AFRICAN GOVERNANCE AND DEVELOPMENT INSTITUTE

A G D I Working Paper

WP/14/011

Global trajectories, dynamics, and tendencies of business software piracy: benchmarking IPRs harmonization

Simplice A. Asongu
African Governance and Development Institute,
Yaoundé, Cameroon.
E-mail: asongusimplice@yahoo.com

Antonio R. Andrés
Universidad Camilo Jose CelaFacultad de CC. Jurídicas y Económicas C/
Castillo de Alarcón, 49 – Urb. Villafranca del Castillo 28692 –
Villanueva de la Cañada (Madrid).
E-mail : antoniorodriguezandres70@gmail.com

© 2014 African Governance and Development Institute WP/14/011

AGDI Working Paper

Research Department

Global trajectories, dynamics, and tendencies of business software piracy: benchmarking IPRs harmonization

Simplice A. Asongu[1] & Antonio R. Andrés

June 2014

Abstract

In this paper, we examine global trajectories, dynamics, and tendencies of software piracy to ease the benchmarking of current efforts towards harmonizing the standards and enforcements of Intellectual Property Rights (henceforth IPRs) protection worldwide. Our empirical exercise is based on 15 different panel regressions, which together consists of 99 countries. The richness of the dataset allows us to disaggregate countries into fundamental characteristics of business software piracy based on income-levels (high-income, lower-middle-income, upper-middle-income and low-income), legal-origins (English common-law, French civil-law, German civil-law and, Scandinavian civil-law) and, regional proximity (South Asia, Europe & Central Asia, East Asia & the Pacific, Middle East & North Africa, Latin America & the Caribbean and, Sub-Saharan Africa). Our main finding suggest that, a genuine timeframe for standardizing IPRs laws in the fight against software piracy is most feasible within a horizon of 4.3 to 10.4 years. In other words, full (100%) convergence within the specified timeframe will mean the enforcements of IPRs regimes without distinction of nationality or locality within identified fundamental characteristics of software piracy. The absence of convergence (in absolute and conditional terms) for the World panel indicates that, blanket policies may not be effective unless they are contingent on the prevailing trajectories, dynamics and tendencies of software piracy. Policy implications and caveats are also discussed.

JEL Classification: F42; K42; O34; O38; O57
Keywords: Piracy; Business Software; Software piracy; Intellectual Property Rights; Panel data; Convergence

[1] Simplice A. Asongu is lead economist in the Research Department of the AGDI (asongus@afridev.org).

1. Introduction

Although piracy of software on personal computers (henceforth PC) declined in many countries a few years ago, fast growing PC makers in some of the world's highest piracy nations have caused the overall numbers to worsen (BSA[2], 2007). With dollar losses from piracy rising by $8 billion to nearly $48 billion, the trend is expected to soar exponentially if urgent action is not taken (Andrés & Asongu, 2013)[3]. In recent history, there has been a wide consensus on the key role that intellectual property rights (IPRs) protection play in the promotion of innovations and economic growth (Andrés & Asongu, 2013). This has made it abundantly clear that, for any country, region or continent to be actively engaged in the global economy, it must be competitive. Competition derives from intellectual capital that is protected by IPRs laws. Unfortunately, innovation and technological progress have not only brought an increase availability of information and technology related products, but also the proliferation of technology used to copy and pirates such commodities (Asongu, 2013a). In light of the pressing issues, efforts have been devoted to increasing and harmonizing the standard and enforcement of IPRs protection worldwide. Until much recently, the debate (centered on IPRs protection) has been focused on the pros and cons of IPRs, especially on developing countries[4]. However a

[2] Business Software Alliance.

[3] The traditional point of view on piracy is that it is harmful. The mains argument is that potential consumers get to consume illegal products that are substitutes to the legal ones. The argument is based on the assumption that there is a significant displacement rate. Nevertheless, more recently Waldfogel (2012) suggests that this assumption is not correct. Substantial part of the products consumed illegally would simply not have been purchased in absence of piracy. Another study, reports that a certain level of piracy could have some positive effect (Lahiri and Dey, 2013).

[4] "*The debate has centered around IPRs protection, with some scholars postulating that increased protection of IPRs stimulates economic growth and development through the appealing impact on factor productivity (Gould & Gruben, 1996; Falvey et al., 2006). On the other hand, skeptics are of the position that IPRs protection and adherence to international treaties (laws) may seriously limit the growth prospects of developing countries (Yang & Maskus, 2001). This strand is of the view 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. According to them, the existing technology in developing countries is more imitative and/or adaptive in nature and not suitable for the creation of new innovations*".

novel strand has emerged that cuts adrift the debate and focuses on the feasibility of and timeframe for adopting common policies in the battle against software piracy.

Cognizant of the above, this paper complements existing literature on IPRs harmonization against software piracy from four standpoints: current disturbing evidence on global software piracy; missing link in the literature; availability of a richer new dataset to extend the theoretical underpinnings of Asongu (2013a) and; assessment of certain findings within a global framework. Firstly, evidence on global levels in software piracy are deserving of examination (BSA, 2007). Hence, this paper in partial response to highlighted concerns will attempt to provide global benchmarks for policy harmonization, with particular emphasis on the 'feasibility of' and 'ideal timeframe for' common policies against software piracy. Secondly, as far as we have reviewed, the absence of studies that have addressed the concern of policy harmonization represents an important missing link in the software piracy literature. The present paper is therefore in view of filling this scholarly gap. Thirdly, availability of a broader dataset provides two unique opportunities: on the one hand, it provides ample degrees of freedom to investigate the scourge of software piracy that has not received the much needed scholarly focus owing to the absence of relevant data and; on the other hand, it provides room for the extension of previous literature from an African to a global platform. Accordingly, the richness of the dataset in appealing time series properties enables the current paper to steer clear of previous empirical literature from four critical standpoints: the period of study is 1994-2010 instead of 2000-2010; 99 countries make-up the dataset as opposed to 11 countries in the pioneering study; 3 categorization criteria based on legal origins, income-levels and, regional proximity are employed contrary to an exclusive (but non arbitrary)[5] usage of only legal origin as the segmentation criterion in the formal literature; instead of 3 fundamental characteristics of

[5] The unique segmentation based on legal origin is due to constraints in degrees of freedom.

software piracy used in the pioneering study, the richness of our dataset has given room for the derivation of 15 fundamental characteristics of software piracy. Fourthly, the use of a global dataset also presents the opportunity of empirically assessing the impact of legal origins on software piracy. The imperative of this assessment is twofold: on the one hand, the 6 English common-law (5 French civil-law) countries on which previous findings are based are extended to 27 (50) countries and; on the other hand, German civil-law and Scandinavian civil-law are included in the investigation to enrich the comparative analysis of legal origins.

In light of the above foundations, upholding blanket IPRs policies in the battle against software piracy may not be effective unless they are contingent on fundamental characteristics and prevailing global trajectories, dynamics and tendencies of software piracy. Hence, policy makers are most likely to ask the following three questions before considering the harmonization of IPRs policies on software piracy. (1) Is software piracy converging globally? (2) If so, what is the degree and timing of the convergence process? (3) For which relevant fundamental characteristics of software piracy do answers to the first and second questions apply? While an answer to the first question will guide on the feasibility of harmonizing blanket policies, the answer to the second will guide on an optimal timeframe for such blanket policies. Ultimately, the answer to the third (given that the first and second questions are already answered), will determine the feasibility-of, timeframe-for and exclusiveness (or non arbitrariness) of the common IPRs policies. This third question is most relevant because, it underscores the need for common policies to be contingent on the prevailing speeds of and time for full (100%) convergence within each identified fundamental characteristic of software piracy.

Harmonization here refers to the adjustment of inconsistencies and differences among different procedures, specifications, systems or methods to make them mutually compatible or

uniform in fighting software piracy (Asongu, 2013a). Convergence refers to the elimination of cross-country dispersions in the rate of business software piracy. In other words, it implies, the cross-country differences in the use of pirated software is reducing. In the same vein, full convergence means that the elimination of cross-country differences in software piracy is complete such that, countries within a homogenous panel have become indifferent in terms of software piracy. The link between convergence and harmonization is based on the fact that, with the former, countries with lower rates of software piracy are catching-up their counterparts with higher rates. Hence, the problem is getting worse. With full convergence, common policies can be harmonized without distinction of nationality because countries within a homogenous panel are now indifferent in terms of software piracy rates.

Our findings show that a genuine timeframe for the standardization of IPRs laws in the battle against the piracy of software is most feasible within a horizon of 4.3 to 10.4 years. This implies, with 100% or full convergence during this specified timeframe, the harmonization of IPRs is optimal. In other words, the enforcement of IPRs regimes without distinction of nationality is optimal among countries within sampled fundamental characteristics. The findings also show an absence of convergence in the World panel. An indication that blanket policies may not be effective. Hence, policy measures should be based on the prevailing dynamics, trajectories and tendencies of software piracy.

The rest of the paper is organized as follows. Section 2 reviews existing literature. Data and methodology are discussed and outlined respectively in Section 3. Empirical analysis and discussion of results are covered in Section 4. Section 5 concludes.

2. Motivation, literature and scope

2.1 Motivation

The intuition motivating this paper is typically consistent with the evidence of per capita income convergence across countries which has been examined in the context of neoclassical growth models, originally developed by the pioneering works of Baumol (1986), Barro & Sala-i-Martin (1992, 1995) and Mankiw et al. (1992). The theoretical underpinnings of income convergence are abundant in the empirical growth literature (Solow, 1956; Swan, 1956) and have recently been applied in other areas of economic development (Narayan et al., 2011; Bruno et al., 2012; Asongu, 2012a). While there is a theory and vast empirical work on per capita income convergence, there is yet not a theory on convergence in other development areas, e.g financial markets, knowledge economy (KE), Intellectual Property Rights (IPRs)...etc. However, there is increasing application of convergence underpinnings to IPRs harmonization (Asongu, 2013a), financial markets (Bruno et al., 2012; Narayan et al., 2011; Asongu, 2013b, 2014a) and, optimality of currency areas (Asongu, 2013c, 2014b). Cognizant of these recent empirical developments, aware of the risks of 'doing measurement without theory'; we argue that, reporting facts even without the presence of a formal theoretical model is a useful scientific activity. Therefore, we are consistent with recent literature (Costantini & Lupi, 2005; Narayan et al., 2011; Asongu, 2013a) in the assertion that, applied econometrics has other tasks than the mere validation or refutation of economic theories.

The intuition underpinning the linkage between software piracy and harmonization of policies within a homogenous panel (or fundamental characteristic) is twofold: (1) convergence in the software piracy rate will imply that, the adoption of common policies to combat the scourge is feasible and; (2) full (100%) convergence will mean, the enforcement of these policies

without distinction of nationality or locality. This intuition is consistent with very recent methodological insights into IPRs harmonization against software piracy (Asongu, 2013a). Since it is unlikely to find convergence within a very heterogeneous set of countries, the original sample is splitted into fundamental characteristics of software piracy based on income-levels, legal origins, and regional proximity. We provide justification for this segmentation in the data section. The segmentation consists of fundamental characteristics that determined absolute convergence. The intuition behind conditional convergence is that, if there are cross-country differences in macroeconomic and institutional characteristics that determine the rate of software piracy, it is possible for countries with a lower rate of software piracy to catch-up their counterparts with higher levels of software piracy. These macroeconomic and institutional characteristics that determine the scourge include, among others: economic prosperity, rule of law, Research & Development (R&D), internet penetration, population growth, life expectancy, financial development and, main IPR laws (Constitution, Main IP law, WIPO, Multilateral and Bilateral)[6].

2.2 Scope, positioning and testable hypotheses

2. 2. 1 Intellectual Property Rights (IPRs) and development

We devote space to emphasizing the relation between IPRs and development largely borrowed from Asongu (2013a). Consistent with Bezmen & Depken (2004), there are two main avenues along which intellectual property (IP) and the strength of IPRs regimes are thought to influence the level of economic growth and development. The first strand emphasizes the extent to which IPRs influence the creation of new knowledge and information within nations, as well as the diffusion of existing knowledge across countries. The second strand concentrates on the

[6] Please see Appendix 3 for definitions of IPRs laws.

indirect effect of a nation's IPRs regime on international transactions that provide factors imperative to the growth process.

In the first strand that deals with the 'creation and dissemination of information', IPRs protection could be traced to the foundation of endogenous theories of economic growth whereby, investment in R&D rewards individual investors with profit (returns) and also increase society's stock of knowledge. Lowering the cost of future innovation is appealing to the accumulation of knowledge for economic growth (Romer, 1990; Grossman & Helpman, 1991). The underlying wisdom of strict and tight IPRs is based on the notion that, protection of IPRs serves as a stimulus to growth by encouraging innovations and inventions. Recently, many newly industrialized countries have pushed for tighter IPRs through bilateral, multilateral and regional arrangements. This difference in strategy could be traced to the interest of developing countries to specialize in labor intensive production in agricultural industries. These industries, until much recently have largely been supported by public budgets on research and technology and have also greatly benefited from shared knowledge spillovers.

In the second strand, borrowing from Asongu (2013a), IPRs also have the tendency to affect a nation's growth and development process through their influence on a nation's ability to engage in international transactions such as trade, Foreign Direct Investment (FDI) flows and technology transfers (Bezmen & Depken, 2004). International trade has been presented by endogenous growth theories as an important stimulus to economic prosperity, as access to world markets could spur greater utilization of human resources (Todaro & Smith, 2003), and facilitate the transmission of technology by providing contact with foreign counterparts and direction of domestic resources towards more research intensive sectors. Nevertheless, these models do not necessarily foresee that openness engenders economic growth for all countries and under all

circumstances; principally because, theoretical prediction depends on country-specific conditions. It has also been substantially documented that, a stronger IPRs regime is a crucial factor in attracting the inflows of FDI and technological transfers (Lee & Mansfield, 1996), stimulating exports (Maskus & Penubarti, 1995) and, increasing the likelihood of investment undertaken by multinational enterprises (Mansfield, 1994; Seyoum, 1996). On the other hand, stronger IPRs protection could mitigate the need for FDI (Yang & Maskus, 2001).

2.2.2 Scope and positioning of the paper

Consistent with Asongu (2013a), a great bulk of the empirical literature has examined the determinants of the willingness to pirate software by assessing the socio-economic factors that affect piracy. Solid findings have been established that nations with higher income and greater individualism have lower piracy rates (Maskus & Penubarti, 1995; Gould & Gruben, 1996; Park & Ginarte, 1997; Rushing & Thompson, 1996, 1999; Husted, 2000; Marron & Steel, 2000; Kranenberg & Hogenbirk, 2003; Kim, 2004; Depken & Simmons, 2004). A substantial bulk of empirical literature has also focused on the socio-economic determinants of piracy rates in several copyright industries (Andrés, 2006; Banerjee et al., 2005; Bezmen & Depken, 2006; Peitz & Waelbroeck, 2006; Goel & Nelson, 2009; Andrés & Goel, 2012).

At the advent of globalization with recent developments in Information & Communication Technologies (ICTs), the concern over software piracy has retained scholarly attention. International organizations are currently advocating global convergence in IPRs as a necessary condition for successful innovation strategies. The difficulties of achieving such harmonization are however obvious from the attempts of several nations to develop divergent IPRs systems. Therefore, IPRs are growingly involved in standard-setting activities. In light of the pressing issues, efforts have been devoted to increasing and harmonizing the standard and

enforcement of IPRs protection worldwide. As emphasized in the introduction, until much recently, the debate centered on IPRs protection has been focused on the pros and cons of IPRs, especially on developing countries. However a novel strand has emerged that cuts adrift the debate and focuses on the feasibility of and timeframe for adopting common policies in the battle against software piracy (Asongu, 2013a). The present paper substantially complements Asongu (2013a) in the dimensions already covered in the introduction.

2.2.3 Testable hypotheses

In light of the theoretical underpinnings discussed in Section 2.1, we are consistent with Bacharach (1989) in clearly articulating the testable hypotheses. Fundamentally, these testable hypotheses are based on two main questions.

-First, is software piracy converging globally? The resulting hypothesis is that the issue of software piracy is getting worse globally because countries with low levels are converging or catching-up with nations of high levels in software piracy (*Hypothesis 1*).

-If nations are converging in terms of software piracy, what is the degree and timing of the convergence processes? In other words, if *Hypothesis 1* holds, then based on the stylized facts in the introduction, the rate of convergence is high or the timing to full convergence is fast (*Hypothesis 2*).

Whereas evidence of catch-up or convergence is used to assess *Hypothesis 1*, the rate of catch-up and time needed for full catch-up are used to address *Hypothesis 2*.

3. Data and Methodology

3.1 Data

The data used in this study were obtained from several sources such as the World Bank's World Development Indicators (WDI), the Financial Development and Structure Database (FDSD) and the BSA (2007) for the period 1994-2010. The limitation to 99 countries and the 17 year annual periodicity is due to constraints in data availability on software piracy.

3.1.1 Measuring piracy

Consistent with SIIA (2000), software piracy is defined as "the unauthorized copying of computer software that constitutes copyright infringement for either commercial or personal use". Owing to the fact that software piracy could 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 in the literature. There are many types of piracy and with respect to the Business Software Alliance (BSA), we can distinguish among: 1) end user copying; 2) downloading; and 3) counterfeiting (Andrés & Asongu, 2013). The level of piracy is computed as the variation between the demand for new software applications (estimated from PC shipments) and the legal supply of software. In the context of this study, 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 presented in percentages, scaling from 0 % (no piracy) to 100 % (i.e., all software installed is pirated). The rate of software piracy is computed as: 'logarithm of (piracy/(100-piracy))' to ensure comparability of the variables. Piracy levels source from the Business Software Alliance (BSA, 2007). An exhaustive account

of the measurement could be obtained from BSA (2009)[7]. As far as we have reviewed, though the BSA is an industry group, its data on software piracy is the best cross-country measure currently available; though object of some inherent upward bias[8]. In the current paper, we focus on end-user piracy where consumers will use the software at home, and software is not sold to the others (commercial piracy).

3.1.2 Determination of fundamental characteristics

We devote space to discussing the determination of fundamental characteristics. Consistent with the literature (Asongu, 2013a), it is unlikely to find convergence within a heterogeneous set of countries. Hence, the determination of characteristics that are fundamental to software piracy is crucial. Government quality (transparency, corruption, regulation quality …etc) and macroeconomic fundamental characteristics have the draw-back of being time-dynamic. Therefore, the same threshold may not be consistent over time, especially on a horizon of over 17 years. We shall take a minimalistic approach and be consistent with recent literature (Narayan et al., 2011; Asongu, 2013b, 2014a) in determining fundamental characteristics based on: legal origins, income-levels and, regional proximity.

Firstly, the premise of legal origin as a fundamental characteristic of software piracy is based on: the emphasis legal origins place on private property rights vis-à-vis those of the state (La Porta et al., 1998); the empirical evidence on the link between legal origins and corruption (La Porta et al., 1999) and; recent comparative institutional literature on the weight of legal origins in the effect of IPRs on software piracy (Asongu, 2014c). While English common-law

[7]The BSA data measures the piracy of commercial software for the most part. We are not knowledgeable of any publicly available cross-national data on end-user software piracy. See Traphagan & Griffith (1998) and Png (2010) for a discussion on the reliability of piracy data.

[8]Among the many researchers that have used this data are: Marron & Steel (2000), Banerjee et al. (2005), Andrés (2006), Goel & Nelson (2009) and, Asongu (2013a).

countries place more emphasis on private property rights (or IPRs), French civil-law focuses more on state power. In essence, the underlying logic for this segmentation is that, the institutional web of informal norms, formal rules and enforcement characteristics affect software piracy (Asongu, 2013a). We also include German civil-law and Scandinavian civil-law countries as in La Porta et al. (1998) in order to obtain results with broader policy implications.

Secondly, assessing software piracy trajectories with income-level dynamics could also provide relevant policy implications. Beside sound justification from empirical underpinnings of the convergence literature (Narayan et al., 2011; Asongu, 2013b, 2014a), piracy has been documented to be associated with wealth (Moores & Esichaikul, 2011). Intuitively, the foundation for this segmentation criterion is solid because many engage in software piracy because they do not have money to buy the right thing (Asongu, 2014c). Also, deep-rooted findings have been established that nations with higher income and greater individualism have lower piracy rates (Maskus & Penubarti, 1995; Gould & Gruben, 1996; Park & Ginarte, 1997; Rushing & Thompson, 1996, 1999; Gopal & Sanders 1998; Gopal & Sanders 2000; Husted, 2000; Marron & Steel, 2000; Kranenburg & Hogenbirk, 2003; Kim, 2004; Depken & Simmons, 2004; Andrés, 2006; Driouchi et al. 2014). The income-levels include: High-income, Upper-middle-income, Lower-middle-income and, Low-income.

Thirdly, regional proximity is an important premise for studying convergence, especially from a global perspective (Narayan et al., 2011). According to the BSA (2011), a number of factors contribute to regional differences in piracy: the strength of the IPRs, the availability of pirated software and cultural variations. More so, piracy is not uniform within a country; it varies from city to city, industry to industry and demographic to demography. Hence, it could therefore be argued that, piracy networks may not only be local but regional as well. These regions

include: South Asia, Europe & Central Asia, East Asia & the Pacific, Middle East & North Africa, Sub-Saharan Africa and, Latin America & the Caribbean.

3.1.3 Choice of control variables

The choice of control variables is contingent on the theoretical underpinnings of conditional convergence which state that, if countries differ in macroeconomic and institutional characteristics that determine software piracy then, it is possible for conditional convergence to take place. 12 control variables are employed in two different specifications to control for macroeconomic and institutional determinants of software piracy. These include: economic prosperity, rule of law, R&D, internet penetration, population growth, life expectancy, financial development and IPR laws (Constitution, Main IP law, WIPO, Multilateral and Bilateral)[9]. Accordingly, we intuitively expect economic prosperity to mitigate piracy because as the wealth of nation increase, citizens have the money to buy the right thing, assuming income is evenly distributed. The rule of law and IPRs laws are naturally expected to have a negative incidence on piracy (Asongu, 2014c). Previous empirical studies suggested that there is a significant link between the legal framework proxied by the rule of law, international treaties and software piracy (Holm 2003; Van Kranenburg and Hogenbirk 2005; Andrés 2006; Baghci *et al.* 2006; Ki *et al.* 2006: Driouchi et al. 2014).

Internet penetration should have a positive effect on piracy (Asongu, 2013a). Large sums of money owing to financial development have been documented to be associated with software piracy (Moores & Esichaikul, 2011, p.1). However from intuition, the effect of money supply on software piracy should depend (for the most part) on the income-strata of the population that

[9] Please see Appendix 3 for definitions of IPRs laws.

accounts for the high money velocity[10]. Positive demographic change and life expectancy should naturally increase the percentage of the population tempted to pirate software. Ultimately the economic, institutional and technological factors employed as control variables are broadly consistent with Andrés & Goel (2011, pp. 7-8).

Summary statistics (with presentation of countries), correlation analysis (showing the basic correlations between key variables used in this paper) and variable definitions (with corresponding data sources) are displayed in Appendix 1, Appendix 2 and Appendix 3 respectively. The descriptive statistics of the variables show that, there is quite a degree of variation in the data utilized so that one should be comfortable and confident that reasonable estimated relationships would emerge. The purpose of the correlation matrix is to mitigate issues of overparameterization and multicollinearity. Based the correlation coefficients, there do not appear to be any major issues in terms of the relationships to be estimated.

3.2 Methodology

First, panel data regression models were run where the rate of software piracy was regressed on a set of explanatory variables chosen according to previous studies. In the second part of the paper, a neoclassical convergence analysis was conducted. Following Asongu (2013a), the estimation approach is based on one the traditional convergence models, the beta convergence (or absolute convergence) due to constraints in the data set. The use of cointegration and unit roots tests are not convenient owing of limited degrees of freedom in homogenous panels or fundamental characteristics. Additionally, the alternative stance of convergence (sigma-convergence) which is of the view that, a group of economies converge when the cross-section variance of the variable under consideration declines, is also

[10] Piracy is strongly link to poverty: faction of the population with low income. A position that is valid from economic and cultural considerations (Moores & Esichaikul, 2011, p.1).

inappropriate because the data structure of the study is a panel dataset. This type of convergence occurs when dispersions in software piracy fall over time. Our estimation procedure typically follows the evidence of income convergence across countries that have been investigated in the context of pioneering works in neoclassical growth models (Baumol, 1986; Barro & Sala-i-Martin, 1992, 1995; Mankiw et al., 1992).

In line with the convergence literature (Fung, 2009, p. 3; Asongu, 2013a), the two equations below are the standard approaches in the literature for investigating conditional convergence if $W_{i,t}$ is taken as strictly exogenous.

$$\ln(Y_{i,t}) - \ln(Y_{i,t-\tau}) = \beta \ln(Y_{i,t-\tau}) + \delta W_{i,t-\tau} + \eta_i + \xi_t + \varepsilon_{i,t} \qquad (1)$$

$$\ln(Y_{i,t}) = \sigma \ln(Y_{i,t-\tau}) + \delta W_{i,t-\tau} + \eta_i + \xi_t + \varepsilon_{i,t} \qquad (2)$$

Where $Y_{i,t}$ is the proxy for the rate of piracy in country *i* at period *t*. $\sigma = 1 + \beta$. $W_{i,t}$ is a vector of determinants of piracy, η_i is a country-specific effect, ξ_t is a time-specific constant and $\varepsilon_{i,t}$ is the classical error term. According to the neo-classical growth model, a statistically significant negative coefficient on β in Eq. (1) suggests that, countries relatively close to their steady state in 'piracy-rate growth' will experience a slowdown in the growth of piracy, known as conditional convergence (Narayan et al., 2011, p. 2). In the same line of thinking, according to Fung (2009, p. 3) and recent African convergence literature (Asongu, 2013ab), if $0 < |\sigma| < 1$ in Eq. (2), then $Y_{i,t}$ is dynamically stable around the path with a trend piracy rate the same as that of W_t, and with a height relative to the level of W_t. The variables incorporated in $W_{i,t-\tau}$ and the individual effect η_i are measures of the long-term level the software piracy market is converging

to. Hence, the country-specific effect η_i emphasizes other determinants of a country's steady state not captured by $W_{i,t-\tau}$.

Conditions for convergence outlined above are valid if and only if, $W_{i,t}$ exhibits strict exogeneity. Unfortunately, this is not the case in the real world because, while economic prosperity, rule of law, R&D, internet penetration, population growth, life expectancy, financial development and IPR laws (components of $W_{i,t}$) influence piracy rate, the reverse effect is also true. Hence, we are faced with the issue of endogeneity in which control variables ($W_{i,t}$) are correlated with the error term ($\varepsilon_{i,t}$). Moreover, country- and time-specific effects could be correlated with other variables in the model, which is very probable with lagged dependent variables included in the equations. This issue of endogeneity has been substantially documented in the piracy literature (Ginarte & Park, 1997; Bezmen & Depken, 2004)[11]. A means of tackling the problem of the correlation between the individual specific-effect and the lagged dependent variables consists of eliminating the individual effect by first differencing. Thus Eq. (2) becomes:

$$\ln(Y_{i,t}) - \ln(Y_{i,t-\tau}) = \sigma \ln(Y_{i,t-\tau} - Y_{i,t-2\tau}) + \delta(W_{i,t-\tau} - W_{i,t-2\tau}) + (\varepsilon_{i,t} - \varepsilon_{i,t-\tau}) \quad (3)$$

However Eq. (3) presents another issue; estimates by Ordinary Least Square (OLS) are still biased because there remains a correlation between the lagged endogenous independent variable and the disturbance term. To tackle this concern, we estimate the regression in differences jointly with the regression in levels using the Generalized Method of Moments

[11] As emphasized by Bezmen & Depken (2004), papers investigating the piracy-development nexus are subject to potential endogeneity problems, because it is likely that a nation's level of development is a crucial factor in its choice of or adherence to a particular IPRs regime. This confirms an earlier stance by Ginarte & Park (1997) who found strong evidence that the level of economic development explains the strength of patent protection provided by individual countries.

(henceforth, GMM) estimation. In practice, Hansen (1982) showed that all instrumental variables estimators can be interpreted as GMM estimators. The most important step in applying GMM is to find good instruments (instruments are valid and strong). Arellano & Bond (1991) has suggested an application of the GGMM that exploits all the orthogonality conditions between the lagged dependent variables and the error term. The process employs lagged levels of the regressors as instruments in the difference equation, and lagged differences of the regressors as instruments in the levels equation, therefore exploiting all the orthogonality conditions between the lagged dependent variables and the error term. Between the difference GMM estimator (Arellano & Bond, 1991) and system GMM estimator (Arellano & Bover, 1995; Blundell & Bond, 1998), we opt for the latter in accordance with Bond et al. (2001, pp. 3-4)[12].

The GMM estimation approach has been substantially applied in the convergence literature. Consistent with Asongu (2013a), as opposed to Narayan et al. (2011), we shall adopt Fung (2009) owing to software specificities[13]. In model specification, we choose the two-step GMM because it corrects the residuals for heteroscedasticity[14]. The hypothesis of no auto-correlation in the residuals is crucial as lagged variables are to be used as instruments for the dependent variables. Accordingly, the estimation depends on the assumption that the lagged values of the dependent variable and other independent variables are valid instruments in the regression. When the error terms of the level equation are not auto-correlated, the first-order

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

[13] While Narayan et al. (2011) have used Eq. (1) in the absence of fixed effects, this paper employs Eqs. (2) and (3) instead; in line with Fung (2009). The Fung (2009) approach has been used in recent African convergence literature (Asongu, 2013ab).

[14] In the *one-step* approach, the residuals are assumed to be homoscedastic.

auto-correlation of the differenced residuals should be significant whereas their second-order auto-correlation should not be. The validity of the instruments is examined with the Sargan over-identifying restrictions (OIR) test.

In accordance with Islam (1995, p. 14), yearly time spans are too short to be appropriate for studying convergence, as short-run disturbances may loom substantially in such brief time spans. Therefore, considering the data span of 17 years, we are consistent with Asongu (2013a) in using two-year non-overlapping intervals (NOI)[15]. This implies in our analysis, τ is set to 2. We also compute the implied rate of convergence by calculating $\sigma/2$. Accordingly, the estimated coefficient of the lagged differenced endogenous variable is divided by 2 because we have used a two year interval to absorb the short-term disturbances. When the absolute value of the estimated autoregressive coefficient is greater than zero but less than one ($0<|\sigma|<1$), we establish evidence of convergence. The broader interpretation suggests, past variations have less proportionate impact on future differences, implying the variation on the left hand side of Eq. (3) is decreasing overtime as the country is converging to a steady state (Asongu, 2013ab).

4. Empirical analysis

4.1 Presentation of results

This section looks at three principal concerns: (1) investigation of the presence of convergence; (2) computation of the speed of convergence and; (3) determination of the time needed for full (100%) convergence. The summary of overall findings is presented in Table 1 in which, the three issues are addressed. Results for absolute (unconditional) and conditional convergence are reported in Table 2 and Tables 3-4 respectively.

[15] We have 9 two-year non-overlapping intervals: 1994; 1995-1996; 1997-1998; 1999-2000; 2001-2002; 2003-2004; 2005-2006; 2007-2008; 2009-2010. Owing to data and periodical constraints, the first interval is short of one year.

Whereas, absolute convergence is estimated with just the lagged difference of the endogenous variable as independent variable, conditional convergence is with respect to Eqs. (2) and (3) in the presence of control variables. Hence, unconditional convergence is estimated in the absence of $W_{i,t}$: vector of determinants (economic prosperity, rule of law, R&D, internet penetration, population growth, life expectancy, financial development and IPR laws) of software piracy. In order to assess the validity of the model and indeed the convergence hypothesis, we perform two tests, notably the Sargan-test which examines the over-identification restrictions and, the Arellano and Bond test for autocorrelation which assesses the null hypothesis of no autocorrelation. The Sargan-test investigates if the instruments are uncorrelated with the error term in the equation of interest. The null hypothesis is the stance that, the instruments as a group are strictly exogenous (do not suffer from endogeneity), that is needed for the validity of the GMM estimates. The p-values of estimated coefficients are reported in brackets in the line following the reported values of the estimated coefficients. With the exception of World panel findings (last columns of Tables 2-4), we notice that the Sargan-test statistics often appear with a p-value greater than 0.10, hence its null hypothesis is not rejected in all the regressions. We report both the first and second order correlation tests, but give priority to the second order autocorrelation: AR (2) test in first difference because it is more relevant than AR (1) as it detects autocorrelation in levels. For majority of estimated models, we are unable to reject the AR (2) null hypothesis for the absence of autocorrelation, especially for conditional convergence specifications. For a few exceptions, we take a minimalistic approach of considering models with a AR (2) test result of 10% significance as moderately efficient because the arguments against the null hypothesis of no autocorrelation are moderately weak. Hence,

there is robust evidence that most of the models are deficient of autocorrelation at the 1% and 5% significance levels.

A summary of the results from Tables 2-4 is reported in Table 1. This includes results for Absolute Convergence (AC), Conditional Convergence (CC), the Speed of Absolute Convergence (SAC), the Speed of Conditional Convergence (SCC) and the rate required to achieve full (100%) convergence in both types of convergences.

From a general standpoint, the following conclusions could be drawn. (1) While there is a significant evidence of the absence of convergence (both in absolute and conditional terms) in the World panel, there is substantial evidence of convergence within fundamental characteristics. (2) Absolute convergence is consistent across fundamental characteristics within the horizon of 4-6 years. (3) Conditional convergence is averagely within 4.4-10.4 (4.6-8.2) years (yrs) for Specification 1 (Specification 2). (4) Income-levels matter in the convergence process, especially in CC. While AC increases with the importance of a positive wealth-effect (5yrs, 5.19yrs and 5.71 yrs for Lower-middle-income, Upper-middle-income and High-income respectively), there is evidence of a U-shape in CC with corresponding years to convergence of 10.38, 5.19 and 7.14 (Specification 1) and 6.28, 5.97 and 6.15 (Specification 2) as we move from Lower-middle-income to Higher-income countries, passing through Upper-middle-income countries respectively. (5) Legal origins also count in the convergence process. Firstly, while no evidence of CC is found in German and Scandinavian civil-law countries, the timeframe in French civil-law countries is slightly higher than that in their English common-law counterparts with corresponding 'rates of' (and time to full) convergence of 38% per annum (5.26yrs) and 34.5% per annum (5.79yrs) respectively. Secondly for CC, while the results of French civil-law countries are almost consistent across specifications, the convergence rate of German civil-law

countries decreases by about 2.4 years as one moves from the second to the third specification. Thirdly, while there is no CC for both specifications of Scandinavian countries and the second specification of English common-law countries, with respect to the first specification, English common-law countries have the highest CC rate (and time to full convergence) of 45% per annum (4.44 yrs). (5) Regional proximity also matters in the convergence processes. Firstly, while there is no evidence of AC in Europe & Central Asia, significant signs of this convergence are highest in South Asia and lowest in Latin America & the Caribbean with corresponding 'rates of' (and time to full) convergence in increasing order: 37.5% per annum (5.33 yrs) for Latin America & the Caribbean; 38% per annum (5.26 yrs) for the Middle East & North Africa; 39% per annum (5.12 yrs) for East Asia & the Pacific; 42.5% per annum (4.7 yrs) for Sub-Saharan Africa and; 46% per annum (4.34 yrs) for South Asia. Secondly, while CC findings differ more or less across specifications, a genuine timeframe for policy harmonization is within the horizon of 4.59-8.33 yrs.

Most of the significant control variables have the expected signs: (1) economic growth decreases piracy because as the wealth of nations increase, citizens have the money to buy the right commodity; (2) the rule of law mitigates the scourge, consistent with intuition; (3) Population growth increases piracy and; (4) IPRs laws consistently act as deterrents to the phenomenon for the most part.

Table 1: Summary of results on Absolute and Conditional Convergences

	Income Levels				Legal Origins				Regions						
	HI	UMI	LMI	LI	English	French	German	Scandi	SA	ECA	EAP	MENA	SSA	LAC	World
Panel A: Absolute Convergence with Specifications in Table 2															
Absolute C (AC)	Yes	Yes	Yes	No	Yes	Yes	No	No	Yes	No	Yes	Yes	Yes	Yes	No
% of A.C	35%	38.5%	40%	n.a	34.5%	38%	n.a	n.a	46%	n.a	39%	38%	42.5%	37.5%	n.a
Years to A.C	5.71Yrs	5.19Yrs	5Yrs	n.a	5.79Yrs	5.26Yrs	n.a	n.a	4.34Yrs	n.a	5.12Yrs	5.26Yrs	4.7Yrs	5.33Yrs	n.a
Panel B: Conditional Convergence with Specifications in Table 3															
Conditional C (CC)	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	No
% of CC	28%	38.5%	19.25%	n.a	45%	31%	24.5%	n.a	n.a	34.5%	24%	38.5%	37%	43.5%	n.a
Years to CC	7.14Yrs	5.19Yrs	10.38Yrs	n.a	4.44Yrs	6.45Yrs	8.16Yrs	n.a	n.a	5.79Yrs	8.33Yrs	5.19Yrs	5.4Yrs	4.59Yrs	n.a
Panel C: Conditional Convergence with Specifications in Table 4															
Conditional C (CC)	Yes	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	No
% of CC	32.5%	33.5%	31.8%	n.a	n.a	33%	34.5%	n.a	n.a	43%	35.5%	39%	43%	24.5%	n.a
Years to CC	6.15Yrs	5.97Yrs	6.28Yrs	n.a	n.a	6.06Yrs	5.79Yrs	n.a	n.a	4.65Yrs	5.63Yrs	5.12Yrs	4.65Yrs	8.16Yrs	n.a

AC: Absolute Convergence. CC: Conditional Convergence. Yrs: Years. HI: High Income. UMI: Upper Middle Income. LMI: Lower Middle Income. LI: Low Income. English: English Common-law. French: French Civil-law. German: German Civil-law. Scandi: Scandinavian Civil-law. SA: South Asia. ECA: Europe and Central Asia. EAP: East Asia and the Pacific. MENA: Middle East and North Africa. SSA: Sub-Saharan Africa. LAC: Latin America and the Caribbean.

Table 2: Absolute Convergence

	Income Levels				Legal Origins				Regions						
	HI	UMI	LMI	LI	English	French	German	Scandi	SA	ECA	EAP	MENA	SSA	LAC	World
Initial	**0.70*** **	**0.77*** **	**0.80*** **	-0.84	**0.69*** **	**0.76*** **	**0.73*** **	**1.14*** **	**0.92*** **	**0.70*** **	**0.78*** **	**0.76*** **	**0.85*** **	**0.75*** **	**0.71*** **
	(0.000)	**(0.000)**	**(0.000)**	(0.513)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.001)**	**(0.003)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
AR(1)	-2.8***	-2.30**	-3.2***	**0.555**	-2.7***	-3.8***	**-1.483**	**-1.268**	**-0.366**	-2.12**	-1.818*	-2.03**	**-1.348**	-3.0***	-4.6***
	(0.000)	(0.020)	(0.001)	**(0.578)**	(0.006)	(0.000)	**(0.137)**	**(0.204)**	**(0.714)**	(0.033)	(0.069)	(0.041)	**(0.177)**	(0.002)	(0.000)
AR(2)	**-0.543**	**-1.112**	-1.658*	**-1.007**	**-0.782**	**-1.378**	-2.02**	**0.516**	**-0.957**	-2.14**	-1.676*	**-1.025**	**-1.639**	**1.495**	-2.26**
	(0.586)	**(0.265)**	(0.097)	**(0.313)**	**(0.433)**	**(0.168)**	(0.042)	**(0.605)**	**(0.338)**	(0.032)	(0.093)	**(0.305)**	**(0.101)**	**(0.134)**	(0.023)
Sargan OIR	**42.670**	**26.313**	**23.797**	**0.029**	**25.683**	**42.929**	**16.779**	**3.572**	**2.613**	**38.299**	**10.00**	**12.856**	**7.338**	**18.97**	72.0***
	(0.146)	**(0.824)**	**(0.904)**	**(1.000)**	**(0.846)**	**(0.140)**	**(0.994)**	**(1.000)**	**(1.000)**	**(0.280)**	**(1.000)**	**(0.999)**	**(1.000)**	**(0.982)**	(0.000)
Wald	**244*** **	**713*** **	**1215*** **	0.426	**145*** **	**1466*** **	**124.8*** **	**9.91*** **	**8.77*** **	**296*** **	**142*** **	**191*** **	**36.1*** **	**852*** **	**851*** **
	(0.000)	**(0.000)**	**(0.000)**	(0.513)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.001)**	**(0.003)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Countries	44	29	24	2	27	50	18	4	3	43	11	13	8	19	99
Observations	335	177	164	11	206	331	118	32	24	270	87	94	44	152	687

***,**,*: significance levels of 1%, 5% and 10% respectively. AR(2): Second Order Autocorrelation test. OIR: Overidentifying Restrictions test. Initial: lagged endogenous estimated coefficient. NOI: Non overlapping intervals. Wald: test for the joint significance of estimated coefficients. HI: High Income. UMI: Upper Middle Income. LMI: Lower Middle Income. LI: Low Income. English: English Common-law. French: French Civil-law. German: German Civil-law. Scandi: Scandinavian Civil-law. SA: South Asia. ECA: Europe and Central Asia. EAP: East Asia and the Pacific. MENA: Middle East and North Africa. SSA: Sub-Saharan Africa. LAC: Latin America and the Caribbean. The significance of bold values is twofold. 1) The significance of estimated coefficients and the Wald statistics. 2) The failure to reject the null hypotheses of: a) no autocorrelation in the AR(1) and AR(2) tests and; b) the validity of the instruments in the Sargan OIR test.

Table 3: Conditional Convergence (First Specification)

	Income Levels				Legal Origins				Regions						
	HI	UMI	LMI	LI	English	French	German	Scandi	SA	ECA	EAP	MENA	SSA	LAC	World
Initial	**0.56*** **	**0.77*** **	**0.385** **	-4.074	**0.90*** **	**0.62*** **	**0.49*** **	0.525	-0.08	**0.69*** **	-0.482	**0.77*** **	**0.74** **	**0.85*** **	**0.70*** **
	(0.000)	**(0.000)**	**(0.011)**	(0.379)	**(0.001)**	**(0.000)**	**(0.004)**	(0.173)	(0.928)	**(0.000)**	(0.382)	**(0.000)**	**(0.022)**	**(0.000)**	**(0.000)**
Constant	0.534	0.679	**-0.34*** **	2.883	0.637	-0.267	**2.838** **	13.60	0.408	0.652	0.809	**0.45*** **	0.575	**-0.551** **	-0.070
	(0.188)	(0.812)	**(0.000)**	(0.272)	(0.168)	(0.117)	**(0.037)**	(0.218)	(0.198)	(0.198)	(0.909)	**(0.008)**	(0.425)	**(0.014)**	(0.822)
GDP	-0.120	-0.123	---	---	-0.116	-0.033	**-0.630** **	-3.051	---	**-0.194***	-0.614	**-0.11*** **	-0.139	-0.062	-0.041
	(0.194)	(0.845)			(0.157)	(0.622)	**(0.024)**	(0.212)		**(0.093)**	(0.603)	**(0.003)**	(0.420)	(0.666)	(0.515)
R&D	**-0.03*** **	0.110	0.063	---	0.001	-0.020	0.020	---	---	-0.008	-0.161	---	---	0.276	**-0.05*** **
	(0.000)	(0.314)	(0.649)		(0.953)	(0.660)	(0.730)			(0.363)	(0.516)			(0.392)	**(0.003)**
Internet	-0.030	0.016	-0.040	---	0.064	-0.022	-0.037	---	---	-0.017	**-0.16** **	---	---	0.003	-0.004
	(0.327)	(0.816)	(0.188)		(0.361)	(0.372)	(0.539)			(0.672)	**(0.038)**			(0.940)	(0.847)
Population	0.018	-0.035	**0.11*** **	---	-0.054	**0.07** **	-0.006	---	---	0.036	0.406	---	---	0.075	**0.049***
	(0.500)	(0.697)	**(0.000)**		(0.345)	**(0.042)**	(0.941)			(0.363)	(0.279)			(0.366)	**(0.068)**
Constitution	0.046	0.041	---	---	0.050	-0.001	---	---	---	0.030	---	---	---	-0.095	0.014
	(0.049)	(0.416)			(0.162)	(0.974)				(0.187)				(0.410)	(0.560)
Main IP Law	-0.006	-0.008	0.044	---	-0.005	0.005	-0.000	---	---	0.004	**-0.07*** **	---	---	-0.033	**-0.007***
	(0.109)	(0.478)	(0.334)		(0.543)	(0.654)	(0.984)			(0.356)	**(0.004)**			(0.341)	**(0.082)**
IP_Law	-0.0005	-0.004	-0.005	---	0.001	0.0008	-0.012	---	---	**0.002***	**0.01*** **	---	---	**-0.010***	0.001
	(0.751)	(0.599)	(0.646)		(0.539)	(0.889)	(0.125)			**(0.088)**	**(0.006)**			**(0.068)**	(0.390)
WIPO Treaties	0.005	0.034	---	---	0.001	**0.029** **	---	---	---	**0.018***	---	---	---	**0.094** **	---
	(0.387)	(0.141)			(0.864)	**(0.044)**				**(0.077)**				**(0.039)**	
Multilateral	**-0.004** **	**-0.015***	-0.012	---	-0.002	**-0.01*** **	-0.002	---	---	**-0.009** **	---	---	---	-0.019	**-0.002***
	(0.041)	**(0.098)**	(0.284)		(0.574)	**(0.000)**	(0.565)			**(0.011)**				(0.144)	**(0.093)**
Bilateral	**-0.007** **	**0.019***	-0.013	---	-0.003	0.003	0.0001	---	---	-0.002	---	---	---	0.016	-0.004
	(0.028)	**(0.087)**	(0.772)		(0.358)	(0.826)	(0.967)			(0.427)				(0.314)	(0.448)
AR(1)	-2.301**	-0.978	-1.729*	**0.619**	-1.723*	-2.52**	**-0.686**	**-0.115**	**0.386**	-1.684*	**0.711**	-2.10**	**-0.884**	-2.13**	-2.8***
	(0.021)	(0.327)	(0.083)	**(0.535)**	(0.084)	(0.011)	**(0.492)**	**(0.907)**	**(0.698)**	(0.092)	**(0.476)**	(0.035)	**(0.376)**	(0.032)	(0.004)
AR(2)	**-1.619**	**-1.000**	**-0.929**	**-0.805**	**-1.376**	**-1.085**	**-1.138**	**1.101**	**-0.876**	**-1.477**	**-0.666**	**-1.169**	**-1.488**	**1.328**	-2.24**
	(0.105)	**(0.316)**	**(0.352)**	**(0.420)**	**(0.168)**	**(0.277)**	**(0.255)**	**(0.270)**	**(0.380)**	**(0.139)**	**(0.505)**	**(0.242)**	**(0.136)**	**(0.184)**	(0.024)
Sargan OIR	**23.721**	**11.642**	**9.307**	**0.000**	**10.455**	**26.899**	**6.427**	**1.031**	**1.347**	**24.649**	**0.437**	**9.615**	**6.717**	**11.829**	43.90**
	(0.591)	**(0.993)**	**(0.999)**	**(1.000)**	**(0.997)**	**(0.523)**	**(1.000)**	**(1.000)**	**(1.000)**	**(0.538)**	**(1.000)**	**(1.000)**	**(1.000)**	**(0.996)**	(0.028)
Wald	**3170*** **	**786.0*** **	**488*** **	0.772	**5977*** **	**846*** **	**11492*** **	4.135	0.007	**5241*** **	**8052*** **	**800*** **	**61.9*** **	**538*** **	**3787*** **
	(0.000)	**(0.000)**	**(0.000)**	(0.379)	**(0.000)**	**(0.000)**	**(0.000)**	(0.126)	(0.928)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Countries	37	18	15	2	19	32	15	4	3	33	9	13	8	16	70
Observations	229	104	67	11	112	171	91	32	24	200	55	88	44	78	400

***,**,*: significance levels of 1%, 5% and 10% respectively. AR(2): Second Order Autocorrelation test. OIR: Overidentifying Restrictions test. Initial: lagged endogenous estimated coefficient. Wald: test for the joint significance of estimated coefficients. HI: High Income. UMI: Upper Middle Income. LMI: Lower Middle Income. LI: Low Income. English: English Common-law. French: French Civil-law. German: German Civil-law. Scandi: Scandinavian Civil-law. SA: South Asia. ECA: Europe and Central Asia. EAP: East Asia and the Pacific. MENA: Middle East and North Africa. SSA: Sub-Saharan Africa. LAC: Latin America and the Caribbean. GDP: GDP per capita. R & D: Research and Development. IP: Intellectual Property. WIPO: World Intellectual Property Organization. Multilateral: Multilateral Treaties. Bilateral: Bilateral Treaties. The significance of bold values is twofold. 1) The significance of estimated coefficients and the Wald statistics. 2) The failure to reject the null hypotheses of: a) no autocorrelation in the AR(1) and AR(2) tests and; b) the validity of the instruments in the Sargan OIR test.

Table 4: Conditional Convergence (Second Specification)

	Income Levels				Legal Origins				Regions						
	HI	UMI	LMI	LI	English	French	German	Scandi	SA	ECA	EAP	MENA	SSA	LAC	World
Initial	**0.65*** **	**0.67*** **	**0.63*** **	-4.074	**0.73*** **	**0.66*** **	**0.69*** **	-0.94	-0.08	**0.86*** **	**0.71*** **	**0.78*** **	**0.86*** **	**0.49*** **	**0.68*** **
	(0.000)	**(0.000)**	**(0.000)**	(0.379)	**(0.000)**	**(0.000)**	**(0.000)**	(0.379)	(0.928)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.001)**	**(0.000)**	**(0.000)**
Constant	-0.112	0.093	-0.526	2.883	1.259	**2.07*** **	0.639	3.340	0.408	-2.224	**10.66***	4.692	0.017	5.917	0.880
	(0.935)	(0.943)	(0.910)	(0.272)	(0.250)	**(0.000)**	(0.902)	(0.129)	(0.198)	(0.199)	**(0.056)**	(0.349)	(0.876)	(0.553)	(0.164)
Rule of Law	**-0.1*** **	**-0.07*** **	0.034	---	**-0.07** **	-0.028	-0.073	-2.120	---	-0.031	0.067	-0.084	-0.050	-0.076	**-0.07*** **
	(0.000)	**(0.001)**	(0.712)		**(0.041)**	(0.202)	(0.119)	(0.112)		(0.217)	(0.367)	(0.127)	(0.160)	(0.217)	**(0.001)**
Life Expectancy	0.200	0.277	0.229	---	-0.511	**-1.09*** **	-0.241	---	---	1.139	**-5.965***	-2.324	---	-2.572	-0.393
	(0.786)	(0.669)	(0.914)		(0.359)	**(0.002)**	(0.932)			(0.218)	**(0.053)**	(0.361)		(0.616)	(0.247)
Money Supply	-0.020	0.008	-0.172	---	0.056	-0.022	-0.026	---	---	-0.0001	0.063	---	---	-0.090	-0.0009
	(0.112)	(0.805)	(0.279)		(0.127)	(0.180)	(0.778)			(0.992)	(0.173)			(0.416)	(0.968)
Population	-0.017	**-0.06** **	0.061	---	**-0.044***	0.009	-0.020	---	---	0.013	---	-0.049	---	-0.145	-0.006
	(0.315)	**(0.024)**	(0.563)		**(0.085)**	(0.624)	(0.610)			(0.478)		(0.226)		(0.102)	(0.715)
Constitution	-0.032	---	-0.002	---	0.061	0.018	---	---	---	-0.027	---	---	---	0.041	0.017
	(0.278)		(0.980)		(0.149)	(0.563)				(0.330)				(0.491)	(0.488)
Main IP Law	-0.007	---	0.015	---	**-0.01*** **	0.001	0.001	---	---	0.002	---	---	---	0.006	-0.008
	(0.124)		(0.434)		**(0.001)**	(0.829)	(0.823)			(0.618)				(0.831)	(0.155)
IP_Law	**0.003***	**-0.004** **	-0.013	---	**0.004*** **	-0.0007	-0.007	---	---	**0.002** **	---	---	---	-0.004	0.002
	(0.066)	**(0.048)**	(0.231)		**(0.004)**	(0.844)	(0.508)			**(0.046)**				(0.497)	(0.371)
WIPO Treaties	-0.001	---	---	---	0.0002	0.016	---	---	---	**0.02*** **	---	---	---	---	0.007
	(0.854)				(0.981)	(0.105)				**(0.000)**					(0.423)
Multilateral	-0.003	**-0.006***	**-0.007***	---	0.002	**-0.008*** **	---	---	---	**-0.01*** **	---	---	---	0.004	**-0.005** **
	(0.114)	**(0.091)**	**(0.061)**		(0.357)	**(0.004)**				**(0.001)**				(0.680)	**(0.020)**
Bilateral	-0.003	**0.02*** **	-0.004	---	**-0.005***	0.007	---	---	---	**-0.002** **	---	---	---	**0.028** **	-0.004
	(0.294)	**(0.000)**	(0.938)		**(0.068)**	(0.289)				**(0.044)**				**(0.020)**	(0.146)
AR(1)	-2.5***	-1.775*	-2.59***	**0.619**	-2.066**	-3.48***	**-0.815**	**0.993**	**0.386**	**-1.871**	-1.789*	-2.14**	**-1.139**	-2.8***	-3.58***
	(0.009)	(0.075)	(0.009)	**(0.535)**	(0.038)	(0.000)	**(0.414)**	**(0.320)**	**(0.698)**	**(0.061)**	(0.073)	(0.032)	**(0.254)**	(0.004)	(0.000)
AR(2)	-1.806*	**-0.775**	-1.764*	**-0.805**	-2.153**	**-1.118**	**-1.544**	**0.434**	**-0.876**	-1.893*	**-1.386**	**-1.112**	**-1.556**	**0.740**	-2.284**
	(0.070)	**(0.438)**	(0.077)	**(0.420)**	(0.031)	**(0.263)**	**(0.122)**	**(0.663)**	**(0.380)**	(0.058)	**(0.165)**	**(0.266)**	**(0.119)**	**(0.459)**	(0.022)
Sargan OIR	**29.866**	**16.556**	**14.974**	**0.000**	**14.539**	**35.194**	**6.520**	**0.029**	**1.347**	**20.66**	**5.567**	**8.098**	**6.246**	**14.433**	49.8***
	(0.273)	**(0.921)**	**(0.957)**	**(1.000)**	**(0.965)**	**(0.107)**	**(1.000)**	**(1.000)**	**(1.000)**	**(0.759)**	**(1.000)**	**(0.999)**	**(1.000)**	**(0.966)**	(0.003)
Wald	**3548*** **	**249*** **	**1064*** **	0.772	**4792*** **	**2035*** **	**980*** **	**6.160** **	0.007	**24941*** **	**1397*** **	**1022*** **	**77.9*** **	**623*** **	**2532*** **
	(0.000)	**(0.000)**	**(0.000)**	(0.379)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.046)**	(0.928)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Countries	38	22	19	2	24	40	13	4	3	31	11	13	8	17	81
Observations	235	135	117	11	149	243	78	32	24	189	76	81	44	119	496

***,**,*: significance levels of 1%, 5% and 10% respectively. AR(2): Second Order Autocorrelation test. OIR: Overidentifying Restrictions test. Initial: lagged endogenous estimated coefficient. Wald: test for the joint significance of estimated coefficients. HI: High Income. UMI: Upper Middle Income. LMI: Lower Middle Income. LI: Low Income. English: English Common-law. French: French Civil-law. German: German Civil-law. Scandi: Scandinavian Civil-law. SA: South Asia. ECA: Europe and Central Asia. EAP: East Asia and the Pacific. MENA: Middle East and North Africa. SSA: Sub-Saharan Africa. LAC: Latin America and the Caribbean. IP: Intellectual Property. WIPO: World Intellectual Property Organization. Multilateral: Multilateral Treaties. Bilateral: Bilateral Treaties. The significance of bold values is twofold. 1) The significance of estimated coefficients and the Wald statistics. 2) The failure to reject the null hypotheses of: a) no autocorrelation in the AR(1) and AR(2) tests and; b) the validity of the instruments in the Sargan OIR test.

4.2 Discussion of results policy implications and caveats

4.2.1 Discussion and policy implications

It is interesting to understand the economic intuition motivating absolute and conditional convergence of software piracy before diving into the discussion of results. Absolute convergence in software piracy takes place when countries share similar fundamental characteristics with regard to the laws governing private IP such that, only variations across countries in initial levels of software piracy exist (Asongu, 2013a). Absolute convergence therefore results from factors such as: the formulation of laws protecting IPRs against software piracy within a legal system; wealth-effects (or income-levels) expressing how people do not have money to buy the right commodity; regional proximity, since cross-regional cultural difference significantly affects the availability of pirated software (BSA, 2011); among others. Absolute convergence also occurs because of adjustments common to the fundamental characteristics of piracy. Hence based on intuition, differences in initial conditions may significantly affect the process owing to: (1) the diffusion of legal cultures transmitted by colonial powers over time through regionalization and globalization such that, the legal origin fundamental holds less ground and; (2) non-uniformity of piracy within a country as well as variations from city to city, industry to industry and, demography to demography.

Conversely, conditional convergence is that which depends on structural and institutional characteristic that determine software piracy. It depicts the kind of convergence whereby, one's own long-term steady state (equilibrium) is contingent on structural characteristics and fundamentals of its economy in general and ICT sector in particular. Hence, within a fundamental characteristic of piracy (say Low-income countries), cross-country differences in

factors that explain piracy could facilitate conditional convergence. Accordingly, in our models conditional convergence has been contingent on macroeconomic and institutional characteristics that determined software piracy, notably: economic prosperity, rule of law, R&D, internet penetration, population growth, life expectancy, financial development and IPR laws. Hence, the findings are contingent on the variables we choose and empirically test. Owing to constraints in degrees of freedom, we have not been able to employ all components of the conditional information set in modeling the fundamental characteristics. As far as we have reviewed, this is not an issue because some models in the literature are not conditioned beyond two macroeconomic control variables (Bruno et al., 2012).

We have observed the following general findings. (1) There is no evidence of convergence (in absolute and conditional terms) for the World panel. This indicates that, blanket policies may not be effective unless they are contingent on the prevailing trajectories, dynamics and tendencies of software piracy. (2) Differences in absolute convergence rates and time required for full (100%) AC could be traced to disparities in initial conditions of software piracy. Hence, fundamental characteristics with lower (higher) rates (time) of (to full) convergence are the result of significant differences in initial conditions: the diffusion of legal cultures transmitted by colonial powers over time through regionalization and globalization such that, the legal origin fundamental holds less ground and; non-uniformity of piracy within a country as well as variations from city to city, industry to industry and, demography to demography. (3) From a CC perspective, variations across fundamental characteristics depend on cross-country differences in institutional and macroeconomic characteristics that determined software piracy. Accordingly, a higher (lower) rate of CC within a fundamental characteristic indicates lower (higher) differences in cross-country institutional and macroeconomic characteristics that

determine software piracy. (4) Regardless of fundamental characteristic, a feasible timeframe for the harmonization of policies in the fight against software piracy is within a horizon of 4.3 to 10.4 years which is broadly consistent with the Asongu (2013a) finding of 4-8 years for the African continent. A broad interpretation indicates that, (both in absolute and conditional terms) countries with lower rates of software piracy are catching-up their counterparts with higher rates. Consistent with the intuition motivating this analysis on policy harmonization, two inferences could be made: on the one hand, convergence implies that, adopting common policies against the scourge is feasible and; full (100%) convergence within the specified time horizon reflects the implementation (or harmonization) of the feasible policies without distinction of nationality or locality within each fundamental characteristic.

It is also relevant to discuss a finding of Asongu (2013a) that has partially motivated this study. Asongu has established that: the argument that the institutional web of informal norms, formal rules and enforcement characteristics affect the quality of IPRs protection is not visible from a software piracy perspective. Our findings are inconsistent with this conclusion from a two-dimensional perspective: on the one hand, African countries on which the findings are based may have a higher degree of regional proximity whose weight (through regional corporations for example) could outweigh the incidence of legal cultures (which might have been diluted with time) and; on the other hand, we have used 21 (45) more English common-law (French civil-law) countries from different global economic blocks.

We have shown that the issue of software piracy is getting worse across the globe and that urgent action is needed. The paper offers useful practical implications on the timing of feasible timeframes for the fight against software piracy. At the methodological level, it offers practical insight into the application of a reverse Solow-Swan methodology. Hence, the

contribution of the paper to the literature is not only in terms practical guidelines in the battle against software piracy. The study has also offered a new approach on how to calibrate negative signals of economic activity.

4.2.2 Caveats

Four main caveats have been retained: the absence of a theoretical basis, draw-backs in the methodology, limitations in the measurement of software piracy and, doubts about the 'law and property rights theory'.

Firstly, using econometrics to engage in more than just testing theory is not without risks. The intuition premise of the study means, results should be interpreted with caution as the model is conditioned on the variables we choose and empirically test, which may not directly reflect all macroeconomic conditions on which 'piracy convergence' is endogenous. We also leave for future research, a meta regression analysis (MRA) that can be used to identify the existence of publication bias in empirical studies on software piracy rates. This analysis can also provide us with new directions for future research.

Secondly, as already emphasized in the first paragraph of Section 4.1, the choice of the convergence approach (which is based on constraints in data structure) also has its draw-backs. Borrowing from Apergis et al. (2008), critics of β-convergence argue that, if countries converge to a common equilibrium with identical internal structures, then the dispersion of the variable under consideration should disappear in the long-run as all countries converge to the same long-run path. Moreover, if countries converge to 'convergence clubs' or to their own unique equilibrium, the dispersion of this measure will not approach zero (Miller & Upadhyay, 2002; Asongu, 2014d). Accordingly, in the latter case of country-specific equilibrium, the movements of the dispersion will depend on the initial distribution of the variable under investigation with

regard to their final long-run outcomes. Overall, as emphasized by Caporale et al. (2009), the approach suffers from specific estimation deficiencies associated with the data structure. As justified by Asongu (2013a), piracy data is scarce and some of these issues can only be overcome with time.

Thirdly, consistent with Asongu (2014c) the measurement of software piracy has relevant issues. (1) Piracy level in the study is computed as the difference in demand for new software applications (computed from PC shipments) and the legal supply of software. It is worth noting that, this metric defines piracy as the drop in demand of software products. Therefore, all pirated copies constitute lost sales. (2) It has been substantially documented that, those who purchase pirate copies don't always have the money to buy the true commodity. Hence, to consider the use of pirated products as diminishing demand for originals could be some kind of overstatement. (3) The employment of the metric presupposes knowledge of the elasticity of demand for the original product. Otherwise, there will be a comparison of pirated commodities that constitutes loss in sales with ones that do not. Therefore, there is some upward bias in the software piracy estimate.

Fourthly, some doubts have been documented about the 'law and property rights theory', which postulates 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 based suggest that Common law systems (strong property rights, the role of the judiciary…etc) are more innovation-friendly than Civil law systems. Four points are important to retain here. (1) Some scholars have expressed doubts about whether the distinction between Common law and Civil law can be justified from an historical perspective (Deakin & Siems, 2010, p. 10). (2) Today, with regionalization and internationalization, modern trends make the Common law/Civil

law distinction even less persuasive. (3) It is not very clear why in essence 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), while 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 categorization 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).

5. Conclusion

In this paper, we have examined global trajectories, dynamics and tendencies of software piracy to ease the benchmarking of current efforts towards harmonizing the standards and enforcements of IPRs protection worldwide. Our empirical exercise has been based on 15 different panels, which together consists of 99 countries. The richness of the dataset has allowed us to disaggregate countries into fundamental characteristics of software piracy based on income-levels (high-income, lower-middle-income, upper-middle-income and low-income), legal-origins (English common-law, French civil-law, German civil-law and, Scandinavian civil-law) and, regional proximity (South Asia, Europe & Central Asia, East Asia & the Pacific, Middle East & North Africa, Latin America & the Caribbean and, Sub-Saharan Africa). A generalized finding suggest that, a genuine timeframe for standardizing IPRs laws in the fight against software piracy is most likely on a horizon of 4.3 to 10.4 years. In other words, full (100%) convergence within the specified timeframe will mean the enforcements of IPRs regimes

without distinction of nationality or locality within identified fundamental characteristics of software piracy. The absence of convergence (in absolute and conditional terms) for the World panel indicates that, blanket policies may not be effective unless they are contingent on the prevailing trajectories, dynamics and tendencies of software piracy. Policy implications and caveats have been discussed.

Appendices

Appendix 1: Summary Statistics

Panel A: Summary Statistics

	Variables	Mean	S.D	Min.	Max.	Obs
Dependent Variable	Software Piracy rate	0.272	0.456	-0.602	1.995	787
First Set of Control Variables (Institutional, macroeconomic and ICT related)	GDP per capita	3.998	0.456	0.000	4.919	872
	Research & Development (R & D)	1.050	0.955	0.000	4.811	481
	Internet Penetration	2.739	1.219	-1.000	5.606	842
	Personal Computer Users	2.989	0.846	0.000	5.455	813
	Population	7.054	0.750	0.000	9.125	890
	Rule of Law	0.341	0.953	-1.612	1.946	786
	Life Expectancy	1.854	0.049	1.623	1.916	788
	Finance	0.619	0.496	0.000	4.781	748
Second Set of Control Variables (IPRs laws and treaties related)	Constitution	0.242	0.428	0.000	1.000	891
	Main IP Law	2.081	2.518	0.000	20.00	891
	IP Law	2.203	4.606	0.000	45.50	891
	WIPO Treaties	3.396	1.849	0.000	7.000	891
	Multilateral Treaties	10.41	5.803	0.000	25.00	891
	Bilateral Treaties	0.957	2.473	0.000	21.00	891
Fundamental Characteristics	High Income (HI)	0.443	0.497	0.000	1.000	891
	Upper Middle Income (UMI)	0.292	0.455	0.000	1.000	891
	Lower Middle Income (LMI)	0.241	0.428	0.000	1.000	891
	Low Income (LI)	0.020	0.140	0.000	1.000	891
	English Common Law (English)	0.272	0.445	0.000	1.000	891
	French Civil Law (French)	0.503	0.500	0.000	1.000	891
	German Civil Law (German)	0.181	0.385	0.000	1.000	891
	Scandinavian Civil Law (Scandi)	0.040	0.197	0.000	1.000	891
	South Asia (SA)	0.030	0.171	0.000	1.000	891
	Europe and Central Asia (ECA)	0.433	0.495	0.000	1.000	891
	East Asia and the Pacific (EAP)	0.112	0.315	0.000	1.000	891
	Middle East and North Africa (MENA)	0.131	0.337	0.000	1.000	891
	Sub-Saharan Africa (SSA)	0.080	0.272	0.000	1.000	891
	Latin America and the Caribbean (LAC)	0.190	0.393	0.000	1.000	891

Panel B: Presentation of Countries

Albania, Algeria, Argentina, Armenia, Australia, Austria, Azerbaijan, Bahrain, Belgium, Bolivia, Bosnia, Botswana, Brazil, Bulgaria, Cameroon, Canada, Chile, China, Colombia, Costa Rica, Croatia, Cyprus, Czech Republic, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, Estonia, Finland, France, Germany, Greece, Guatemala, Honduras, Hong Kong, Hungary, Iceland, India, Indonesia, Ireland, Israel, Italy, Japan, Jordan, Kazakhstan, Kenya, Kuwait, Latvia, Lebanon, Lithuania, Luxembourg, Macedonia, Malaysia, Malta, Mauritius, Mexico, Moldova, Montenegro, Morocco, Netherlands, New Zealand, Nicaragua, Nigeria, Norway, Oman, Pakistan, Panama, Paraguay, Peru, Philippines, Poland, Portugal, Puerto Rico, Qatar, Romania, Russia, Saudi Arabia, Senegal, Serbia, Singapore, Slovakia, Slovenia, South Africa, South Korea, Spain, Sweden, Switzerland, Thailand, Tunisia, Turkey, Ukraine, UAE, United Kingdom, United States, Uruguay, Venezuela, Vietnam, Zambia.

S.D: Standard Deviation. Min: Minimum. Max: Maximum. ICT: Information and Communication Technology. Scandi: Scandinavian. Obs: Observations.

Appendix 2: Correlation Analysis

Piracy rate	Macroeconomic, institutional and ICT-related control variables								IPRs laws and treaties related control variables						
	GDP	R & D	Internet	PC	Pop.	R.L	Life E.	Finance	Const.	MIPlaw	IPrlaw	WIPO	Multi.	Bilat.	
1.000	-0.663	-0.633	-0.512	-0.500	0.087	-0.737	-0.427	-0.431	0.138	-0.400	-0.104	-0.251	-0.460	-0.180	Piracy
	1.000	0.598	0.371	0.421	-0.152	0.766	0.726	0.484	-0.077	0.289	0.063	0.183	0.321	0.115	GDP
		1.000	0.436	0.508	0.062	0.679	0.485	0.373	-0.180	0.200	-0.040	0.068	0.343	0.185	R & D
			1.000	0.839	0.468	0.278	0.317	0.271	0.012	0.351	0.216	0.335	0.392	0.250	Internet
				1.000	0.640	0.334	0.342	0.293	0.069	0.356	0.236	0.286	0.395	0.281	PCs
					1.000	-0.234	-0.209	-0.063	0.188	0.102	0.192	0.090	0.131	0.155	Pop.
						1.000	0.588	0.520	-0.163	0.304	0.048	0.070	0.343	0.083	R.L
							1.000	0.419	0.044	0.194	0.094	0.238	0.278	0.146	Life E.
								1.000	-0.089	0.227	0.076	0.026	0.193	0.091	Finance
									1.000	0.105	0.352	0.078	-0.061	0.161	Const.
										1.000	0.548	0.328	0.324	0.020	MIPlaw
											1.000	0.283	0.175	0.084	IPlaw
												1.000	0.715	0.252	WIPO
													1.000	0.172	Multi.
														1.000	Bilat.

GDP: GDP per capita. R&D: Research and Development. Internet: Internet penetration. PC: Personal Computer Users. Pop: Population. R.L: Rule of Law. Life E: Life Expectancy. Const: Constitution. MIPlaw: Main Intellectual Property Law. IPrlaw: Intellectual Property Rights Law. WIPO: World Intellectual Property Organization Treaties. Multi: Multilateral Treaties. Bilat: Bilateral Treaties.

Appendix 3: Variable Definitions

Variables	Abbreviation	Variable Definitions (Measurement)	Sources
Piracy	Piracy	Logarithm of Piracy rate (annual %)	BSA
Growth per capita	GDP	Logarithm of GDP per Capita, PPP (international constant dollars, 2005)	World Bank (WDI)
Research and Development	R & D	Research and Development Expenditure (% of GDP)	World Bank (WDI)
Internet Penetration	Internet	Logarithm of Internet Users per 1000	GMID
PC Users	PC	Logarithm of PC Users per capita	GMID
Population	Pop.	Logarithm of Population	World Bank (WDI)
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)
Life Expectancy	Life E.	Logarithm of Life Expectancy at birth (total years)	World Bank (WDI)
Financial Depth	Finance	Monetary base plus savings, demand and time deposits (% of GDP)	World Bank (FDSD)
Constitution	Const.	Dummy variable: Copyright is mentioned in the constitution	WIPO
Main_IP_law	MIPlaw	Main Intellectual Property Law	WIPO
IP_rlaw	IPlaw	Intellectual Property Rights Law	WIPO
Wipotreaties	WIPO	World Intellectual Property Organization	WIPO
Mutilateral	Multi.	Multilateral Treaties	WIPO
Bilateral	Bilat.	Bilateral Treaties	WIPO

WDI: World Bank's World Development Indicators. FDSD: Financial Development and Structure Database. BSA: Business Software Alliance. GMID: Global Market Information Database. GDP: Gross Domestic Product. Log: Logarithm. WIPO: World Intellectual Property Organization.

References

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

Andrés, A. R., & Goel, R. K., (2011). "Corruption and Software Piracy: A Comparative Perspective", Policy & Internet, 3(3), pp. 1-24.

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

Andrés, A. R., & Asongu, S. A., (2013). "Fighting Software Piracy: Which Governance Tools Matter in Africa?", *Journal of Business Ethics*, 118(3), pp. 667-682.

Apergis, N., Christou, C., & Miller, S. M., (2010). "Country and Industry Convergence in Equity Markets: International Evidence from Club Convergence and Clustering", Department of Banking and Financial Management, University of Piraeus, Greece.

Arellano, M., & Bond, S., (1991). "Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations", *The Review of Economic Studies*, 58, pp. 277-297.

Arellano, M., & Bover, O., (1995). "Another look at the instrumental variable estimation of error-components models", *Journal of Econometrics*, 68, pp. 29-52.

Asongu, S. A., (2013a). "Harmonizing IPRs on Software Piracy: Empirics of Trajectories in Africa", *Journal of Business Ethics*, 118(1), pp. 45-60.

Asongu, S. A., (2013b). "African Stock Market Performance Dynamics: A Multidimensional Convergence Assessment", *Journal of African Business*, 14(3), pp. 186-201.

Asongu, S. A., (2013c). "Real and Monetary Policy Convergence: EMU Crisis to the CFA Zone", *Journal of Financial Economic Policy*, 5(1), pp. 20-38.

Asongu, S. A., (2014a). "African Financial Development Dynamics: Big Time Convergence", *African Journal of Economic and Management Studies*, 5(2), pp. 160-194.

Asongu, S. A., (2014b). "Are Proposed African Monetary Unions Optimal Currency Areas? Real, Monetary and Fiscal Policy Convergence Analysis", *African Journal of Economic and Management Studies*, 5(1), pp. 9-29.

Asongu, S. A., (2014c). "Fighting software piracy in Africa: how do legal origins and IPRs protection channels matter?" *Journal of the Knowledge Economy*: Forthcoming.
http://link.springer.com/article/10.1007/s13132-012-0137-0

Asongu, S. A., (2014d). "Fighting African Capital Flight: Empirics on Benchmarking Policy Harmonization", *The European Journal of Comparative Economics*, 11(1), pp. 93-122.

Bacharach, S. B., (1989). "Organisational Theories: Some Criteria for Evaluation", *The Academy of Management Review*, 14(4), pp. 496-515.

Bagchi, K., Kirs, P., and Cerveny, R. (2006). "Global software piracy: can economic factors alone explain the trend?" *Communications of the ACM*, Vol. 49, No. 6, pp. 70-75.

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

Barro, R. J., (1991). "Economic growth in a cross section of countries", *Quarterly Journal of Economics*, 106, pp. 407-443.

Barro, R. J., & Sala-i-Martin, X., (1992). "Convergence", *Journal of Political Economy*, 100, pp. 223-251.

Barro, R. J., & Sala-i-Martin, X., (1995). *Economic Growth*. The MIT Press, Cambridge, MA.

Baumol, W. J., (1986). "Productivity, growth, convergence and welfare: what the long run data show", *American Economic Review*, 76, pp. 1072-1085.

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

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

Blundell, R., & Bond, S., (1998). "Initial conditions and moment restrictions in dynamic panel data models", *Journal of Econometrics*, 87(1), pp. 115-143.

Bond, S., Hoeffler, A., & Temple, J., (2001). "GMM Estimation of Empirical Growth Models", University of Oxford.

Bruno, G., De Bonis, R., & Silvestrini, A., (2012). "Do financial systems converge? New evidence from financial assets in OECD countries", *Journal of Comparative Economics*, 40(1), pp. 141-155.

Business Software Alliance, (2007). 2006 Piracy study. BSA, New York.

Business Software Alliance: BSA, (2009). What is Software Piracy? http://www.bsa.org/Piracy%20Portal.aspx, accessed May 2012.

Business Software Alliance, (2011). "Ninth Annual BSA Global Software 2011 Piracy Study" http://portal.bsa.org/globalpiracy2011 (accessed: 21/12/2012).

Caporale, G. M., Erdogan, B., & Kuzin, V., (2009). "Testing for Convergence in Stock markets: A Non-Linear Factor Approach", *Discussion Paper* No. 932, Deutsches Institut fur Wirtschaftsforschung, Berlin.

Costantini, M., & Lupi, C., (2005). "Stochastic Convergence among European Economies", *Economics Bulletin*, 3(38), pp.1-17.

Deakin, S., & Siems, M., (2010). "Comparative law and finance: past, present and future research", *Journal of Institutional and Theoretical Economics*, 166(1), pp. 120-140.

Depken, C.A., & Simmons, L., (2004). "Social Construct and the Propensity for Software Piracy", *Applied Economics Letters*, 11, pp. 97-100.

Driouchi, A., Wang, M., Driouchi, T. (2014). Determinants of software piracy under risk aversion: A model with empirical evidence. Forthcoming *European Journal of Information Systems*
http://www.palgrave-journals.com/ejis/journal/vaop/ncurrent/pdf/ejis201414a.pdf

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

Fung, M. K., (2009). "Financial development and economic growth: convergence or divergence?", *Journal of International Money and Finance*, 28, pp. 56-67.

Ginarte, J. C., & Park, W. G., (1997). "Determinants of Patent Rights: A Cross-National Study", *Research Policy*, 26(3), pp. 283-301.

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

Gopal, R.D. and Sanders, G. L. (1998). "International Software Piracy: Analysis of key issues and impacts." *Information Systems Research*, 9, pp. 380-397.

Gopal, R.D. and Sanders, G.L. (2000). "Global Software Piracy: You Can't Get Blood Out of a Turnip." *Communications of the ACM*, 43, pp. 82-89.

Gould, D. M., & Gruben, W. C., (1996) "The Role of Intellectual Property Rights in Economic Growth", *Journal of Development Economics*, 48, pp. 323-350.

Grossman, G. M., & Helpman, E., (1991). *Innovation and Growth in the Global Economy*, MIT Press, Cambridge, MA.

Hansen, L.P. (1982). Large Sample properties of Generalized Methods of Moments Estimators. *Econometrica*, 50, pp. 1029-1053

Holm, H. J. (2003). "Can economic theory explain piracy behaviour?" *The B.E. Journal of Economic Analysis & Policy*, 3, pp. 1–15.

Husted, B. W., (2000). "The Impact of National Culture on Software Piracy", *Journal of Business Ethics*, 26, pp. 197-211.

Islam, N., (1995). "Growth Empirics: A Panel Data Approach", *The Quarterly Journal of Economics*, 110, (4), pp. 1127-1170.

Ki, E., Chang, B. and Khang, H. (2006). "Exploring Influential Factors on Music Piracy Across Countries." *Journal of Communication*, 56, pp. 406-426.

Kim, L., (2004). "The Multifaceted Evolution of Korean Technological Capabilities and its Implications for Contemporary Policy", *Oxford Development Studies*, 32(3), pp. 341-63.

Kranenburg, H. L., & Hogenbirk, A.E., (2003). "Determinants of Multimedia, Entertainment, and Business Software Copyright Piracy: A Cross-national Study," mimeo, Department of Organization and Strategy, University of Maastricht.

Lahiri, A., & Dey, D. (2013). "Effects of Piracy on Quality of Information Goods". *Management Science* 59(1), pp. 245-264

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

La Porta, R., Lopez-de-Silanes, F., Shleifer, A., & Vishny, R. W., (1999), "The quality of government", *Journal of Law, Economics and Organization*, 15, pp. 222-279.

Lee, J., & Mansfield, E., (1996). "Intellectual Property Protection and U.S. Foreign Direct Investment," *The Review of Economics and Statistics*, 78(2), pp. 181-86.

Mankiw, N. G., Romer, D., & Weil, D. N., (1992). "A contribution to the empirics of economic growth", *Quarterly Journal of Economics*, 107, pp. 407–437.

Mansfield, E., (1994). *Intellectual Property Protection, Foreign Direct Investment, and Technology Transfer*, (Washington D.C.: International Finance Corporation).

Marron, D. B., & Steel, D. G., (2000). "Which Countries Protect Intellectual Property? The Case of Software Piracy", *Economic Inquiry*, 38(2), pp. 147-74.

Maskus, K. E., & Penubarti, M., (1995). "How Trade Related are Intellectual Property Rights?", *Journal of International Economics*, 39, pp. 227-248.

Miller, S. M., & Upadhyay, M. P., (2002). "Total factor productivity and the convergence hypothesis", *Journal of Macroeconomics* 24, 267-286.

Moores, T. T., & Esichaikul, V., (2011). "Socialization and Software piracy: A study", *Journal of Computer Information Systems,* pp. 1-9. (http://iacis.org/jcis/articles/Moores_Esichaikul_51_3.pdf) (accessed: 25/10/2012).

Narayan, P. K., Mishra, S., & Narayan, S., (2011). "Do market capitalization and stocks traded converge? New global evidence", *Journal of Banking and Finance,* 35, pp. 2771-2781.

North, D. C., (1990). *Institutions, Institutional Change and Economic Performance*. Cambridge University Press, Cambridge, UK.

North, D. C., (1994). "Economic performance through time", *American Economic Review,* 84, pp. 359-368.

Park, W., & Ginarte, J., (1997). "Intellectual Property Rights and Economic Growth", *Contemporary Economic Policy,* 15, pp. 51-61.

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

Png, I., (2010). *On the reliability of software piracy statistics*. *Electronic Commerce Research and Applications,* 9, pp. 365-373.

Romer, P. M., (1990). "Endogenous Growth and Technical Change", *Journal of Political Economy,* 98, pp. 71-102.

Rushing, F., W., & Thompson, M. A., (1996). "An Empirical Analysis of the Impact of Patent Protection on Economic Growth", *Journal of Economic Development,* 21(2), pp. 61-79.

Rushing, F., W., & Thompson, M. A., (1999). "An Empirical Analysis of the Impact of Patent Protection on Economic Growth: An Extension", *Journal of Economic Development,* 24(1), pp. 67-76.

Seyoum, B., (1996). "The Impact of Intellectual Property Rights on Foreign Direct Investment", *Columbia Journal of World Business,* 31(1), pp. 50-59.

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

Solow, R. M., (1956). "A contribution to the theory of economic growth", *Quarterly Journal of Economics,* 70, pp. 65-94.

Swan, T., (1956). "Economic growth and capital accumulation". *Economic Record*, pp. 32, 334–361.

Todaro, M. P., & Smith, S. C., (2003). *Economic Development*, 8th ed. Addison Wesley.

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

Van Kranenburg, H. and Hogenbirk, A. (2005). “Multimedia, Entertainment, and Business Software Copyright Piracy: A Cross-National Study.” *The Journal of Media Economics*, 18, pp. 109-129.

Yang, G., & Maskus, K. E., (2001). “Intellectual Property Rights, Licensing, and Innovation in an Endogenous Product-Cycle Model”, *Journal of International Economics*, 53, pp. 169-187.