). (2) For the remaining government quality channels, failure to reject the null hypothesis of the Sargan OIR test points to the validity of the instruments in explaining piracy only through government quality channels. Hence, the instrumental variables are strictly exogenous and not correlated with the error term in the main equation. These interpretations are consistent with robust findings in Table 3. Most of the control variables are significant with the right signs.

A motivation for this study has been the fact that, a substantial bulk of the literature has focused on the relation between corruption and piracy (Banerjee et al. 2005; Goel

Table 2 Governance and cross-country piracy: 2SLS regressions without HAC standard errors

	Dependent variable: Piracy rate							
Constant	**3.769*** (6.570)**	1.639 (1.343)	0.998 (0.906)	**1.550** (1.995)**	**4.62*** (5.458)**	−0.041 (−0.026)	−2.442 (−0.847)	**2.740* (1.884)**
Rule of law	**−0.83*** (−9.605)**	–	–	–	–	–	–	–
Regulation quality	–	**−0.74*** (−4.232)**	–	–	–	–	–	–
Gov. effectiveness	–	–	**−0.71*** (−5.141)**	–	–	–	–	–
Voice & account.	–	–	–	**−0.65*** (−6.653)**	–	–	–	–
Political stability	–	–	–	–	**−0.91*** (−6.167)**	–	–	–
C. of corruption	–	–	–	–	–	**−0.98*** (−3.801)**	–	–
Freedom	–	–	–	–	–	–	**0.030*** (3.367)**	–
Democracy	–	–	–	–	–	–	–	**−0.123*** (−4.017)**
Pop. growth	**−0.63*** (−7.703)**	−0.184 (−1.336)	−0.175 (−1.446)	**−0.24*** (−2.776)**	**−0.70*** (−5.518)**	−0.207 (−0.026)	−0.074 (−0.334)	−0.212 (−1.445)
Savings	**0.015** (2.507)**	0.013 (1.007)	**0.026** (1.982)**	0.008 (1.074)	0.011 (1.317)	**0.055** (2.281)**	0.045 (1.436)	−0.012 (−0.869)
FDI	**−0.058* (−1.946)**	−0.012 (−0.222)	−0.072 (−1.245)	−0.036 (−0.911)	**0.058* (0.065)**	−0.143 (−1.538)	−0.210 (−1.414)	0.027 (0.389)
GDP growth	0.045 (0.826)	−0.142 (−1.416)	−0.081 (−0.889)	0.013 (0.186)	0.034 (0.440)	−0.008 (−0.065)	0.211 (0.892)	−0.074 (−0.552)
Pub. Invt	**0.101*** (4.797)**	**0.082* (1.881)**	**0.109*** (2.706)**	**0.089*** (3.160)**	0.036 (1.412)	**0.187*** (2.768)**	**0.133* (1.872)**	**0.087* (1.892)**
Hausman	**73.11*** **	**71.67*** **	**209.2*** **	**75.82*** **	**64.40*** **	**245.5*** **	**266.1*** **	**59.433*** **
Sargan OIR	**2.186 [0.335]**	**3.105 [0.211]**	**0.116 [0.943]**	8.048** [0.017]	12.28*** [0.002]	**0.639 [0.726]**	**0.066 [0.967]**	9.389*** [0.009]
Adjusted R^2	0.776	0.312	0.438	0.593	0.580	0.277	0.260	0.267
Fisher	**27.81*** **	**5.701*** **	**7.911*** **	**14.13*** **	**12.74*** **	**4.390*** **	**3.307*** **	**5.701** **
Observations	47	47	47	47	47	47	50	50
Instruments	Constant; Main_IP_law; IP_rlaw; Wipo_treaties; Mutilateral; Bilateral; LM_Income; M_Income; FreeD; English							

HAC heteroscedasticity and autocorrelation consistent, *Gov* government, *C* control, *Pub Invt* public investment, *FDI* foreign direct investment, *GDP* gross domestic product, *OIR* overidentifying restrictions. *, **, and *** Significance levels of 10, 5, and 1 %, respectively. *p* values in brackets; *z* statistics in parenthesis

and Nelson 2009; Andrés and Goel 2011; Robertson et al. 2008), while very little is known about how other governance tools play-out in the fight against piracy. We have confirmed from the findings that corruption-control is the best governance tool in the battle against software piracy. It will be interesting to devote space to explaining the intuition behind this finding. We postulate three justifications: a 'conceptual' explanation; an 'end-game', 'final-phase' or 'last resort' status of corruption-control in the pragmatism of governance and; the most appropriate channel for enforcing IPR regimes (treaties).

Firstly, from a conceptual standpoint, the degree by which a country's citizens are able to participate in the political decision making process (voice & accountability), the stability of the government to political violence and terrorism (political stability and/or no violence), the capability of a government to implement effective policies to maintain credibility (government effectiveness), the ability of the government to formulate and implement sound policies that encourage private sector participation (regulation quality), the existences of a good legal system including property rights and enforcement of contracts (rule of law), the existence of a form of government in which all eligible citizens have an equal say in decisions that affect their lives (democracy) and, the right to publish newspapers, magazines and other printed matter without

Table 3 Governance and cross-country piracy: 2SLS regressions with HAC standard errors

	Dependent variable: Piracy rate							
Constant	**3.769*** (10.66)**	**1.639*** (2.891)**	0.998 (1.482)	**1.550*** (2.763)**	**4.623*** (5.595)**	−0.041 (−0.033)	−2.442 (−0.972)	**2.740* (1.854)**
Rule of law	**−0.83*** (−11.92)**	–	–	–	–	–	–	–
Regulation quality	–	**−0.74*** (−5.630)**	–	–	–	–	–	–
Gov. effectiveness	–	–	**−0.71*** (−6.347)**	–	–	–	–	–
Voice & account.	–	–	–	**−0.65*** (−5.854)**	–	–	–	–
Political stability	–	–	–	–	**−0.91*** (−7.305)**	–	–	–
C. of corruption	–	–	–	–	–	**−0.98*** (−4.463)**	–	–
Freedom	–	–	–	–	–	–	**0.030*** (3.212)**	–
Democracy	–	–	–	–	–	–	–	**−0.123*** (−3.445)**
Pop. growth	**−0.63*** (−11.25)**	**−0.18*** (−3.145)**	**−0.17*** (−4.219)**	**−0.24*** (−3.581)**	**−0.70*** (−6.945)**	**−0.20*** (−3.727)**	−0.074 (−0.275)	**−0.212**** (−0.275)
Savings	**0.015** (2.260)**	0.013 (0.961)	**0.026* (1.874)**	0.008 (0.717)	**0.011*** (3.057)**	**0.055** (1.969)**	**0.045* (1.749)**	−0.012 **(1.749)**
FDI	**−0.058* (−1.920)**	−0.012 (−0.223)	−0.072 (−1.210)	−0.036 (−0.647)	**0.058*** (3.353)**	−0.143 (−1.320)	**−0.210* (−1.952)**	0.027 (0.275)
GDP growth	0.045 (0.702)	−0.142 (−1.144)	−0.081 (−0.806)	0.013 (0.106)	0.034 (0.765)	−0.008 (−0.050)	0.211 (1.313)	−0.074 (−0.324)
Pub. Invt	**0.101*** (12.92)**	**0.082*** (4.334)**	**0.109*** (8.906)**	**0.089*** (4.802)**	0.036 (1.094)	**0.187*** (5.950)**	**0.133*** (4.075)**	**0.087** (2.393)**
Hausman	**73.11*** **	**71.67*** **	**209.2*** **	**75.82*** **	**64.40*** **	**245.5*** **	**266.1*** **	**59.433*** **
Sargan OIR	**2.186 [0.335]**	**3.105 [0.211]**	**0.116 [0.943]**	8.048** [0.017]	12.28*** [0.002]	**0.639 [0.7263]**	**0.066 [0.967]**	9.389*** [0.009]
Adjusted R^2	0.776	0.312	0.438	0.593	0.580	0.277	0.260	0.267
Fisher	**268.9*** **	**43.73*** **	**220.4*** **	**30.64*** **	**1118*** **	**424.6*** **	**3016*** **	**16.876*** **
Observations	47	47	47	47	47	47	50	50
Instruments	Constant; Main_IP_law; IP_rlaw; Wipo_treaties; Mutilateral; Bilateral; LM_Income; M_Income; FreeD; English							

HAC heteroscedasticity and autocorrelation consistent, *Gov* government, C control, *Pub Invt* public investment, *FDI* foreign direct investment, *GDP* gross domestic product, *OIR* overidentifying restrictions. *, **, and *** Significance levels of 10, 5 and 1 % respectively. *p* values in brackets; *z* statistics in parenthesis

government restriction (press freedom quality); are not as important as the degree to which public power is diverted from private gain (control of corruption) in the fight against software piracy.

Secondly, among the governance tools, corruption-control is the most important for the battle against the scourge of software piracy because; it is like the 'end-game', 'final-phase' or 'last resort' in the fight against piracy. Leaders maybe voted into office by a majority of the population after engaging in vote-buying (quasi-democracy), the voted leaders may formulate rules by the legislature but catching people publicly violating the rules depends of the incorruptible character of security offices, even enforcements by the courts through sanctions on those caught pirating also depends on the incorruptible nature of the judges. People may express themselves as they see fit as means of press freedom; but above all only in absence of corruption can real leaders be voted, genuine laws passed by the legislature and law enforcement officers drag caught pirates to courts and, judges inflict appropriate sanctions to those caught pirating to deter the scourge.

Thirdly, the instrumental variables used (for the most part) are IPRs laws (treaties). It would be hard to expect the enforcement of these IPRs laws through the degree by which a country's citizens are able to participate in the political decision making process (voice & accountability), the

stability of the government to political violence and terrorism (political stability and/or no violence), the existence of a form of government in which all eligible citizens have an equal say in decisions that affect their lives (democracy), the right to publish newspapers, magazines and other printed matter without government restriction (press freedom quality). From a realistic point of view, control-corruption (especially in the application of the 'rule of law', maintenance of 'regulation quality' and, insurance of 'government effectiveness') seem valid as the most effective channel for fighting piracy by virtue of IPRs laws (treaties).

Concluding Remarks

Before discussing concluding remarks, it is worthwhile highlighting the intuition motivating this article. Its object has been to assess how IP rights (treaties) are instrumental in the fight against piracy through good governance tools. Some researchers have explored the link between corruption and piracy, albeit at a rudimentary level (Banerjee et al. 2005; Goel and Nelson 2009; Andrés and Goel 2011; Robertson et al. 2008). Though these studies have generally found that corruption affects positively piracy rates, they have stopped short of two important considerations. (1) The instrumentality of IP laws (treaties) in the piracy-corruption nexus which could greatly address endogeneity concerns owing to reverse causality and bias in the perception-based measurement of corruption. At the advent of globalization, greased with increasing sophistication of ICTs, the role of international, bilateral and multilateral IP laws (treaties) must be integrated into the piracy governance nexus. (2) The argument that nations with high levels of corruption are likely to not place much emphasis on the morality of protecting IP rights (Logsdon et al. 1994; Husted 2000) is quite incompletely stated because; corruption-control is not the only tool in the hands of governments to tackle piracy and uphold IPRs. Other government quality dynamics like, voice and accountability, rule of law, regulation quality, political stability, press freedom, democracy and government effectiveness must be added to the equation for an objective assessment.

The contribution of this article to the literature has been threefold. (1) The article has integrated previously missing government quality dynamics into the debate over how governance plays-out in the battle against piracy and protection of IPRs. While a substantial bulk of the literature has focused on the relation between corruption and piracy, very little is known about how other governance tools matter in the fight against this scourge. (2) A corollary of the above contribution has been the assessment of best governance tools in the fight against piracy. Hence we have been able to give policy makers the much needed guidance on which governance tools are best in the process of upholding IPRs and fighting piracy. (3) The seminal character of this article has been buttressed by a further examination of the ability of IPR laws (treaties) to fight piracy through good governance mechanisms. In other words, we have explored governance mechanisms by which global obligations for the treatment of IPRs are effectively transmitted from international to the national level in the fight against piracy. In contextual terms, this third contribution has aimed to investigate the instrumentality of IPR laws (treaties) in the fight against piracy through government quality dynamics.

Our main findings can be summarized as follows: (1) While all governance tools under consideration significantly decrease the incidence of piracy, corruption-control is the most effective tool. (2) But for voice and accountability, political stability and democracy, IPR laws (treaties) are instrumental in tackling piracy through government quality dynamics of rule of law, regulation quality, government effectiveness, corruption-control and press freedom. Hence the need for a policy approach most conducive to expanding development is to implement an integrated system of both IPRs and corollary good governance policies. More substantially, the findings support the relevance of good governance measures in developing countries wishing to complement their emerging IPR regimes.

It is interesting to point out some ethical implications of software piracy in Africa and limitations of the study. On the one hand, the fight against software piracy could be thwarted by ethical justifications: (1) the seller of pirated software thinks (S)he's right to continue her (his) business because the company may incur more expenses taking the matter to court and; (2) users of pirated software think it is right to use pirated commodities because they are poor. It is very much worthwhile to try to expand the sample to a large number of African countries. In addition, illegal copying might be based on interpersonal trust. First, those who either copy or share software with others must trust that the software no contain viruses. Second, individuals distributing illegal copies to others must trust these persons not to report to the police. This issue has not been examined in the literature on piracy. A limitation of this study is that institutional variables are based on perceptions that maybe biased by media propaganda.

Acknowledgments The authors are highly indebted to the editor and referees for their very useful comments.

Appendix

See Tables 4, 5, and 6.

Table 4 Summary statistics and presentation of countries

Panel A: Summary statistics					
	Mean	SD	Min	Max	*N*
Dependent variable					
Piracy	0.409	0.307	−0.288	0.720	106
Independent variables					
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	0.696	−1.256	1.047	110
Political stability/no violence	−0.393	0.842	−2.094	0.996	110
Control of corruption	−0.309	0.641	−1.236	1.086	110
Press freedom quality	46.06	17.72	17.00	77.00	72
Democracy	4.950	3.539	0.000	10.00	121
Control variables					
Population growth	7.268	0.602	6.074	8.199	121
Savings	21.51	12.83	2.754	57.53	106
Foreign direct investment	2.527	2.902	−7.646	11.60	110
Economic prosperity	4.360	2.165	−3.653	10.60	121
Public investment	6.706	3.477	0.000	16.49	106
Instrumental variables					
Main_IP_law	2.256	2.835	0.000	11.00	121
IP_rlaw	1.438	1.944	0.000	7.000	121
Wipo_treaties	2.735	0.793	2.000	4.000	121
Mutilateral	9.628	3.304	4.000	17.00	121
Bilateral	0.322	0.535	0.000	2.000	121
Lower middle income	0.454	0.500	0.000	1.000	121
Middle income	0.818	0.387	0.000	1.000	121
Freedom	0.333	0.474	0.000	1.000	72
English common law	0.545	0.500	0.000	1.000	121
Panel B: Presentation of countries					
Algeria, Botswana, Cameroon, Egypt, Kenya, Mauritius, Morocco, Nigeria, Senegal, South Africa, Zambia					

SD standard deviation, *Min* minimum, *Max* maximum, *N* no of observations

Table 5 Correlation matrix of key variables ($N = 121$)

Piracy	Government quality dynamic independent variables								Control variables					Instrumental variables									
	RL	RQ	GE	V&A	PolS	CC	Free	Demo	Popg	Sav.	FDI	GDP	PubI	MIPlaw	IPrlaw	Wipo	Multila	Bilater	LMI	MI	FreeD	English	
1.00	−0.5	−0.6	−0.6	−0.42	−0.29	−0.4	0.65	−0.21	−0.06	0.27	0.11	0.17	0.16	−0.71	−0.01	0.32	0.02	0.01	0.12	−0.2	−0.77	−0.15	Piracy
	1.00	0.87	0.88	0.72	0.82	0.90	−0.8	0.48	−0.70	0.07	0.12	−0.07	0.22	0.100	0.12	−0.12	−0.06	−0.14	−0.33	0.3	0.75	0.17	RL
		1.00	0.93	0.84	0.76	0.86	−0.8	0.64	−0.63	−0.04	0.03	−0.09	0.05	0.29	0.08	−0.09	−0.15	−0.28	−0.47	0.15	0.82	0.40	RQ
			1.00	0.83	0.71	0.94	−0.9	0.59	−0.51	0.08	0.00	0.01	0.09	0.43	0.28	−0.10	−0.12	−0.32	−0.30	0.48	0.84	0.44	GE
				1.00	0.72	0.79	−0.9	0.89	−0.64	−0.08	0.02	−0.00	0.06	0.29	−0.02	−0.09	−0.20	−0.61	−0.55	0.04	0.81	0.63	V&A
					1.00	0.77	−0.6	0.52	−0.83	0.03	0.24	−0.07	0.10	0.01	0.01	−0.22	−0.14	−0.18	−0.37	0.06	0.62	0.26	PolS
						1.00	−0.9	0.55	−0.66	0.25	0.09	−0.05	0.20	0.23	0.19	−0.09	−0.26	−0.24	−0.39	0.39	0.76	0.27	CC
							1.00	−0.82	0.46	−0.3	0.07	−0.06	−0.26	−0.39	−0.24	0.20	0.22	0.47	0.34	−0.5	−0.82	−0.25	Free
								1.00	−0.54	−0.1	−0.02	−0.02	0.07	0.22	−0.19	−0.00	−0.20	−0.67	−0.59	−0.1	0.66	0.68	Demo
									1.00	−0.1	−0.08	0.10	−0.17	0.36	0.07	0.17	0.15	0.27	0.43	−0.02	−0.44	−0.24	Popg
										1.00	0.10	0.10	0.32	−0.00	0.07	−0.29	−0.52	0.12	−0.32	0.30	0.43	−0.09	Sav.
											1.00	0.37	0.06	−0.07	0.10	−0.09	−0.02	0.005	−0.05	−0.1	−0.07	0.16	FDI
												1.00	−0.09	−0.03	0.13	−0.06	0.108	−0.007	0.10	−0.05	0.006	0.11	GDP
													1.00	−0.13	0.02	0.07	−0.266	−0.19	−0.18	0.13	0.10	−0.01	PubI
														1.00	0.10	−0.27	−0.22	−0.07	−0.17	0.20	0.49	0.27	MIPlaw
															1.00	0.30	0.44	0.14	0.41	0.35	0.02	−0.13	IPrlaw
																1.00	0.31	−0.05	0.22	−0.1	−0.48	−0.07	Wipo
																	1.00	0.26	0.63	0.06	−0.42	−0.29	Multila
																		1.00	0.47	0.28	−0.26	−0.66	Bilater
																			1.00	0.43	−0.54	−0.63	LMI
																				1.00	0.40	−0.43	MI
																					1.00	0.40	FreeD
																						1.00	English

RL rule of law, *RQ* regulation quality, *GE* government effectiveness, *V&A* voice and accountability. *PolS* political stability/no violence, *CC* corruption-control, *Free* press freedom quality, *Demo* democracy, *Popg* population growth, *Sav* Savings, *FDI* foreign direct investment, *GDP* GDP growth, *PubI* public investment, *LMI* lower middle income, *MI* middle income, *FreeD* freedom, *English* English common law countries, *MIPlaw* main intellectual property law, *IPrlaw* intellectual property rights law, *Wipo* World Intellectual Property Organization, *Multila* multilateral treaties, *Bilater* bilateral treaties

Table 6 Variable definitions

Variables	Signs	Variable definitions	Sources
Piracy	Piracy	Software piracy rate (annual %)	Business Software Alliance (BSA)
Rule of law	R.L	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	World Bank (WDI)
Regulation quality	R.Q	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	World Bank (WDI)
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 (WDI)
Voice & accountability	V & A	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	World Bank (WDI)
Political stability/ no violence	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 (WDI)
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	World Bank (WDI)
Freedom	Free	Press freedom quality	Freedom House
Democracy	Demo	Institutionalized democracy	World Bank (WDI)
Population growth	Popg	Population growth rate (annual %)	World Bank (WDI)
Savings	Savings	Gross domestic savings (% of GDP)	World Bank (WDI)
Foreign investment	FDI	Gross foreign direct investment (% of GDP)	World Bank (WDI)
Economic prosperity	GDPg	Real GDP growth rate (annual %)	World Bank (WDI)
Public investment	PubInvt	Gross public investment (% of GDP)	World Bank (WDI)
Main IP law	MIPlaw	Main intellectual property law	World Intellectual Property Organization (WIPO)
IPR law	IPrlaw	Intellectual property rights law	World Intellectual Property Organization (WIPO)
WIPO treaties	Wipo	World Intellectual Property Organization	World Intellectual Property Organization (WIPO)
Mutilateral	Multiter	Multilateral treaties	World Intellectual Property Organization (WIPO)
Bilateral	Bilater	Bilateral treaties	World Intellectual Property Organization (WIPO)

References

AFROL. (2009). Egypt's software piracy rating drops. *afrol News*. Accessed September 24, 2012, from http://www.afrol.com/articles/33242.

Agabi, C. (2012). Nigeria: Firm fights software piracy in Nigeria. Accessed September 24, 2012, from http://allafrica.com/stories/201207030367.html.

Agbor, J. A. (2011). *How does colonial origin matter for economic performance in Sub-Saharan Africa*. World Institute for Development Economics Research Working Paper No. 2011/27.

Andrés, A. R. (2006). The relationship between copyright software protection and piracy: Evidence from Europe. *European Journal of Law and Economics, 21*, 29–51.

Andrés, A. R., & Goel, R. K. (2011). Corruption and software piracy: A comparative perspective. *Policy and Internet*, 3, Article 2. Accessed June 27, 2012, from http://www.psocommons.org/policyandinternet/vol3/iss3/art2.

Andrés, A. R., & Goel, R. K. (2012). Does software piracy affect economic growth? Evidence across countries. *Journal of Policy Modeling, 34*, 284–295.

Asche, H., & Schüller, M. (2008). *China's engagement in Africa: Opportunities and risks for development*. Eschborn: Africa Department, Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH.

Asongu, S. A. (2011). *Law, democracy and the quality of government in Africa*. MPRA Paper No. 35502. Accessed December 19, 2012, from http://econpapers.repec.org/paper/pramprapa/35502.htm.

Asongu, S. A. (2012a). Harmonizing IPRs on software piracy: Empirics of trajectories in Africa. *Journal of Business Ethics*. Accessed December 19, 2012, from http://link.springer.com/article/10.1007%2Fs10551-012-1552-7?LI=true#page-1.

Asongu, S. A. (2012b). Fighting software piracy in Africa: How do legal origins and IPRs protection channels matter? *Journal of the Knowledge Economy*. Accessed December 19, 2012, from http://link.springer.com/article/10.1007/s13132-012-0137-0.

Asongu, S. A. (2012c). On the effect of foreign aid on corruption. *Economics Bulletin, 32*(2), 2174–2180.

Asongu, S. A. (2012d). Government quality determinants of stock market performance in African countries. *Journal of African Business, 13*(2), 183–199.

Banerjee, D. S. (2006). Enforcement sharing and commercial piracy. *Review of Economic Research on Copyright Issues, 3*, 83–97.

Banerjee, D., Khalid, A. M., & Sturm, J.-E. (2005). Socio-economic development and software piracy. An empirical assessment. *Applied Economics, 37*, 2091–2097.

Beck, T., Demirgüç-Kunt, A., & Levine, R. (2003). Law and finance: Why does legal origin matter? *Journal of Comparative Economics, 31*, 653–675.

Besen, S. M., & Kirby, S. N. (1989). Private copying, appropriability, and optimal copying royalties. *Journal of Law and Economics, 32*, 255–280.

Besen, S. M., & Raskind, L. J. (1991). An introduction to the law and economics of intellectual property. *Journal of Economics Perspectives, 5*, 3–27.

Bessen, J., & Maskin. E. (2000). *Sequential innovation, patents, and imitation*. Department of Economics, Massachusetts Institute of Technology Working Paper No. 00-01.

Bezmen, T. L. and Depken, C. A. (2004). The impact of software piracy on economic development, *Working Paper*. Francis Marion University.

Bezmen, T. L., & Depken, C. A. (2006). Influences on software piracy: Evidence from the various United States. *Economics Letters, 90*, 356–361.

Blakeney, M., & Mengistie, G. (2011). Intellectual property and economic development in Sub-Saharan Africa. *The Journal of World Intellectual Property, 3–4*, 238–264.

Business Software Alliance (BSA). (2007). *Piracy study, Fifth Annual BSA and IDC Global Software*. Accessed October 3, 2012, from http://global.bsa.org/idcglobalstudy2007/studies/2007_global_piracy_study.pdf).

Business Software Alliance (BSA). (2009). *What is software piracy?* Accessed June 27, 2012, from http://www.bsa.org/Piracy%20Portal.aspx.

Business Software Alliance (BSA). (2010). *Eighth Annual BSA Global Software 2010 Piracy Study*.

Chen, C., Chen, C., & Yeh, C. (2010). Determinants of software piracy: Evidence from Far East countries. *Journal of International and Global Economic Studies, 3*(2), 53–62.

El-Bialy, N. (2010). *The role of institutions within the IPR enforcement context: The case of de facto software protection in Egypt*. Discussion Papers on Strategy and Innovation 10-02, Philipps-University Marburg.

Falvey, R., Foster, N., & Greenway, D. (2006). Intellectual property rights and economic growth. *Review of Development Economics, 10*, 700–719.

Fripp, C. (2011). Kenya fighting software piracy. *IT News Africa*. Accessed September 24, 2012, from http://www.itnewsafrica.com/2011/04/kenya-fighting-software-piracy.

Gallegos, F. (1999). Software piracy: Some facts, figures, and issues. *Information Systems Security, 8*, 34–56.

Goel, R. K., & Nelson, M. A. (2009). Determinants of software piracy: Economics, institutions, and technology. *Journal of Technology Transfer, 34*, 637–658.

Gopal, R. D., & Sanders, G. L. (2000). You can't get blood out of a turnip. *Communications of the ACM, 43*, 83–89.

Haley, G. T. (2000). Intellectual property rights and foreign direct investment in emerging countries. *Marketing Intelligence and Planning, 18*(5), 273–280.

Hamade, S. N. (2006). *The legal and political aspects of software piracy in the Arab World.* In ITNG '06 Proceedings of the Third International Conference on Information Technology: New Generations, pp. 137–142.

Heller, M. A., & Eisenberg, R. S. (1998). Can patents deter innovation? The anticommons in biomedical research. *Science, 280*, 698–701.

Helpman, E. (1993). Innovation, imitation, and intellectual property rights. *Econometrica, 61*, 1247–1280.

Holm, H. J. (2003). Can economic theory explain piracy behavior? *Topics in Economic Analysis & Policy, 3*, article 5.

Husted, B. W. (2000). The impact of national culture on software piracy. *Journal of Business Ethics, 26*, 197–211.

IMF. (2005, June). The IMF approach to promoting good governance and combating corruption—a guide, International Monetary Fund.

International Development Corporation (IDC). (2009). *How to reduce software piracy in the Middle East and Africa: The case of South Africa*.

Johnson, W. R. (1985). The economics of copying. *Journal of Political Economy, 93*, 158–174.

Kaufmann, D., Kraay, A., & Mastruzzi, M. (2006). *Governance Matters V: Aggregate and Individual Governance Indicators for 1996-2005*. Washington, D.C: World Bank.

Kim, L. (2004). The multifaceted evolution of Korean technological capabilities and its implications for contemporary policy. *Oxford Development Studies, 32*(3), 341–363.

Koboldt, C. (1995). Intellectual property and optimal copyright protection. *Journal of Cultural Economics, 19*, 131–155.

La Porta, R., Lopez-de-Silanes, F., & Shleifer, A. (2008). The economic consequences of legal origins. *Journal of Economic Literature, 46*(2), 285–332.

La Porta, R., Lopez-de-Silanes, F., Shleifer, A., & Vishny, R. W. (1998). Law and finance. *Journal of Political Economy, 106*, 1113–1155.

Lessig, L. (2001). *The future of ideas: The fate of the commons in a connected world*. New York: Random House.

Liebowitz, S. J. (1985). Copying and indirect appropriability: Photocopying of journals. *Journal of Political Economy, 93*, 945–957.

Logsdon, J., Thompson, J., & Reid, R. (1994). Software piracy: Is it related to moral judgment? *Journal of Business Ethics, 13*, 649–857.

Marron, D. B., & Steel, D. G. (2000). Which countries protect intellectual property? The case of software piracy. *Economic Inquiry, 38*, 159–174.

Maskus, E. K. (2000). *Intellectual property rights and economic development*. Boulder: University of Colorado.

Maskus, K. E., & Penubarti, M. (1995). How trade related are intellectual property rights? *Journal of International Economics, 39*, 227–248.

North, D. (1995). Five propositions about institutional change. In J. Knight & I. Sened (Eds.), *Explaining social institutions* (pp. 15–26). Ann Arbor, MI: The University of Michigan Press.

North, D. (1996). *Where have we been and where are we going?*. St. Louis: Washington University.

Park, W. G., & Ginarte, J. C. (1997). Intellectual property rights and economic growth. *Contemporary Economic Policy, 15*, 51–61.

Peitz, M., & Waelbroeck, P. (2006). Piracy of digital products: A critical review of the theoretical literature. *Information Economics and Policy, 18*, 449–476.

Png, I. (2008). *On the reliability of software piracy statistics*. Mimeo: National University of Singapore.

Robertson, C., Gilley, K. M., & Crittenden, W. F. (2008). Trade liberalization, corruption and software piracy. *Journal of Business Ethics, 78*, 623–634.

Rodrik, D. (2008). Second-best institutions. *American Economic Review, 98*(2), 100–104.

Shadlen, K. C., Schrank, A., & Kurtz, M. J. (2005). The political economy of intellectual property protection: The case of software. *International Studies Quarterly, 49*, 45–71.

Shy, O., & Thisse, J. F. (1999). A strategic approach to software protection. *Journal of Economics and Management Strategy, 8*, 163–190.

SIIA. (2000). *SIIA report on global software piracy 2000*. Washington, DC: Software and Information Industry Association.

Stulz, R. M., & Williamson, R. (2003). Culture, openness and finance. *Journal of Financial Economics, 70*, 313–349.

Takeyama, L. N. (1994). The welfare implications of unauthorized reproduction of intellectual property rights in presence of network externalities. *Journal of Industrial Economics, 62*, 155–166.

Traphagan, M., & Griffith, A. (1998). Software piracy and global competitiveness: Report on global software piracy. *International Review of Law, Computers & Technology, 12*, 431–451.

UNDP. (2002). *Giving voice to the voiceless: Good governance*.New York: UNDP.

Varian, H. R. (1998). *Markets for information goods*. Mimeo: University of California Berkeley.

Varian, H. R. (2000). Buying, sharing and renting information goods. *Journal of Industrial Economics, 48*, 473–488.

Watt, R. (2001). *Prices in cultural markets: A theoretical introduction for beginners*. http://www.serci.org/documents/pricing.pdf.

Yang, D., Sonmez, M., Bostworth, D., & Fryxell, G. (2009). Global software piracy: Searching for further explanations. *Journal of Business Ethics, 87*, 269–283.

Yang, D., Sonmez, M., & Bosworth, D. (2004). Intellectual property abuses: How should multinationals respond? *Long Range Planning, 37*, 459–475.