Fighting Software Piracy in Africa: How Do Legal Origins and IPRs Protection Channels Matter?

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Abstract In the current efforts toward harmonizing intellectual property rights (IPRs) regimes in the African continent, this paper provides answers to four key questions relevant in the policy decision-making processes. After empirically examining the questions, the following findings are established. (1) In comparison to common law countries, civil law countries inherently have a significant autonomous rate of software piracy; consistent with the "law and property rights" theory. (2) But for IPRs laws, the other intellectual property (IP) protection channels (World Intellectual Property Organization treaties, main IP law, and multilateral treaties) reduce the incidence of software piracy. (3) In both short-run and long-term, IPRs protection channels in civil law countries appear to mitigate software piracy more than in common law countries. (4) Formal institutions are instrumental in the fight against software piracy through IPRs protection channels.

Keywords Software piracy · Intellectual property rights · Panel data · Africa

JEL Classification F42 · K42 · O34 · O38 · O57

Introduction

It has become crystal clear that, for any country, region, or continent to be actively involved in the global economy, it must be competitive. Competition derives from intellectual property (IP), which is protected by intellectual property laws. In recent history, there has been a wide consensus on the key role that intellectual property rights (IPRs) protection and strength of IPRs regimes play in promoting innovation processes and economic growth. Hence, the debate has centered around IPRs protection, with some scholars postulating that increased protection of IPRs stimulates

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economic growth and development through the appealing impact on factor productivity (Gould and Gruben 1996; Falvey et al. 2006). On the other hand, skeptics are of the stance that IPRs protection and adherence to international treaties (laws) may seriously infringe the growth prospects of developing countries (Yang and Maskus 2001). This strand supports its thesis by purporting that less-tight IPRs regimes are necessary (at least, in the short-term) for developing countries, to enable knowledge spillovers, imperative for growth and development. In their perspective, 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, while theoretical literature has addressed the concern to some degree, little scholarly attention has been paid to empirical literature. The focus of the existing empirical studies has been on socio-economic determinants of piracy in several copyright industries (Bezmen and Depken 2004, 2006; Banerjee et al. 2005; Peitz and Waelbroeck 2006; Andrés 2006; Goel and Nelson 2009; Andrés and Goel 2012). However, the debate has recently shifted toward measures needed to curb the proliferation of technology used to copy or pirate commodities. The recent trend of globalization, strengthened by increasingly sophisticated information and communication technologies (ICTs) has motivated efforts toward increasing and harmonizing the standards (and enforcement) of IPRs protection worldwide. Europe and North America have mastered the dynamics of IP and inexorably driving developments in the global and international arena. Other regions like Asia and South America are reacting in calculated steps that underscore the role of IP in the current pursuit of national, regional, and international initiatives. In Africa, IPRs issues are also assuming central stage in discussions on development in the continent.

To the best of our knowledge, current efforts towards harmonizing IPRs regimes in the continent will be eased if policy makers have answers to the following four questions. (1) Which IPRs regimes matter in the fight against software piracy? (2) How do legal origins matter in the effectiveness of IPRs regimes? (3) Are formal institutions instrumental in the enforcements of IPRs regimes? (4) If so, for which IPRs protection channels are they instrumental? Answers to the questions will provide the much needed policy guidance, as blanket IPRs regimes may not be effective without due considerations of legal origins and effectiveness of existing IPRs laws (treaties) in the policy-making process. The intuition behind the second question is that legal origins differ in the emphasis they place on private property rights vis-a-vis those of the state. Hence, then need for standardization of IPRs regimes to be contingent on existing trends in their effectiveness and tailored differently across countries with diverse legal origins. The motivation for the third question is the substantially documented issue of poor government quality in African countries (Asongu 2011, 2012a, b). Thus, it is would be interesting to know if formal institutions are a necessary condition for the enforcement of IPRs against software piracy. The fourth question helps in the understanding of which IPRs laws (treaties) result in the mitigation of software piracy when enforced by formal institutions. This last question is important in providing policy makers with the much needed guidance on

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

which IPRs channels to prioritize, given limited financial resources allocated for the fight against software piracy.

In order to find answers to the above questions, the two-stage least-squares (2SLS) estimation approach is employed. Government quality dynamics (of regulation quality, control of corruption, government effectiveness, voice and accountability, rule of law, and political stability) are used as instrumental variables. Four main findings are established. (1) In comparison to common law countries, civil law countries inherently have a significant autonomous rate of piracy, consistent with the "law and property rights" theory. (2) But for IPRs laws, the other IP protection channels (World Intellectual Property Organization (WIPO)[2] treaties, main IP law, and multilateral treaties) reduce the incidence of piracy. (3) In both short-run and long-term, IPRs protection channels in civil law countries appear to mitigate piracy more than in common law countries. (4) Formal institutions are instrumental in the fight against piracy through IPRs protection channels.

The rest of the paper is organized as follows. The section on "Literature Review" examines existing literature. Data and methodology are discussed and outlined respectively in "Methodology." The next section covers "Empirical Analysis." The last section is the "Conclusion."

Literature Review

Software Piracy, IPRs Protection, and the Quality of Institutions in Africa

Software piracy has reached an epidemic threshold in Africa (Hamade 2006; El-Bialy 2010). Consistent with the Business Software Alliance Global Software Piracy Study (Business Software Alliance (BSA) 2010) that evaluates the state of software piracy around the world, software piracy in Africa is double the global rate. For example, the commercial value of unlicensed software installed on personal computers (PCs) in Eastern and Southern Africa, which excludes South Africa attained $109 million in 2010 as 83 % of software installed on PCs during the year was pirated. This stands at almost double the global piracy rate for PC software (that is 42 %), having soared by 3.6 points on the previous 5-year average. To this effect, the role of governance and formal institutions have been substantially documented as a means of effectively tackling the rising phenomenon (International Development Corporation IDC 2009; El-Bialy 2010; Fripp 2011; Blakeney and Mengistie 2011; AFROL 2009; Agabi 2012). Two strands will make up this section. 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 growing phenomenon.

With respect to the growing importance of piracy in Africa, Kenya, Egypt, and Nigeria best illustrate the situation. Firstly, Agabi (2012) reports that software developers are losing millions of naira annually to software thefts. The phenomenon of software piracy is negatively affecting Nigeria's economy. Agabi further confirms from business experts that the problem of illegal software usage in the country is a serious one and posits that finding a solution is likely to become even more urgent

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[2] World Intellectual Property Organization

with the usage rate expected to increase over the coming years. Secondly, the Kenya Copyright Board is currently increasing its efforts in the fight against software piracy. It is reported that it would battle piracy with vigor as of 2012 in order to increase investment potential and crackdown on illegal use of software (Fripp 2011). Fripp emphasizes 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 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 (and strengthen) Kenya's IPRs laws/treaties/regimes by firmly dealing with those engaging in software piracy.[3] Thirdly, 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. It is highlighted that this is largely due to the improved collaboration between Egypt and the US on enforcement for IPRs cases (AFROL 2009). According to this AFROL report, Egypt is fully committed to further reducing its piracy rating and tackling the challenges facing the industry with a number of initiatives; among others, 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 (FDI)).

In the second strand, we devote space to discussing the role of institutions in IPRs protection and reduction of software piracy. Firstly, as concerns IPRs protection, the World Trade Organization (WTO) can be counted among the different multilateral organizations that are laying emphasis on the importance of legal reforms in African countries. These organizations guard these countries to grant and protect IPRs, given minimum requirement standards that should be fulfilled by each member country. A downside of this approach is that their strategy is mainly based on promoting one-fits-all institutions. Hence, they seem to ignore (or neglect) alternative institutional arrangements that could be used to reach efficient outcomes for the conflicting parties for a long time (El-Bialy 2010) or how institutions matter in upholding IPRs (as the present 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 significantly from those prevailing in rich countries. For example, Rodrik (2008) has qualified them as "second-best institutions" and described the institutional reforms promoted by multilateral organizations such the World Bank and International Monetary Fund or WTO as being heavily biased towards a best-practice approach. Even before Rodrik, this position had been well documented in the IPRs literature.[4]

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[3] "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).

[4] The model assumes the likelihood of determining a unique set of appropriate institutional arrangements in advance and then expects convergence towards those arrangements to be inherently desirable (El-Bialy 2010). Countries applying the same formal rules will have very different performance characteristics, since it is obvious that they have different informal norms and enforcement characteristics (North 1995). Hence, it is very uneasy 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 setup 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.

Secondly (on the role of institutions on software piracy), during the end of the twentieth century, the world began moving toward new IPR strategies, with emphasis on the need for cooperative policies to reduce software piracy. Governments, together with software companies, the International Intellectual Property Alliance and the BSA started doing lots of cooperative efforts to tackle 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 country- and regional-specific piracy trends (El-Bialy 2010). Consistent with El-Bialy, it started looking at alternative solutions to tackle piracy. Beside 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.[5] During the past few years, the tendency toward reforming "IPR enforcing organs" within developing countries has become the focus of much attention. The efficiency of the enforcement authorities or the process of factual (de facto) enforcement is now acknowledged an important orientation of modern IPRs policies (El-Bialy 2010).

Theoretical Framework: Legal Origins and IPRs

This section describes the "Law and Property Rights Theory." We devote space to spell out the difference in how legal heritage continue to shape private property rights protection, investor protection laws, and development today. In this section, we also describe two mechanisms via which legal origin may affect the contracting environment: the political and adaptability mechanisms.

Law, Enforcement, and Private Property Rights

The first strand of the "law and property rights" theory emphasizes that legal institutions influence property rights and development (La Porta et al. 1998). The law and property rights theory stresses that cross-country differences in: (1) contract, company, bankruptcy, and security laws; (2) the legal system emphasis on private property rights, and (3) the efficiency of enforcement, influence the degree of expropriation, and hence the confidence by which people are motivated to take part in innovation and invention processes. As sustained by La Porta et al. (2000) and backed by Beck and Levine (2005), the law and property rights view follows naturally from the evolution of corporate laws handed down to colonies during the past half century. A country's contract, company, security, bankruptcy, and IPRs laws, as well as the enforcement of these laws fundamentally determine the rights of IP holders and the level of innovation.

Concerning how legal establishments should influence IP and the strength of IPRs, within a broad vision there are differing opinions regarding the degree to which legal systems should support the private contractual arrangements and the degree to which

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

the legal system should have specific laws concerning property rights. According to Coasians (Coase 1960), the legal system should simply enforce private contracts. Hence, effective legal establishments allow knowledgeable and experienced market participants to design a vast array of sophisticated private contracts in a bid to ameliorate complex agency problems (Coase 1960; Stigler 1964; Easterbrook and Fischel 1991). The law and private property theory three-point view has been highlighted in the "Introduction" of this strand. Whether assuming a Coasian dependence on enforcing complex private contracts or an approach that augments the support of private contracts with company, bankruptcy, securities, IPR laws, etc., the law and property rights theory argues that the degree of protection of private property is a paramount determinant of incentives to innovation and invention that ultimately lead to development.[6]

From Legal Origin to Piracy: Political and Adaptability Mechanisms

In the second strand, we extend theories by Beck et al. (2003) in presenting a case as to *why* legal origin matters in IPRs, innovation, and development. They have examined two channels by which legal origins may influence development: the political and adaptability channels.

The political mechanism is based on two standpoints. Firstly, legal traditions differ in the emphasis they attribute to protecting the rights of private investors (in innovation for example) relative to those of the state. Secondly, private property rights protection forms the foundation for innovation and development. Hence, historically based differences in legal origin can help explain existing disparities in development with respect to this component of law and "investor right" (La Porta et al. 1998). A great many scholars argue that the Civil law has tended to support the rights of the State, vis-a-vis private property rights, which is quite the opposite in Common law. Hence, Civil law countries have provided for legal systems that have unhealthy implications for innovation and development. A powerful State with a responsive civil law at its disposal will tend to divert the flows of society's resources towards favored ends, which is not conducive for competition. More so, a powerful State will have difficulty credibly committing to not interfere in the innovation process that will also obstruct financial development. Thus, the law and property rights theory emphasizes that Civil law countries will have feebler property rights protection and lower levels of innovation (and development) than countries with other legal traditions. In contrast, Common law has historically tended to side with private property owners against the State. Instead of becoming a tool of the state, Common law has acted as a powerful tool in the upholding of private property rights. Rajan and Zingales (2003) note that governments in Civil law countries were more effective than governments in Common law countries in stretching the role of government at the cost of market growth during the Interwar period 1919–1939. They attribute this difference to the heavy task of the judiciary vis-a-vis the legislature. Thus, the law and property rights theory postulates that the British

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[6] The link between strong property rights and innovation and the idea of proper incentives are the subject of vigorous academic debate (see section "The politics of piracy and intellectual property rights protection").

Common law supports innovation development to a greater extent than Civil law systems.[7]

The second mechanism linking legal origin to development is the adaptability channel that is also built on two premises. On a first note, legal systems differ in their ability to adjust to changing and evolving circumstances. Secondly, if a country's legal system adapts only slowly to changing circumstances (especially economic), large gaps will open between the innovation needs of an economy and the ability of the legal system to support and fulfill those needs. An influential, albeit by no means unanimous position of inquiry holds that legal systems that espouse case and judicial discretion tend to adhere more efficiently to changing conditions than legal systems that adapt rigidly to formalistic procedures and that rely more strictly on judgments narrowly based on statutory law (Coase 1960). Posner (1973) disputes that, although legislators consider the incidence on particular individuals and interest groups when writing statutes, judges are forbidden from considering the deservedness of specific litigants and thus more likely to render decisions founded on objective efficiency criteria (Rubin 1982, p 205). It follows that Common law systems are much more efficient than statutory-based systems because inefficient laws are routinely litigated and re-litigated pushing the law toward more efficient outcomes (Rubin 1977; Priest 1977), especially in the rapidly evolving context of ICTs and IPRs protection. From another perspective, some authors argue that statutory law evolves slowly and is subject to a greater degree of inefficient political pressures than Common law (Posner 1973; Bailey and Rubin 1994).

The Politics of Piracy and Intellectual Property Rights Protection

Developing countries in particular may have strong incentives to offer minimal protection of IP. In the simplest terms, this implies these countries may have strong incentives to offer minimal protection to IPRs to favor users of IP over (usually non-local) producers and hence, mitigate the negative welfare effects of raising the price of potentially key inputs. In the same line of thinking, as a country develops, the need for IPRs protection becomes essential to ameliorate the investment climate, stimulate innovation, and improve economic prosperity.

Consistent with Shadlen et al. (2005), managing the trade-off between consumers and producers is particularly complex with regard to IPR. The complexities are derived from the characteristics of expression (and ideas) as distinct types of commodities. IPRs are different from "normal" property rights from the perspective that ideas are different from tangible goods. Accordingly, ideas are non-rival in consumption and non-exhaustible. This implies that an unlimited number of people can use the same idea simultaneously and repeated use does not deplete (diminish) the stock of the idea. Owing to these distinct features, many of the standard rationales for giving property owners extensive rights to control the use of their commodities go by the wayside. In the absence of proper incentives to producers, ideas like tangible goods

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[7] Note should be taken of the fact that many scholars have expressed doubts about the validity of the legal origin theory. A more balance discussion has been presented to address the debates on comparative property law in caveats of the paper (see section "Caveats").

run the risk of being undersupplied. However, endowing owners with strong rights to control distribution (and hence restrict use) so as to avoid depletion of goods (that by their definition are nonexhaustible) is unnecessary. In the same vein, restricting use can freeze ideas and stifle innovation. Indeed, a substantial body of the literature cautions on the dangers of too much protection of IPRs.[8]

In order to strike the delicate balance between provision and distribution, IPRs have historically been limited. Private rights over ideas may not be automatically conferred upon possession. Nor are rights indefinite: For instance, patents and copyrights expire, after which what is private property enters into the public domain. Private property rights are also limited in the perspective of being object of a range of automatic exceptions (in that third parties also have rights to use ideas and goods protected by IPRs). As concerns copyrights, these rights fall under the doctrine of "fair use" which enables third parties to use copyrighted material regardless of the intent of the copyright owner. Indeed, before the 1980s, most governments throughout the world offered porous and weak copyright protection, precisely to stimulate diffusion and use (Lessig 2001, p. 249).

As emphasized by Shadlen et al. (2005), much has changed in IPRs since the 1980s. Fundamental variations to the limitations have traditionally distinguished the treatment of intellectual property from tangible property (May 2000). With the example of software, in addition to making copyrights easier to obtain by simplifying the process of registration, the current arrangement endows copyright owners with significantly greater control and exclusion rights; implying third parties' rights to fair use have been significantly reduced (Shadlen et al. 2005). This represents a significant challenge for governments in the enforcement of international treaties (laws) on IPRs protection in a bid to mitigate the soaring phenomenon of piracy. By granting extensive periods of protection to patents (and copyrights), IPRs are made effectively permanent (Shadlen et al. 2005). As Lessig (2001, p.252) has sustained, 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. This substantially implies the sea of changes includes introduction of software under copyright law, significantly greater scope of protection for copyright owners, and longer periods of protection. Beside the extraordinary trade-off between innovation and diminished diffusion of new commodities, at the national level, an issue arises on how to enforce IPRs and fight piracy, which is the object of this paper.

Intellectual Property Rights (IPRs) and Development

There are two principal avenues along which IP and the strength of IPRs regimes are thought to affect the level of economic growth and development (Bezmen and

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[8] For instance, by providing the owners of ideas with more protection, stronger IPRs may stifle incentives to innovate and introduce novel 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 "anticommons" (Heller and Eisenberg 1998), since diminished access to upstream ideas can significantly deter downstream innovation. Hence, the challenge for the management of IPRs and policy orientation is to create incentives for provision that do not unnecessarily inhibit the distribution.

Depken 2004). The first strand provides analysis of the extent to which IPRs influence the creation of novel knowledge and information within nations, as well as the diffusion of existing knowledge across countries. The second strand is focused on the indirect effects of a nation's IPRs regime on international transactions that provide factors crucial for the growth process. Some discussion on the debate on how a nation effectively uses its potential for IPRs to spur growth (in the context of developing countries) is discussed in the third strand.

In the first strand which is tilted towards "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 rewards individual investors with profit (returns) and also augments society's stock of knowledge. Lowering the cost of future innovation and invention 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 catalyst to growth by encouraging inventions and innovations. In recent history, many newly industrialized countries have campaigned for stronger IPRs through bilateral, multilateral, and regional arrangements. This difference in approach derives from the desire of developing countries to specialize in labor-intensive production in agricultural industries. Until much recently, these industries have greatly benefited from shared knowledge spillovers and public expenditures have largely supported them in research and technology.

In the second strand, IPRs may also influence a nation's growth and development process through their influence on the nation's ability to engage in international transactions such as technology transfers, trade, and FDI flows (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 spur greater utilization of human resources (Todaro and Smith 2003) and ease the transmission of technology by providing contact with foreign counterparts and direction of domestic resources towards more research focused and intensive sectors. Nevertheless, these models do not necessarily predict that openness brings economic growth for all countries and under all circumstances, principally because theoretical prediction depends on country-specific conditions. There is substantial documentation to support the view that a stronger IPRs regime is a crucial factor in attracting the inflows of FDI and technological transfers (Lee and Mansfield 1996), stimulating exports (Maskus and Penubarti 1995), and increasing the possibility of investment undertaken by multinational enterprises (Mansfield 1994; Seyoum 1996). From the other side of the coin, stronger IPRs protection could mitigate the need for FDI (Yang and Maskus 2001).

The third strand is devoted to discussing the debate on how a developing nation uses its potential for IPRs to spur growth. According to some scholars: "IPRs are thought to be successful at spurring economic growth and activity only after a nation has acquired or accumulated sufficient human capital and technology infrastructure for creative imitation to take place" (Maskus and Penubarti 1995; Kim 2004; Bezmen and Depken 2004). This issue remains open to debate in the light of the East Asian

Miracle'.[9] Whereas Nelson and Pack (1999) have postulated that the assimilation of existing (foreign) productive techniques and technologies "was a critical component of the success of these countries," Maskus (2000) cautions that weaker protection of IPRs will not necessarily be rewarding for developing countries as it may cause them to remain dependent on older and/or less efficient technologies.

Methodology

Data

Measuring Software Piracy

The measure of piracy is the software piracy rate, which is defined as "the unauthorized copying of computer software which constitutes copyright infringement for either commercial or personal use" (SIIA 2000). Software piracy is multidimensional and complex and could potentially take many avenues, e.g., organized copiers, piracy by individuals, and commercial or business piracy. Hence, obtaining an accurate measure of the prevalence of software piracy remains quite a challenge in the literature. Borrowing from the BSA, there are many types of piracy, and we can distinguish among: (1) end-user copying; (2) downloading; and (3) counterfeiting. Piracy level is computed as the difference in demand for new software applications (computed from PC shipments) and the legal supply of software. In the present paper, the measure of piracy employed is the percentage of software (primarily business software) in a country that is illegally installed (without a license) on a yearly basis and is taken to capture the level of piracy in software. This proxy is reported in percentages, varying from 0 % (or no piracy) to 100 % (i.e., all software installed is of pirated origin). Piracy data is gathered from the BSA (Business Software Alliance 2009). Additional discussion on measurement could be obtained from BSA (Business Software Alliance 2009).[10] BSA is an industry group; nonetheless, its data on software piracy are the best cross-country measures currently used in the literature, subject to some inherent upward bias.[11]

Intellectual Property Rights (IPRs) Variables

IPRs variables are collected from the WIPO. The four endogenous explaining variables gathered include: IPRs laws, main IP laws, WIPO treaties, and multilateral

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[9] Additional support for the possibility that the changing strength of IPR regimes is based on a nation's level of development or current technological ability is found in the rapid growth witnessed by Southeast Asia. Some evidence suggests that the "East Asian Miracle" could have been caused by weaker IPRs regimes at the early stages of these nations' development in addition to their accumulation of capital. These nations' capacity to absorb, replicate, and duplicate foreign innovations may have contributed to their relatively high growth rates. It has been further noted that, as these countries became significant producers of new technologies and innovations, their IPR regimes tightened.

[10] Data from the BSA primarily provide measurement for the piracy of commercial software. More discussion on the reliability of piracy data could be obtained from Traphagan and Griffith (1998) and Png (2008).

[11] This data have been widely used in the literature on piracy (Marron and Steel 2000; Banerjee et al. 2005; Andrés 2006; Goel and Nelson 2009).

treaties. IPRs laws and main IP laws are IP laws that are enacted by the legislature and enforced by institutions. WIPO-administered treaties are defined from the day they enter into force for the contracting party (country). IP-relevant multilateral treaties data are also gathered with respect to the date they are enforced by contracting parties.

Instrumental and Control Variables

In this section, we devote space to providing justification for the empirical validity of the instruments. This justification is essential for the relevance of the empirical analysis since a theoretical basis for the instrumental variables is crucial for sound and consistent interpretation of estimated coefficients. In other words, whereas the object of this article is to assess the effect of IPRs laws (treaties) on software piracy, it also indirectly seeks to examine how government institutions are instrumental in the incidence of IPRs protection channels on software piracy. The instrumental variable approach in the empirical section requires that the instruments be correlated with the main endogenous explaining variable (piracy rate). Logic and common sense have it that government institutions and IPRs laws move hand-in-glove. Save in utopia, we cannot discuss one while ruling-out the other. Hence, only formal institutions set up by the government in place can uphold and enforce IPRs laws (treaties). Measures indicating the quality of formal institutions include: the rule of law, regulation quality, government effectiveness, corruption-control, political stability (no violence), and voice and accountability. We argue that these good governance indicators are natural instruments for the upholding and enforcement of IPRs laws (treaties).

Due to constraints in the degrees of freedom required for the test on validity of the instruments, we are unable to use more than one control variable at a time.[12] Consistent with recent piracy literature (Andrés and Goel 2011; Asongu 2012c), we employ two control variables: Internet penetration and literacy rates. From common sense and intuition, these rates should have a positive relationship with the level of software piracy. However, this intuition does not apply in every development context because it is also reasonable to some extent to expect that the type of education that impacts piracy rates and not the country's level of education per se. For instance, technical education is likely to decrease the cost of software piracy, which should increase piracy among software literate groups (Andrés and Goel 2011, p. 14).

Owing to constraints in piracy data availability, the data include annual observations for 11 African countries for the years 2000–2010. The data are made up of six common law countries and five civil law countries. Details about the variable definitions (and data sources), summary 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 quite a degree of variation in the data used so that one should be confident that reasonable estimated relationships should emerge. The purpose of the correlation matrix (Appendix 2) is to

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[12] An over-identifying restrictions (OIR) test is employable only in the presence of over-identification. That is, the instruments should be higher than the endogenous explaining variables by at least one degree of freedom. In cases of exact-identification (instruments equal to endogenous explaining variables) and under-identifications (instruments less than endogenous explaining variables), an OIR test is by definition not possible.

attenuate issues resulting from overparametization and multicolinearity. Based on the correlation coefficients, there do not appear to be any serious concerns in terms of the relationships to be estimated.

Methodology

This paper adopts a 2SLS instrumental variable (IV) estimation technique, in accordance with recent piracy literature (Andrés and Goel 2012). 2SLS 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. More so, the IV approach is consistent with the questions in the "Introduction" of this paper. The 2SLS estimation will entail the following steps:

First-stage regression:

$$IP_{it} = \gamma_0 + \gamma_{1i}(\text{Instruments})_{it} + \upsilon_{it} \tag{1}$$

Second-stage regression:

$$\text{Piracy}_{it} = \gamma_0 + \gamma_1(\text{IP}) + \quad \mu_{it} \tag{2}$$

In the first and second equations, υ_{it} and μ_{it}, respectively, denote the error terms. Instrumental variables are: regulation quality, control of corruption, government effectiveness, voice and accountability, rule of law, and political stability. IP represents IPRs laws (treaties): main intellectual property law, intellectual property rights law, WIPO treaties, and multilateral treaties. *Piracy* is the software piracy rate.

We adopt the following steps in the 2SLS analysis: (1) justify the choice of an IV over an OLS estimation technique with the Hausman-test for endogeneity; (2) verify the instruments are exogenous to the endogenous components of the explaining variables (IPRs channels); and (3) ensure the instruments are valid and not correlated with the error-term in the main equation with an OIR test. Beside the control for endogeneity, further robustness of our models is ensured by the following: (1) use of both "full data" and "average data" with non-overlapping intervals to capture the long-run and short-term tendencies of estimated coefficients respectively; (2) employment of robust heteroscedasticity and autocorrelation consistent (HAC) standard errors; and (3) restricted and unrestricted modeling to control for the "legal origin and property rights" theory.

Empirical Analysis

Presentation of Results

This section examines the four main questions outlined in the "Introduction." (1) "Which IPRs regimes matter in the fight against software piracy?" (2) How do legal origins matter in the effectiveness of IPRs regimes? (3) Are formal institutions instrumental in the enforcements of IPRs regimes? (4) If so, for which IPRs protection channels are they instrumental? To examine these issues, we use the 2SLS approach with government quality instrumental variables.

Table 1 below reports results for the IV regressions. Full data reflect long-run estimate whereas 2-year non-overlapping intervals (NOI) estimates are short-term. We have employed restricted and unrestricted (with a constant) modeling approaches to control for the law-property rights theory. For optimal specification of our models, two main tests are performed: the Hausman and the Sargan–OIR tests. The null hypothesis of the Hausman test is the position that OLS estimates are consistent and efficient. Hence, a rejection of the null hypothesis points to the issue of endogeneity and lends credit the choice of the IV estimation technique. The null hypothesis of the Sargan test is the stance that the instruments do not explain piracy beyond IPRs laws (treaties) channels. In other words, the null hypothesis is the position that the IPRs laws (treaties) are strictly exogenous and do not suffer from endogeneity when instrumented with government quality indicators. Hence, failure to reject the null hypothesis will indicate the instruments are valid. Based on the findings in Table 1: The null hypotheses of the Hausman tests are overwhelmingly rejected for all the models, but for Model 2 at a 10 % significance level, the null hypotheses of the Sargan tests are not rejected. Therefore, results of both tests, respectively, justify the IV estimation approach and validate the government quality instrumental variables. We could not control for more than one variable at a time because of constraints in the Sargan–OIR test for instrument validity. We have six government quality instrumental variables and hence, must use less than six endogenous explaining variables to guarantee at least one degree of freedom: imperative for the OIR test. Both control variables are significant with the right signs.

Discussion of Results, Policy Implications, and Caveats

Law and Property Rights Theory

From the results in Table 1, we notice a very significant constant term for civil law countries. This confirms the law and property right theory we discussed in section "Theoretical framework: legal origins and IPRs." Autonomous piracy in civil law countries is significant because, inherently, contrary to their common law counterparts, civil law countries were handed down a legal heritage that continue to shape private property rights protection in a negative way. While common law champions private property rights vis-a-vis the powers to the state, civil law inherently does the contrary. Hence, the significant autonomous piracy. Our position in this interpretation is supported by a substantial bulk of literature (Coase 1960; Stigler 1964; Posner 1973; Rubin 1977, 1982; Priest 1977; Easterbrook and Fischel 1991; Bailey and Rubin 1994; La Porta et al. 1998, 2000; Beck et al. 2003; Rajan and Zingales 2003; Beck and Levine 2005).

Which IPRs Regimes Matter in the Fight Against Software Piracy?

But for IPRs laws, the other IP laws (WIPO treaties, main IP law, and multilateral treaties) reduce the incidence of piracy. This finding is consistent across legal origins and time-static (stable across short-run and long-term estimates). The fact that IPRs laws channel reflects a positive incidence on piracy in both common and civil law

Table 1 2SLS Regressions (with HAC standard errors)

Dependent variable: piracy rate

	Common law				Civil law			
	Full data		Two-year NOI		Full data		Two-year NOI	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Constant	—	0.440	—	0.179	—	2.555[c]	—	3.061[c]
		(1.403)		(0.535)		(5.576)		(2.654)
Main IP law	−0.194[c]	−0.180[c]	−0.189[c]	−0.184[c]	−0.41[c]	−0.37[c]	−0.471[b]	−0.451[b]
	(−10.24)	(−8.117)	(−8.326)	(−8.301)	(−5.649)	(−4.429)	(−2.080)	(−2.182)
IPRs law	0.142[c]	0.074	0.127[b]	0.103[c]	0.203[c]	0.175[c]	0.256	0.241
	(3.607)	(1.324)	(2.542)	(2.654)	(4.110)	(2.726)	(1.587)	(1.564)
WIPO treaties	−0.155[c]	−0.137[c]	−0.117[a]	−0.116[b]	−0.063	−0.15[c]	−0.103	−0.219[b]
	(−2.672)	(−3.508)	(−1.931)	(−2.310)	(−0.911)	(−4.860)	(−1.170)	(−2.215)
Multilat. treaties	−0.077[c]	−0.095[c]	−0.069[c]	−0.076[c]	−0.12[c]	−0.12[c]	−0.142[a]	−0.154[a]
	(−4.421)	(−8.052)	(−3.088)	(−3.835)	(−4.323)	(−3.127)	(−1.723)	(−1.807)
Internet penetration	0.690[c]	0.572[c]	0.629[c]	0.588[c]	—	—	—	—
	(7.555)	(4.210)	(6.074)	(4.533)				
Literacy rate	—	—	—	—	1.285[c]	—	1.453[b]	—
					(6.773)		(2.457)	
Hausman test	151.77[c]	134.71[c]	132.14[c]	95.140[c]	114.76[c]	148.27[c]	62.223[c]	123.02[c]
Sargan OIR test	3.231	2.753[a]	1.617	1.768	2.520	0.840	2.482	1.094
	[0.198]	[0.097]	[0.445]	[0.183]	[0.283]	[0.656]	[0.289]	[0.578]
Adjusted R^2	0.863	0.885	0.864	0.875	0.439	0.484	0.120	0.170
Fisher	4,122.4[c]	314.86[c]	3,408.6[c]	18.627[c]	52.977[c]	130.60[c]	1.55e+15[c]	297.55[c]

Table 1 (continued)

Dependent variable: piracy rate

	Common law		Civil law	
	Full data	Two-year NOI	Full data	Two-year NOI
Countries	6	6	5	5
Observations	46	26	44	44
Instruments	Constant; control of corruption; government effectiveness; rule of law; regulation quality; political stability; voice, and accountability			

Z-statistics in parentheses; P values in brackets

HAC heteroscedasticity and autocorrelation consistent, *NOI* non-overlapping intervals, *Main IP* main intellectual property, *IPRs* intellectual property rights, *WIPO* World Intellectual Property Organization, *Multilat* multilateral, *OIR* overidentifying restrictions

[a] 10 % significance level

[b] 5 % significance level

[c] 1 % significance levels

countries means other issues common to both types of legal systems significantly affect the enforcement of the IPRs laws enacted by the legislature. Investigating this concern could be an interesting future research direction.

How Do Legal Origins Matter in the Effectiveness of IPRs Laws (Regimes)?

In both short-run and long-term, IPRs protection channels in civil law countries appear to mitigate piracy more than in common law countries. There are two possible explanations to this. (1) IPRs protection channels in civil law countries have a higher impact on the piracy rate because of the inherent absence of a "property rights" legal culture, as confirmed by the significant constant. This explanation is logical in the perspective that where the prevalence of piracy is already high (constant significant term), the effects of introducing IPRs laws will be greater on the rate of piracy than in regions with traditionally low prevalence of piracy rates. The inherent higher prevalence of piracy in civil law countries could further be observed from the summary statistics (Appendix 1) with the mean piracy rate in civil law countries 0.462 as opposed to 0.368 in their common law counterparts. (2) The higher incidence of IPRs laws (treaties) in civil countries could originate from the government quality instruments. Where more government resources are devoted to the fight against piracy through IPRs protection channels, it is only natural that the effect could be greater.

Are Formal Institutions Instrumental in the Enforcement of IPRs Laws (Treaties)? If so, for Which IPRs Laws (Channels)?

The answer is a simple *yes*. The null hypotheses of the Sargan–OIR tests are overwhelmingly rejected. Implying formal institutions are instrumental in the fight against piracy through IPRs laws (treaties) channels. But for one channel, government quality dynamics are instrumental in all the IPRs mechanisms investigated.

Caveats

Three main caveats have been retained: limitations in the measurement of software piracy; the inherent absence of a clear-cut distinction between the effects of upholding IPRs (on innovation and piracy); and doubts about the law and property rights theory.

Firstly, on the measurement of software piracy, three points are relevant. (1) "Piracy level is computed as the difference in demand for new software applications (computed from PC shipments) and the legal supply of software." It should be noted that this metric defines piracy as the drop in demand of software products. Hence, all pirated copies constitute lost sales. (2) It has been substantially documented that those who buy pirate copies do not always have the money to buy the true commodity. Therefore to consider the use of pirated products as diminishing demand for originals could be some kind of overstatement. (3) The use of the metric presupposes knowledge of the elasticity of demand for the original product. Otherwise, there will be a comparison of pirated products that constitutes loss in sales with ones that do not. Thus, there is some upward bias in the software piracy estimate.

Secondly, when it comes to software, innovation could be triggered in an environment where sharing and collaboration is made possible. Piracy can be cracked down by a legal system favoring strong property rights (strict laws and a judiciary in favor of upholding property rights). However, the question of innovation is different and there is a heated debate between innovation levels and IP law. Hence, the inherent absence of a clear-cut distinction between the effects of upholding IPRs (on innovation and piracy) implies that our findings should be interpreted with caution from the innovation dimension.

Thirdly, some doubts have been documented about the law and property rights theory, which suggest that British Common law supports innovation development to a greater extent than Civil law systems. The legal origins theory from which the underlying theory is derived suggests that Common law systems (strong property rights, the role of the judiciary, etc.) promote innovation better than Civil law systems. Four points are important to retain here. (1) Some scholars doubt whether the distinction between Common law and Civil law can be justified from an historical perspective (Deakin and Siems 2010, p. 10). (2) Today, with internationalization, modern trends make the Common law/Civil law distinction even less persuasive. (3) It is not clear why in substance we may expect differences in Common law and Civil law systems on the pure assumption that Common law tradition is characterized by independent judges and juries (relatively weaker reliance on statutes and the preference for contracts and private litigation as a means of dealing with social harms), whereas Civil law tradition is characterized by state-employed judges, great reliance on legal and procedural codes, and a preference for state regulation over private regulation. (4) The classification of countries into Common law and Civil law countries disregards: the ongoing influence of their pre-transplant law; the mixture and modification at the moment when some copying of foreign law occurs; and the post-transplant period (in which the transplanted law may be altered or applied differently from the origin country).

Conclusion

The recent trend of globalization, strengthened by increasingly sophisticated ICTs, has motivated efforts towards increasing and harmonizing the standards (and enforcement) of IPRs protection worldwide. Europe and North America have mastered the dynamics of IP and inexorably driving developments in the global and international arena. Other regions like Asia and South America are reacting in calculated steps that underscores the role of IP in the current pursuit of national, regional, and international initiatives. In Africa, IPRs issues are also assuming central stage in discussions on development in the continent. To ease current efforts towards harmonizing IPRs regimes in the continent, this paper has provided answers to four key questions for which policy makers could be seeking answers.

The following findings have been established. (1) In comparison to common law countries, civil law countries inherently have a significant autonomous rate of software piracy; consistent with the law and property rights theory. (2) But, for IPRs laws, the other IP protection channels (WIPO treaties, main IP law, and multilateral treaties) reduce the incidence of software piracy. (3) In both short-run and long-term,

IPRs protection channels in civil law countries appear to mitigate software piracy more than in common law countries. (4) Formal institutions are instrumental in the fight against software piracy through IPRs protection channels.

Appendix

Table 2 Summary statistics and presentation of countries

Panel A: summary statistics		Mean	SD	Min	Max	Obser
Dependent variable	Piracy rate	2.745	1.857	0.000	5.250	121
	Piracy rate (Common law)	0.368	0.349	−0.288	0.720	60
	Piracy rate (Civil law)	0.462	0.234	0.034	0.720	46
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
Control variables	Internet penetration	2.888	0.799	1.301	4.727	121
	Literacy	1.826	0.097	1.572	1.956	110
	Control of corruption	−0.309	0.641	−1.236	1.086	110
	Rule of Law	−0.302	0.687	−1.657	1.053	110
Instrumental variables	Regulation quality	−0.180	0.547	−1.305	0.905	110
	Government effectiveness	−0.164	0.583	−1.038	0.807	100
	Voice and 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 (F), Botswana (E), Cameroon (F), Egypt (F), Kenya (E), Mauritius (E), Morocco (F), Nigeria (E), Senegal (F), South Africa (E), Zambia(E)

SD standard deviation, *Min* minimum, *Max* maximum, *Obser* observations

Table 3 Correlation matrix

	Piracy rate	IP independent variables				Government quality instrumental variables						Control variables		
		MIPL	IPRL	WIPO	Multi	CC	RL	RQ	GE	VA	PolS	Internet	Literacy	
1.00														Piracy
	-0.71	1.00										0.43	0.35	MIPL
	-0.01	0.10	1.00									0.25	-0.39	IPRL
	0.32	-0.27	1.00									0.20	-0.53	WIPO
	0.02	-0.22	0.44	0.30	1.00							0.35	-0.61	Multi
	-0.43	0.23	0.19	0.31	-0.09	-0.26	1.00					-0.30	0.41	CC
	-0.50	0.10	0.12		-0.12	-0.06	0.90	1.00				-0.26	0.37	RL
	-0.60	0.29	0.08		-0.09	-0.15	0.86	0.87	1.00			-0.25	0.46	RQ
	-0.60	0.43	0.28		-0.10	-0.12	0.94	0.88	0.93	1.00		-0.12	0.40	GE
	-0.42	0.29	-0.02		-0.09	-0.20	0.79	0.72	0.84	0.83	1.00	-0.35	0.40	VA
	-0.29	0.01	0.01		-0.22	-0.14	0.77	0.82	0.76	0.71	0.72	1.00	-0.49	0.41	PolS
	-0.18											1.00	-0.10	Internet
	-0.34												1.00	Literacy

MIPL main intellectual property rights, *IPRL* intellectual property rights law, *WIPO* WIPO treaties, *Multi* multilateral treaties, *CC* control of corruption, *RL* rule of law, *RQ* regulation quality, *GE* government effectiveness, *VA* voice and accountability, *PolS* political stability

Table 4 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
Internet penetration	Internet	Logarithm of Internet users	WDI (World Bank)
Literacy	Literacy	Logarithm of literacy	WDI (World Bank)
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 governments commitments to such policies	WDI (World Bank)
Voice and 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 destabilized or overthrown by unconstitutional and violent means, including domestic violence and terrorism	WDI (World Bank)

WDI World Bank development indicators, *BSA* business software alliance, *Log* logarithm, *WIPO* World Intellectual Property Organization, *IP* intellectual property

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