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The Impact of Formal Institutions on Knowledge Economy

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The Impact of Formal Institutions on Knowledge Economy

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Abstract

Using Kauffman, Kraay, and Mastruzzi governance indicators, this article analyzes the impact of formal institutions on the knowledge economy- by assessing how the enforcement of Intellectual Property Rights (IPRs) through good governance mechanisms affects the knowledge economy. The article also employs the World Bank's four components of the knowledge economy index characteristic of its knowledge for development (K4D) framework. We estimate panel data models for 22 Middle East & North African and Sub-Sahara African countries over the period 1996-2010. The results show that for this group of countries the enforcement of IPR laws (treaties), although necessary, is not a sufficient condition for a knowledge economy. The results also suggest that other factors are more likely to determine the knowledge economies of these nations. Overall these findings have important implications for both policy and further research.

JEL Classification: O10; O34; O38; P00; P48

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1. Introduction

The importance of a knowledge economy (KE) has emerged as a key theme in the late 1990s as OECD and World Bank reports illustrate (OECD, 2002; World Bank, 2007; Peters, 2008; Weber, 2011). It is now well established that technological knowledge and innovation are long-run drivers of economic growth (Lerner, 2009). Already following the example set by Japan, the governments of South Korea, Taiwan, Hong Kong, Singapore, Malaysia, and China are moving rapidly towards 'knowledge-based' economies from 'product-based' economies (Chandra and Yokoyama, 2011). This is happening because knowledge creation and diffusion processes depend on appropriate governance policies that are themselves outcomes of good governance – a self-reinforcing and endogenous process. To determine the relevance of the Asian experience to other developing and emerging economies, and the current excitement with the knowledge economy (KE), it is important to identify the institutional factors that promote the creation and diffusion of knowledge, and to ensure that economies not at the technological frontier have access to new technologies developed by technology leaders.

Middle Eastern and North African (MENA), and Sub-Saharan African (SSA) states have remained feeble, and according to their governance indicators as measures of institutional performance have similarly fared poorly in the last ten years or so. The effect of this poor institutional performance on the development, and the main components of the knowledge society, of these nations, while not a secret (UNDP, 2009), has not been quantified as far as we are aware. With respect to the MENA region, we know from a World Bank report that these nations were not investing in key areas that are fundamental to KEs, and specifically that "*to date, related investments in education, information infrastructure, research and development (R&D), and innovation have been insufficient or inappropriate in most MENA countries. Moreover, inadequate economic and institutional frameworks prevent*

these investments from yielding desired results" (Aubert & Reiffers, 2003, p.1). Similarly, Aubert (2007) shows that SSA countries in general have not done well in this regard either, mainly because of the weak linkages between institutions and appropriate technologies that are capable of fostering both foreign and domestic investment. These arguments are not hard to understand; the institutional framework is crucial for gaining an adequate flow of knowledge between scientific research and technological applications, as well as for a good information flow between knowledge users and researchers. Governments play a key role; the creation of knowledge cannot be left to imperfect market mechanisms. Good governance is critical to attracting foreign direct investment (FDI) inflows and to motivating domestic investment, both of which contribute to the development of the infrastructure of a KE[2].

Along the strong interest in the KE themselves has come growing emphases on Intellectual Property Rights (IPRs), and hence the acknowledgement that the enforcements of IPR laws (treaties) by governments have a critical bearing on how developing economies are tilting towards KEs. Based on the situation, the prime objective of this paper is to assess the instrumentality of IPR laws (treaties) in various KE dimensions through good governance channels[3]. In other words, the paper examines how government enforcement of IPR laws is affecting the progress of 22 SSA and MENA countries towards KEs. The examination is important because while much emphasis in the literature have gone to developed and emerging economies of Latin America and East Asia, there has been little scholarly attention paid to the SSA-MENA region. This paper is a modest attempt to fill some of that information gap.

We rationalize this focus with the fact that one of the key pillars of the KE is a favorable institutional framework. The importance of this pillar has been covered in the

[2] Though there is no doubt that good governance helps to promote the KE, we admit that the second statement may be debatable because FDI on its own may not be a sufficient promoter of KE.
[3] It should be noted that, there is also a wealth of literature that criticizes the use of IPRs through international treaties as forbearers of KE (Drahos, 2002; May & Sell, 2001; May, 2006, 2007).

literature on good governance and the knowledge-based economic development in Latin America (Dahlan, 2007) and in East Asia (Chandra and Yokoyama, 2011). From the coverage a positive relationship between good governance and the creation of KE is discernible. Except in China[4], formal institutions have played an important role in attracting FDI, and thereby helped in developing the knowledge-based economic infrastructures necessary for the KEs. Unfortunately, this same literature is not as clear for the SSA and MENA region. The few papers that have focused on the KE of this region have been limited to the impact of knowledge on economic growth using cross-sectional data (Chavula, 2010). While such a nexus is important, the current debate has centered around how and whether SSA and MENA countries can replicate the 'East Asian miracle'. Thus, integrating IPRs and governance structures into the equation is badly needed to provide an updated account of the debate regarding the SSA-MENA countries.

This paper contributes to existing literature in six different ways. Firstly, unlike previous research, it incorporates all dimensions of government quality in its analysis, and hence it provides an exhaustive assessment of six institutional quality indicators. Secondly, the paper puts an investigating lens on the SSA-MENA region. A great chunk of research on the KE focuses on developed and emerging economies of Latin America and East Asia, unfortunately leaving behind only scanty evidence of the nexus in SSA and MENA countries. Thirdly, in contrast to the mainstream approach which is premised mostly on one or two dimensions of the KE, this paper employs all of the four components in the World Bank's Knowledge Economy Index (KEI): economic incentive, innovation, education, and information infrastructure. Fourthly, the significant trends in the KE development witnessed worldwide over the last decade have brought to clear light the growing relevance of IPR treaties, and therefore assessing how the enforcement of these laws affects various dimensions

[4] China's success story in attracting FDI is largely attributed to a spectacular growth track record, the relative better executive power, political stability, good infrastructure, abundant educated labor force and a large domestic market (Chandra & Yokoyama, 2011, p.46).

of KE via good governance in developing countries could provide the needed guidance to policy makers. Fifthly, while some aspects of KE might have been investigated before good governance indicators for developing countries were available, this paper uses recent data to update the account of the nexus, and it does so with focused policy implications. Sixthly, one motivation of this work is the ongoing debate on the 'East Asian miracle', which has been either based on concepts like 'soft authoritarian character' and/or 'governing the market'. Such a debate is premised on certain political and economic conditions that were somehow judged propitious for development. However, some other evidence suggests to the contrary that the 'East Asian miracle' could have been caused instead by low enforcement of IPR regimes at the early stages of these nations' development, e.g., gains from trade distortions like undervalued rates of currency exchange and even innovation copying (imitations), in addition to the accumulation of human and physical capital (Bezmen & Depken, 2004). Still other evidence Lucas argues that there was not anything miraculous about the East Asian miracle (1988; 1993). Hence, examining this debate in the context of SSA and MENA countries could result in relevant policy and further research recommendations.

The rest of this paper is organized as follows. Section 2 reviews the relevant theory and its empirical evidence. Data and methodology issues are discussed in Section 3. Section 4 presents and discusses the empirical results, while Section 5 concludes.

2. Theory and empirical evidence

2.1 Institutions and knowledge-based economies

The fundamental challenge in fostering any KE is to harness knowledge for development by providing an enabling environment for a competitive educational system, highly qualified human resources, excellent information, communication technology infrastructure (ICT), and a capable scientific infrastructure for innovations (Chandra &

Yokoyama, 2011). Where domestic R & D is weak or nonexistent, FDI is a good, though imperfect, substitute, and hence extant literature suggests that the main institutional impediment to FDI may not lie in its effect on the rates of return on investing abroad, but also on the excess risk that such investment entails. Unlike trade, foreign investment is not only subject to a risk of predation and hold-up, but also to expropriation and nationalization risks. For example, Harms & Ursprung (2002) argue that authoritarian regimes are associated with a greater risk of policy reversals due to the dictator's own whims, the need to raise public support through populist measures, or simply coups d'etat. Globerman & Shapiro (2002), Stern (2003), and Bénassy-Quéré et al. (2005) also find that various measures of governance quality are related to FDI inflows. All this work shows that the quality of institutions and of the regulatory system operating in an economy, have a significant impact on inward FDI, and the latter affects the KE, especially in developing countries.

Finally, Lambsdorff (2003) finds that the predictability of corruption has an impact on inward capital flows that is distinct from the impact of the level of corruption. Other authors find that defective institutions tend to be correlated with lower literacy rates, larger public investment in unproductive assets (Mauro, 1998), and lower expenditures devoted to the maintenance of past projects than effective institutions. Hence, by encouraging unproductive public investments that result in less efficient public facilities and a slow accumulation of human capital, defective institutions also indirectly hamper countries' attractiveness to foreign investment, and therefore the development of the KE.

2.2 Intellectual Property Rights (IPRs) in Knowledge Economy (KE)

According to the literature there are two main avenues along which IP and the strength of IPR regimes influence the level of KE, which we describe briefly below (Bezmen & Depken, 2004; Andrés & Goel, 2012). The first captures the degree to which IPRs influence

the creation of new knowledge and information within individual nations, as well as the diffusion of existing knowledge across countries. The second is the indirect effect of a nation's IPR regime on international transactions that provide factors crucial for the growth process.

2.2.1 Creation and dissemination of information

The endogenous theories of economic growth, whereby investment in research and development (R&D) results in profit (returns) to individual investors and also increases society's stock of knowledge, represent the basis for IPRs protection. According to Romer (1990) and Grossman and Helpman (1991), for instance, by diminishing the cost of future innovation, the accumulation of knowledge fosters economic growth. Grossman and Lai (2004) describe the benefits of establishing an effective system of intellectual property rights, but some researchers find that the effects of IPRs on growth depends on the level of economic development, that there is some threshold, and we say more on that argument later, fundamentally, tighter and more restrictive IPRs may serve as stimuli to growth by encouraging innovations and inventions. It then follows naturally that individuals engage in innovative activities in response to expected rewards for their efforts. Following Baumol (1993), Bezmen & Depken (2004) suggest that this aspiration is in fact the primary motivation for any entrepreneurial activity, and it increases both total factor productivity and output level.

The concentration of patent holdings and R&D expenditures is in the industrialized world and where enforcement costs are positively linked with the tightening of IPRs. However, such concentration seems to imply that stronger IPRs increase royalty gains to developed countries (and to the creators of technological advancements) at the expense of developing countries. This has led some authors to argue that net consumers of technological innovation have an incentive to enforce IPRs only when the innovation they consume differs from the type of innovation they supply to foreign markets (Diwan & Rodrik, 1991). It

follows that the effectiveness of IPRs may be substantially contingent on the country's present stage of development. More stringent IPR regimes may restrict diffusion of knowledge and technological development in 'technology followers' while stimulating innovation in 'technology leaders' (Bezmen & Depken, 2004).

Traditionally, industrialized nations have depended substantially on the protection offered by IPRs. In contrast, less developed countries have often preferred quick dissemination of knowledge at the cost of protecting the IPRs of foreigners. From this perspective, many newly industrialized countries have recently pushed for stronger IPRs via bilateral, multilateral, and regional agreements (Mshomba, 2009). This difference in approach could be attributed to the desire of developing countries to specialize in labor intensive production in agricultural industries. Labor-intensive industries, until recently, have largely been supported by public expenditures on research and technology and have substantially gained from shared knowledge spillovers. One application of this argument gaining increasing relevance is the access to and affordability of life-saving drugs, especially with regard to the treatment of HIV/AIDS in developing countries. Intense pressure is being placed on pharmaceutical companies to 'loosen' their patent rights in a bid to allow poor countries the opportunity of better managing the AIDS pandemic (See Mshomba, 2009).

2.2.2 International effects

According to Bezmen & Depken (2004), IPRs may also affect a nation's growth and development process by disengaging it from international transactions (e.g., trade, technology transfers, and FDI inflows). The potential growth rewards emanating from increased participation in international trade have been covered in the literature. For example, it is widely accepted that international trade can be an important stimulus to economic prosperity since access to world markets could spur greater utilization of idle human capital resources

than possible under autarky (Todaro & Smith, 2003). However, a more stringent IPR regime may also be an important factor in attracting inflows of FDI and technological transfers[5]. In addition, individual (investors and firms) views about the strength of a nation's IPR regime positively affects such nations' receipts of FDI and the willingness of foreigners to transfer newer technologies (Lee & Mansfield, 1996). It has also been well documented that strong IPRs have a positive incidence on a nation's level of exports (Maskus & Penubarti, 1995) and they increase the likelihood of investment undertaken by multinational companies (Mansfield, 1994; Seyoum, 1996). However, Yang & Maskus (2001) note that, stronger IPRs protection could also reduce the need for FDI, while Andrés (2006), and Goel and Nelson (2009) have found copyright protection and income to be the most determining factors of IPRs in the software industry.

2.3 Bases for instrumental variables

In this section, we provide a theoretical justification for the empirical validity of the instruments. This justification is crucial for the empirical analysis required for sound and consistent interpretation of estimated coefficients. Moreover, the objective of this paper is not only to assess the impact of formal institutions on KE, but also to examine how the enforcement of IPR laws by formal institutions is instrumental in KE. The presentation is in two main strands: the first strand provides theoretical linkages between IP treaties, government quality and KE; and the second strand justifies the instrumentality of income-levels, legal-origin, and religious-domination. Regarding, the first strand, logic and common-sense have it that IPR laws (treaties) are mostly enforceable only through good governance mechanisms. The most widely known IPR instruments enforced by governments are: main IP laws, IP rights laws, World Intellectual Property Organization (WIPO) treaties, and

[5] There is also literature critical of the role of IPRs (Moser, 2012).

Multilateral (Bilateral) treaties. The empirical section of this paper uses aspects of this strand as instruments.

With respect to the second strand, we provide a theoretical justification for the choice of income-levels, legal-origin, and religious-domination as relevant instrumental variables. (1) From an income-level perspective, high-income countries have tighter IPRs, better governance than their low-income counterparts, and stronger KE (Maskus, 2000). Legal-origins differ in their emphases on private property rights vis-à-vis the powers of the state (La Porta et al., 1998; Beck et al., 2003). Religious-domination is also crucial. The Islamic economic model, for instance, is based on and regulated by the same Shari'ya principles as the overall society (Iqbal, 1997), whereas in non-Islamic economies there is at least a theoretical separation of religion and state.

3. Data and Methodology

3.1 Data

3.1.1 Dependent variables

Borrowing from Chavula (2010) and Weber (2011), our dependent variables are extracted from the World Bank's knowledge index which consists of four dimensions: an economic incentive & institutional regime; educated & skilled workers; an effective innovation system; and a modern & adequate information infrastructure. Our argument for that choice is that to date, efforts to measure knowledge have been undertaken at one of two levels: first, at the individual firm level; and second, at the national systems level. Inevitably, because knowledge has informal and tacit aspects, on the one hand, as well as formal or codified forms, on the other hand, all such measurements involve proxies and indirect estimates. Firm level measurement arises out of business initiatives to manage knowledge and measure intangible assets. These efforts are operationalized at the micro level and use a

combination of accounting and non-financial indicators to measure stocks of intellectual or knowledge capital, and the flows of changes in knowledge stocks (OECD, 2002). The knowledge capacity of firms is proxied by means of instruments like balanced scorecards, intangible assets monitor, intellectual capital accounts and stylized models of knowledge spillovers (Sveiby, 1997; Lev, 2001; Boudreau, 2002). In addition to knowledge stocks and flows, knowledge enablers are measured as a way of identifying practices with the potential to change or maintain knowledge stocks and flows. These may include either leadership, strategy, organizational partnerships, or talent (Kermally, 2002).

At the macro level, economic models capture the generation of ideas and their association with wealth in the production function framework. Conceptually, the generic production function relates total product to labor, capital, and other inputs that combine to produce it. The deficiency of the basic production function, especially in its Cobb-Douglas functional form, in handling new innovations and endogenous technical change has since resulted in many refinements, dating back to the seminal work of Solow (1957) and Abramovitz (1956). The subsequent 'growth accounting' literature attempts to disaggregate the residual in the standard production function by employing increasingly sophisticated econometric methods. Since knowledge is seen as embodied in technical change (Solow, 1957; Abramovitz, 1956; Amavilah, 2009), it is the 'knowledge production function,' which postulates the generation of new knowledge as dependent on R&D capital, labor, and other inputs. Various measures of 'new knowledge', including citation weighted patents as well as new product announcements have been used in these econometric models (see Griliches, 1990, 1992, for discussions on related efforts). An additional complication besides measuring knowledge either as an input or output is that knowledge can also be measure as a quantity like average years of schooling, for instance (Bils & Klenow, 2000), a quality as in cognitive

skills (see, e.g., Hanushek & Woessmann, 2008; Hanushek & Kimko, 2000), as well as along interactions between quality and quantity.

To deal with complications like this one, there has been a variety of attempts by international bodies and countries to develop indices of science, technology or knowledge standing (see, e.g., Grupp & Mogee, 2004). For example, the UNDP's (2001) Technology Achievement Index is a comparative national macro-composite of indicators for technology creation (e.g., patents per capita), diffusion of new innovations (e.g., internet hosts per capita), diffusion of old innovations (e.g. telephones per capita), and human skills (e.g., mean years of schooling for people over 15 years). Similarly, to develop composite indices of innovation performance for EU member states, US, and Japan, the 2004 European Innovation Scoreboard employs 20 indicators comprised of the following four groups: human resources; the creation of new knowledge; the transmission and application of knowledge; and innovation, finance, output and markets (Commission of the European Communities, 2004). The 'creation of knowledge' indicators include public and business R&D/GDP and high tech patents/population. The 'transmission and application of knowledge indicators' include proportion of small and mid-size enterprises (SMEs) that report making innovations or collaborating in innovations, innovation expenditures/sales and non-technical innovations by SMEs. The UNDP, EU, and other similar indices draw on available data reported at the national level, from which national comparisons of standings are then made. This choice of dependent variables is also consistent with recent KE literature (Asongu, 2012a).

3.1.2 Independent variables

Our explanatory variable of interest is governance, which is a multidimensional and broad term. We define governance as the way in which policy makers are empowered to make decisions and the manner in which policy decisions are formulated and implemented. To operationalize this concept we use a set of governance indicators that capture different aspects

of governance. The World Bank indicators meet the requirement because they are constructed from several sources including polls of experts, and surveys of residents and entrepreneurs within a country and they could be grouped into three concepts (Kaufmann, Kraay, & Mastruzzi, 2010). The first concept is about the process by which those in authority are selected and replaced [Political Governance]: voice & accountability and political stability. The second has to do with the capacity of government to formulate & implement policies, and to deliver services [Economic Governance]: regulatory quality and government effectiveness. The last, but by no means least, regards the respect for citizens and the state of institutions that govern the interactions among them [Institutional Governance]: rule of law and control of corruption.

Each indicator, normalized to range from -2.5 to 2.5, with a zero mean and a standard deviation of one, provides a subjective assessment of some aspect of a country's quality of governance. Higher values signal better governance. Although the quality of available data suffers from the data aggregation problems, one of the advantages of aggregate indicators is that they are more informative about broad concepts of governance. Individual data provides a noisy signal of the broader concept of governance. Aggregate indicators also provide a country-wide coverage than individual indicators. Moreover, we use each indicator in isolation since they measure different aspects of the impact of governance on KE. This perspective is supported by the recent piracy literature which has shown that these variables interact differently with IPRs to produce different effects on software piracy (Andrés & Asongu, 2013a).

3.1.3 Control and instrumental variables

We consider the following eight control variables: population growth, financial depth, GDP growth, financial size, inflation, government expenditure, domestic investment and financial efficiency. The choice of only eight control variables is contingent on constraints in

the "Overidentifying Restrictions (OIR)" test for instrument validity[6]. Our general expectation is that population growth has a positive linkage with the ICT and Education dimensions of the KE (Asongu, 2012a)**.** Likewise, we expect government expenditure to stimulate KE if investment resources are efficiently allocated, and not tainted by corruption, for example. Inflation should increase the credit dimension of economic incentive and mitigate the demand for ICT owing to rising prices. Broadly speaking, GDP growth, financial size, financial depth, investment and financial allocation efficiency are also potential drivers of KE.

As rationalized in Section 2.3 above, instrumental variables include: Constitution, Main Intellectual Property Law, Intellectual Property Rights Law, WIPO Treaties, Multilateral Treaties, Bilateral Treaties, Income-levels, Legal-origin and Religious-domination. Moreover, other instrumental variables, besides 'IPR treaties', have been well documented in the recent African growth and development literature (Beck, et. al, 2003; Stultz & Williamson, 2003, Agbor, 2011; Asongu, 2012b) and IPRs (Andrés & Asongu, 2013a,b)[7].

We estimate pooled time-series cross-section (panel data) regressions, using annual observations for 22 SSA and MENA countries for the years 1996-2010[8]. Since some of the data are not available for all countries and/or all years, the panel data is unbalanced and the number of observations depends on the choice of explanatory variables. Details about variable definitions, data sources, summary statistics, and correlation analysis are presented in the appendices. The 'summary statistics' (Appendix 1) of the variables used in the panel regressions show that there is a substantial degree of variation in the data utilized. The correlation matrix (Appendix 2) was examined with the purpose of mitigating concerns

[6]An OIR test is only applicable in the presence of over-identification, that is, the instruments must be higher than the endogenous explaining variables by at least one degree of freedom. In the cases of exact- identification (instruments equal to endogenous explaining variables) and under-identifications (instruments less than endogenous explaining variables) an OIR test is by definition impossible.

[7] It should also be noted that in developing economies, local norms and practices that matter are reflected by the formal institutional channels.

[8]The 22 MENA and SSA countries are listed in Table 1A, Panel B, in the Appendix. Good governance indicators for these countries are only available as from 1996 (See Development Indicators of the World Bank).

resulting from overparametization and multicolinearity. Based on a preliminary assessment of the correlation coefficients, there do not appear to be any serious issues in terms of the relationships to be estimated. Appendix 3 provides definitions and sources of the variables.

3.2 Methodology

3.2.1 Principal Component Analysis (PCA)

An obvious limitation of this paper is that we are interested primarily in evaluating empirically the impact of formal institutions on KE, *ceteris paribus*. One might also criticize the redundancy in the information provided for each dimension of the KE index, since each dimension could be correlated with its component variables individually. For this reason, we use principal component analysis (PCA), a common statistical technique that is used to reduce a large set of correlated variables into a small set of uncorrelated variables, called principal components that account for most of variation in the original data set.

Table 1: Principal Component Analysis

Knowledge Economy dimensions		Component Matrix(Loadings)			First P.C	Eigen Value	Indexes
Education	School enrolment	PSE	SSE	TSE			
		0.535	0.620	0.574	0.771	2.313	Educatex
Information & Infrastructure	ICTs	Internet	Mobile	Telephone			
		0.653	0.661	0.371	0.705	2.115	ICTex
Economic Incentive	Trade & Tariffs	Trade	Tariffs				
		-0.707	0.707		0.645	1.290	Tradex
	Credit & IR Spread	Private Credit	Interest rate spread				
		-0.707	0.707		0.679	1.358	Creditex
Innovation	Scientific Journals FDI Inflows	Reducing the dimensions of these is impractical owing to low correlation and conceptual dissimilarity.					

PSE: Primary School Enrolment. SSE: Secondary School Enrolment.TSE: Tertiary School Enrolment. PC: Principal Component. ICTs: Information and Communication Technologies. IR: Interest Rate. FDI: Foreign Direct Investment.

Table 1 displays the first principal component (PC) accounts for approximately 65% of the variation in all four KE dimensions. The criteria applied to determine how many

common factors to retain are taken from Kaiser (1974) and Jolliffe (2002). They recommend dropping factors with an eigenvalue smaller than one. Note also that the weights in the first PC are almost equal across dimensions, indicating that a one PC model is appropriate for each KE dimension in our sample.

3.2.2 Endogeneity

While a KE depends on formal institutions, we acknowledge that the reverse effect cannot be ruled-out, because as an economy grows in knowledge, it tends to have better governance mechanisms that enforce stringent IPR regimes. This endogeneity represents a reverse-causality. Also, governance indicators are measures of perception, subject to significant media propaganda bias, which in turn lends credibility to the endogeneity concern. In the empirical IPR literature Bezmen & Depken (2004) have insisted that studies investigating the IPRs-development nexus are subject to potential endogeneity problems, because it is likely that a nation's level of development is a crucial factor in the choice of, or adherence to, a particular IPR regime. This confirms an earlier thesis by Ginarte & Park (1997) which reveals that the level of economic development explains the strength of patent protection provided by individual countries. So, before tackling this endogeneity concern, we examine briefly its presence with the Hausman test and then employ an estimation technique compatible with the outcome of the test.

3.2.3 Estimation technique

Following Beck et al. (2003) and recent African development literature (Asongu, 2013), the paper adopts a Two-Stage Least Squares (2SLS) Instrumental Variables (IV) approach. The IV estimation technique deals effectively with the endogeneity puzzle, and therefore avoids the inconsistency of estimated coefficients by Ordinary Least Squares (OLS),

which normally arises when the exogenous variables are correlated with the error term. In accordance with recent IPRs literature, the 2SLS estimation will entail the following steps:

First-stage regression:

$$GQ_{it} = \gamma_0 + \gamma_{1i}(Instruments)_{it} + v_{it} \quad (1)$$

Second-stage regression:

$$KE_{it} = \beta_0 + \beta_{1i}(GQ)_{it} + \beta_{2i}X_{it} + \mu_{it} \quad (2)$$

In Eqs. (1) and (2), *GQ* represents governance, measuring the institutional quality of government in regards to the rule of law, regulation quality, voice & accountability, government effectiveness, political stability/no violence and corruption-control, and γ_i are the estimated effects on *GQ* of instruments, where instruments refer to the variables described above. *KE* denotes the dimensions of a *KE* also outlined above, and β_{1i} are estimated impacts of *GQ* on *KE*. X_{it} is a set of control variables described above and listed in the Appendix, so that β_{2i} are their corresponding effects on *KE*. Lastly, *v* and *u* represent the error terms. Again, to deploy the estimation technique, we (1) justify the choice of a 2SLS over an OLS estimation technique with the Hausman-test for endogeneity; (2) verify the instruments are exogenous to the endogenous components of explaining (GQ channels); and (3) ensure the instruments are valid and not correlated with the error-term in the main equation with an Over-identifying Restrictions (OIR) test. Further robustness checks are ensured with Heteroscedasticity and Autocorrelation Consistent (HAC) standard errors. The results follow next.

4. Empirical analysis

This section has two parts. The first sub-section below presents the main empirical findings. The second sub-section interprets the results for policy and further research.

4.1 Presentation of results

This sub-section deals with results relating to two main issues: (1) the capacity of the exogenous components of the GQ channels to explain KE dimensions; and (2) the ability of the instruments to explain KE dimensions beyond the GQ channels. While the first issue is addressed by the significance of estimated coefficients, the second is contingent on the outcome of the OIR Sargan test. This method explains why we do not include the F-test because for the IV approach it is not an indispensable statistics and alternative tests like the Cragg and Donald (1993) could as well have been used. Having said that, the null hypothesis of this test is the position that the instruments explain KE only through GQ channels, i.e., IPR laws (treaties) that affect KE dimensions are enforced only through good governance mechanisms. Hence, a rejection of this null hypothesis is a rejection of the stance that the IPR laws (treaties) affecting KE dimensions are not enforced beyond formal good governance institutions. A Hausman test for endogeneity precedes every 2SLS approach. The null hypothesis of this test is that OLS estimates are efficient and consistent. Thus, a rejection of this hypothesis points to the presence of inconsistent estimates owing to endogeneity and hence, lends credit to the choice of the 2SLS approach. Tables 2-7 present results for various components of KE. The education (Table 2), information & infrastructure (Table 3), economic incentive (Tables 4-5), and innovation (Tables 6-7) components of KE are regressed on GQ channels, conditional on other control variables using HAC standard errors. For all models, the Hausman test overwhelmingly rejects the null hypothesis, confirms the presence of endogeneity, and supports the adoption of a 2SLS modeling approach.

Except for regulation quality (which has the right sign but an insignificant estimate), the educational dimension of KE (Table 2), but for GQ mitigates education in KE (first issue) and the enforcement of IPR laws (treaties) by GQ channels does not stimulate education in KE (second issue). With respect to the information & infrastructure dimension of KE (Table

3), while GQ dynamics of voice & accountability, political stability and regulation quality address the first issue, only the first of the three, addresses the second issue, and these interpretations are in line with those of Table 2. Concerning the economic incentive side of KE (Tables 4-5), no conclusions could be drawn from findings on private credit and interest rate spread (Creditex) owing to insignificant estimates. However, the results on trade openness and tariffs (Tradex) demonstrate that the enforcement of IPR laws (treaties) through voice & accountability and regulation quality significantly infringes on trade openness. Looking at the innovation component of KE (Tables 6-7), the upholding of tighter IP regimes through political and regulatory quality mechanisms has a negative incidence on the publication of scientific and technical journals (Table 6). The findings pertaining to FDI inflows (Table 7) do not enable us to establish any conclusions owing to insignificance of good governance estimates. However, in reporting such findings we are suggesting that statistical significance does not always imply economic significance. Overall it is clear that *the adoption of tight IP regimes and their enforcements by formal institutional mechanisms do not stimulate KE in SSA and MENA countries.*

Most control variables are significant and have correct signs. For example, government expenditure improves education as well as information and communication infrastructure. In addition, improvements in macroeconomic financial intermediary dynamics of efficiency and size boosts information and communication infrastructure owing to increased economic activity. Furthermore, government expenditure and economic prosperity could lead to a favorable climate for FDI inflows. Given the strength of control variables relative to the weakness of governance indicators in determining KE, it would seem that the prospects for the KE in this group of countries are brightest with improvements in the control variables as opposed to the independent variables.

Table 2: Effect of governance on education (with HAC standard errors)

	Dependent variable: Educatex					
Constant	**0.883***	-0.737	1.030	-0.050	0.494	0.681
	(1.688)	(-0.640)	(1.905)	(-0.047)	(0.704)	(0.940)
Voice & Accountability	**-0.483*** **	---	---	---	---	---
	(-3.272)					
Political Stability	---	**-0.916*** **	---	---	---	---
		(-3.513)				
Government Effectiveness	---	---	**-0.557* **	---	---	---
			(-1.685)			
Regulation Quality	---	---	---	-0.408	---	---
				(-0.810)		
Rule of Law	---	---	---	---	**-0.746*** **	---
					(-3.146)	
Control of Corruption	---	---	---	---	---	**-0.810*** **
						(-2.770)
Trade	-0.000	**0.034* **	-0.001	0.012	0.007	0.006
	(-0.012)	**(1.945)**	(-0.279)	(0.530)	(1.414)	(1.188)
Population Growth	**-1.434*** **	**-1.259*** **	**-1.438*** **	**-1.131*** **	**-1.514*** **	**-1.532*** **
	(-6.434)	**(-4.890)**	**(-5.162)**	**(-5.171)**	**(-6.275)**	**(-6.045)**
Inflation	**0.113*** **	0.036	**0.084** **	0.052	**0.099*** **	**0.098*** **
	(4.621)	(0.879)	**(2.042)**	(1.061)	**(3.743)**	**(3.714)**
Government Expenditure	**0.141*** **	**0.103*** **	**0.139*** **	**0.104*** **	**0.154*** **	**0.172*** **
	(6.256)	**(6.218)**	**(3.960)**	**(6.401)**	**(7.151)**	**(7.022)**
Financial depth	-0.350	-1.987	0.187	-0.315	-0.219	-0.696
	(-0.404)	(-1.642)	(0.209)	(-0.810)	(-0.340)	(-1.190)
Hausman test	**100.44*** **	**38.168*** **	**65.609*** **	**30.488*** **	**54.009*** **	**44.126*** **
	[0.000]	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**
Sargan OIR	**3.938**	**2.677**	**5.604**	10.600*	**4.427**	**3.675**
	[0.558]	**[0.749]**	**[0.346]**	[0.059]	**[0.489]**	**[0.597]**
Adjusted R^2	0.584	0.640	0.536	0.645	0.568	0.542
Fisher	**82.558*** **	**65.541*** **	**101.21*** **	**111.44*** **	**211.47*** **	**261.43*** **
Observations	79	79	79	79	79	79
Instruments	Constant; Constitution; Main_IP_law; IP_rlaw; Wipo_treaties; Mutilateral; Bilateral; LM_Income; M_Income; H_Income; English; Christians.					

*;**;***: significance levels of 10%, 5% and 1% respectively. OIR: Overidentifying Restrictions. [] :P-values. z-statistics in brackets. HAC: Heteroscedasticity and Autocorrelation Consistent. Educatex is the first principal component of primary, secondary and tertiary school enrolments.

Table 3: Effect of governance on Information & Infrastructure (with HAC standard errors)

	Dependent variable: ICTex					
Constant	**-15.490*** **	**-7.799*** **	**-20.86* **	**-6.874*** **	-22.708	**-18.322* **
	(-2.838)	**(-3.457)**	**(-1.702)**	**(-3.874)**	(-1.160)	**(-1.692)**
Voice & Accountability	**-2.053* **	---	---	---	---	---
	(-1.704)					
Political Stability	---	**-1.309*** **	---	---	---	---
		(-2.643)				
Government Effectiveness	---	---	-4.695	---	---	---
			(-1.155)			
Regulation Quality	---	---	---	**-2.352*** **	---	---
				(-2.929)		
Rule of Law	---	---	---	---	-5.246	---
					(-0.754)	
Control of Corruption	---	---	---	---	---	-3.436
						(-1.081)
Trade	**-0.031* **	-0.002	-0.019	0.026	0.026	-0.003
	(-1.793)	(-0.196)	(-0.808)	(1.146)	(0.371)	(-0.146)
Population Growth	-0.036	-0.512	-0.035	-0.593	0.260	0.373
	(-0.036)	(-1.260)	(-0.037)	(-1.617)	(0.145)	(0.330)
Inflation	0.282	**0.107** **	0.117	-0.009	0.048	0.066
	(1.639)	**(2.084)**	(0.556)	(-0.179)	(0.145)	(0.326)
Government Expenditure	0.095	-0.021	**0.162* **	-0.056	0.159	**0.156** **
	(1.535)	(-0.595)	**(1.896)**	(-1.339)	(1.186)	**(2.004)**
Economic Prosperity	-0.538	0.550	-0.478	0.627	-0.794	-0.762
	(-0.432)	(1.247)	(-0.379)	(1.523)	(-0.342)	(-0.556)
Domestic Investment	-0.034	-0.019	-0.135	0.009	-0.113	-0.015
	(-0.240)	(-0.202)	(-0.428)	(0.102)	(-0.235)	(-0.057)
Financial Size	**16.857** **	**5.752** **	22.447	3.934	22.095	18.292
	(2.096)	**(2.509)**	(1.212)	(1.615)	(0.835)	(1.108)
Financial Efficiency	**-4.736* **	**1.492** **	8.114	-0.695	7.193	5.135
	(-1.704)	**(2.229)**	(1.445)	(-1.023)	(0.957)	(1.337)
Hausman test	**120.36*** **	**55.345*** **	**151.62*** **	**42.352*** **	**157.7*** **	**136.71*** **
	[0.000]	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**
Sargan OIR	**1.359**	8.875**	**0.213**	9.33***	**0.068**	**0.414**
	[0.506]	[0.011]	**[0.898]**	[0.009]	**[0.966]**	**[0.812]**
Adjusted R^2	0.090	0.063	0.096	0.116	0.054	0.080
Fisher	**4.174*** **	**11.687*** **	**2.318** **	**9.410*** **	1.062	**1.823* **
Observations	139	139	139	139	139	139
Instruments	Constant; Constitution; Main_IP_law; IP_rlaw; Wipo_treaties; Mutilateral; Bilateral; LM_Income; M_Income; H_Income; English; Christians.					

*;**;***: significance levels of 10%, 5% and 1% respectively. OIR: Overidentifying Restrictions. []:P-values. z-statistics in brackets. HAC: Heteroscedasticity and Autocorrelation Consistent. ICTex is the first principal component of mobile phones, telephone and internet users.

Table 4: Effect of governance on First Economic Incentive (with HAC standard errors)

	Dependent variable: Tradex					
Constant	**4.537*** (2.677)**	**5.380*** (3.521)**	3.830 (1.551)	**5.188*** (3.425)**	3.944 (1.631)	**4.303* (1.730)**
Voice & Accountability	**-0.710* (-1.855)**	---	---	---	---	---
Political Stability	---	-0.582 (-1.427)	---	---	---	---
Government Effectiveness	---	---	-1.166 (-1.302)	---	---	---
Regulation Quality	---	---	---	**-0.690* (-1.833)**	---	---
Rule of Law	---	---	---	---	-1.032 (-1.525)	---
Control of Corruption	---	---	---	---	---	-0.906 (-1.245)
Trade	---	---	---	---	---	---
Population Growth	0.318 (1.173)	0.047 (0.180)	0.175 (0.731)	-0.088 (-0.308)	0.048 (0.208)	0.200 (0.875)
Inflation	-0.072 (-1.433)	**-0.103** (-2.385)**	**-0.129*** (-2.618)**	-0.114 (-2.552)	**-0.126*** (-2.822)**	**-0.133*** (-2.858)**
Government Expenditure	0.003 (0.059)	-0.061 (-0.991)	-0.009 (-0.210)	-0.067 (-1.215)	-0.035 (-0.883)	-0.016 (-0.379)
Economic Prosperity	-0.486 (-1.091)	0.005 (0.014)	-0.221 (-0.653)	0.152 (0.378)	-0.005 (-0.016)	-0.184 (-0.530)
Domestic Investment	0.051 (0.662)	0.053 (0.657)	0.002 (0.031)	0.051 (0.719)	-0.020 (-0.217)	0.005 (0.058)
Financial Size	**-4.075** (-2.417)**	**-4.972** (-1.997)**	-2.466 (-0.792)	**-4.525* (-1.910)**	-1.905 (-0.653)	-2.621 (-0.801)
Financial Efficiency	-0.229 (-0.159)	**-1.504* (-1.886)**	-0.042 (-0.025)	**-2.056*** (-2.872)**	-0.851 (-0.860)	-0.829 (-0.728)
Hausman test	**47.828*** [0.000]**	**75.876*** [0.000]**	**50.741*** [0.000]**	**64.734*** [0.000]**	**46.119*** [0.000]**	**71.148*** [0.000]**
Sargan OIR	**1.295 [0.730]**	**0.937 [0.816]**	**1.947 [0.583]**	**0.830 [0.842]**	**0.343 [0.951]**	**0.515 [0.915]**
Adjusted R^2	0.085	0.158	0.204	0.164	0.311	0.204
Fisher	**13.683*** **	**11.514*** **	**6.222*** **	**13.196*** **	**9.529*** **	**11.258*** **
Observations	82	82	82	82	82	82
Instruments	Constant; Constitution; Main_IP_law; IP_rlaw; Wipo_treaties; Mutilateral; Bilateral; LM_Income; M_Income; H_Income; English; Christians.					

*;**;***: significance levels of 10%, 5% and 1% respectively. OIR: Overidentifying Restrictions. [] :P-values. z-statistics in brackets. HAC: Heteroscedasticity and Autocorrelation Consistent. Tradex is the first principal component of trade openness and tariffs.

Table 5: Effect of governance on Second Economic Incentive (with HAC standard errors)

	Dependent variable: Creditex					
Constant	**9.433****	5.036	8.464	4.127	2.966	6.506
	(2.153)	(1.781)	(1.310)	(1.427)	(1.216)	(1.596)
Voice & Accountability	1.293	---	---	---	---	---
	(1.532)					
Political Stability	---	0.576	---	---	---	---
		(1.515)				
Government Effectiveness	---	---	1.509	---	---	---
			(0.639)			
Regulation Quality	---	---	---	0.313	---	---
				(0.914)		
Rule of Law	---	---	---	---	-0.230	---
					(-0.317)	
Control of Corruption	---	---	---	---	---	0.742
						(0.622)
Population Growth	0.368	0.418	0.307	**0.376***	0.186	0.277
	(1.480)	(1.622)	(0.973)	**(1.677)**	(0.829)	(1.123)
Inflation	-0.036	0.050	0.060	0.071	0.076	0.069
	(-0.302)	(0.591)	(0.484)	(0.870)	(1.097)	(0.650)
Government Expenditure	-0.062	-0.025	**-0.083****	-0.041	**-0.050****	**-0.073****
	(-2.578)	(-0.676)	**(-2.084)**	(-1.126)	**(-2.192)**	**(-2.407)**
Economic Prosperity	0.026	-0.383	0.007	-0.294	-0.074	-0.056
	(0.122)	(-1.354)	(0.022)	(-1.223)	(-0.346)	(-0.244)
Domestic Investment	0.001	0.043	0.044	0.029	-0.014	0.012
	(0.012)	(0.442)	(0.237)	(0.265)	(-0.121)	(0.099)
Financial Size	-6.865	-3.991	-7.615	-3.511	-1.946	-5.408
	(-1.492)	(-1.253)	(-0.816)	(-1.128)	(-0.656)	(-0.942)
Financial Efficiency	**-4.396*****	**-2.043****	-4.174	-1.489	-1.317	**-2.840****
	(-2.733)	**(-2.023)**	(-1.384)	(-1.359)	(-1.252)	**(-2.126)**
Hausman test	**238.74*****	**143.68*****	**101.37*****	**113.22*****	**54.186*****	**89.189*****
	[0.000]	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**
Sargan OIR	**6.155**	11.097**	6.755*	15.858***	25.963***	10.603**
	[0.104]	[0.011]	[0.080]	[0.001]	[0.000]	[0.014]
Adjusted R^2	0.302	0.306	0.172	0.300	0.396	0.232
Fisher	**21.245*****	**6.265*****	**23.544*****	**17.405*****	**125.22*****	**14.145*****
Observations	105	105	105	105	105	105
Instruments	Constant; Constitution; Main_IP_law; IP_rlaw; Wipo_treaties; Mutilateral; Bilateral; LM_Income; M_Income; H_Income; English; Christians.					

*;**;***: significance levels of 10%, 5% and 1% respectively. OIR: Overidentifying Restrictions. [] :P-values. z-statistics in brackets. HAC: Heteroscedasticity and Autocorrelation Consistent. Creditex is the first principal component of private domestic credit and interest rate spreads.

Table 6: Effect of governance on Technical & Scientific Journals (with HAC standard errors)

	Dependent variable: LogJournals					
Constant	0.555	0.600	-2.665	1.958	-4.950	-7.861
	(0.285)	(0.424)	(-0.672)	(1.214)	(-0.898)	(-0.918)
Voice & Accountability	-0.315	---	---	---	---	---
	(-0.701)					
Political Stability	---	**-0.952*** **	---	---	---	---
		(-3.928)				
Government Effectiveness	---	---	-1.301	---	---	---
			(-0.889)			
Regulation Quality	---	---	---	**-1.045*** **	---	---
				(-5.234)		
Rule of Law	---	---	---	---	-1.866	---
					(-1.358)	
Control of Corruption	---	---	---	---	---	-2.251
						(-1.030)
Population Growth	0.256	-0.087	0.282	**-0.291** **	0.067	0.433
	(1.475)	(-0.470)	(1.498)	**(-2.139)**	(0.222)	(1.380)
Inflation	-0.030	-0.021	-0.033	**-0.075** **	-0.003	0.005
	(-0.584)	(-0.543)	(-0.540)	**(-2.016)**	(-0.026)	(0.039)
Government Expenditure	0.045	0.008	**0.070* **	0.012	**0.080*** **	**0.100** **
	(1.450)	(0.504)	**(1.898)**	(0.731)	**(2.578)**	**(2.296)**
Economic Prosperity	**-0.557** **	0.088	**-0.613** **	0.300	-0.341	**-0.776** **
	(-1.980)	(0.305)	**(-2.104)**	(1.553)	(-0.840)	**(-2.116)**
Domestic Investment	0.109	-0.007	0.084	-0.021	0.0001	0.068
	(1.144)	(-0.118)	(0.702)	(-0.444)	(0.001)	(0.418)
Financial Size	0.642	0.446	4.312	-0.019	7.707	10.504
	(0.234)	(0.286)	(0.757)	(-0.011)	(1.149)	(0.914)
Financial Efficiency	0.830	**1.233** **	1.793	0.020	1.902	1.919
	(1.368)	**(2.440)**	(1.548)	(0.063)	(1.403)	(1.168)
Hausman test	**80.646*** **	**143.89*** **	**86.621*** **	**130.43*** **	**115.82*** **	**154.37*** **
	[0.000]	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**
Sargan OIR	**6.917**	**1.823**	**4.998**	**4.401**	**4.525**	**1.720**
	[0.140]	**[0.609]**	**[0.287]**	**[0.221]**	**[0.209]**	**[0.786]**
Adjusted R^2	-0.046	0.476	-0.040	0.231	0.030	-0.026
Fisher	1.371	**28.309*** **	1.252	**32.227*** **	**4.042*** **	1.470
Observations	125	125	125	125	125	125
Instruments	Constant; Constitution; Main_IP_law; IP_rlaw; Wipo_treaties; Mutilateral; Bilateral; LM_Income; M_Income; H_Income; English; Christians.					

*;**;***: significance levels of 10%, 5% and 1% respectively. OIR: Overidentifying Restrictions. [] :P-values. z-statistics in brackets. HAC: Heteroscedasticity and Autocorrelation Consistent.

Table 7: Effect of governance on FDI inflows (with HAC standard errors)

	Dependent variable: FDI Inflows					
Constant	-8.092	-0.392	-5.771	0.008	1.912	1.005
	(-1.018)	(-0.082)	(-0.483)	(0.001)	(0.214)	(0.149)
Voice & Accountability	-1.563	---	---	---	---	---
	(-1.024)					
Political Stability	---	0.555	---	---	---	---
		(0.621)				
Government Effectiveness	---	---	-1.971	---	---	---
			(-0.576)	1.472		
Regulation Quality	---	---	---	(1.381)	---	---
Rule of Law	---	---	---	---	0.977	---
					(0.491)	
Control of Corruption	---	---	---	---	---	0.261
						(0.164)
Population Growth	-0.812	-1.150	**-1.653****	-0.709	-1.259	**-1.720****
	(-0.976)	(-1.241)	**(-2.334)**	(-0.867)	(-1.288)	**(-2.440)**
Inflation	0.249	0.117	0.122	0.143	0.126	0.118
	(1.424)	(1.128)	(1.020)	(1.208)	(1.137)	(1.116)
Government Expenditure	**0.211****	**0.203****	0.178	**0.244****	0.151	0.131
	(2.324)	**(2.084)**	(1.361)	**(2.532)**	(1.237)	(1.134)
Economic Prosperity	0.500	1.116	**1.873***	0.501	1.399	**2.051****
	(0.385)	(0.866)	**(1.921)**	(0.431)	(1.025)	**(2.153)**
Domestic Investment	-0.129	-0.057	-0.205	0.036	-0.047	-0.119
	(-0.670)	(-0.294)	(-0.877)	(0.182)	(-0.262)	(-0.488)
Financial Size	8.266	-0.932	4.841	-3.016	-3.951	-3.007
	(0.870)	(-0.204)	(0.478)	(-0.612)	(-0.525)	(-0.582)
Financial Efficiency	3.675	1.076	2.436	2.329	0.056	-0.279
	(1.018)	(0.368)	(0.434)	(0.963)	(0.014)	(-0.088)
Hausman test	**31.723*****	**22.486*****	**25.020*****	**18.92****	**24.114*****	**23.747*****
	[0.000]	**[0.004]**	**[0.001]**	**[0.015]**	**[0.002]**	**[0.002]**
Sargan OIR	11.393***	11.496***	**7.422**	13.199***	10.126**	**7.368**
	[0.009]	[0.009]	**[0.115]**	[0.004]	[0.017]	**[0.117]**
Adjusted R^2	0.021	0.049	-0.002	0.113	0.041	0.011
Fisher	**2.737*****	**2.052****	1.562	**3.512*****	0.966	1.217
Observations	141	141	141	141	141	141
Instruments	Constant; Constitution; Main_IP_law; IP_rlaw; Wipo_treaties; Mutilateral; Bilateral; LM_Income; M_Income; H_Income; English; Christians.					

*;**;***: significance levels of 10%, 5% and 1% respectively. OIR: Overidentifying Restrictions. [] :P-values. z-statistics in brackets. HAC: Heteroscedasticity and Autocorrelation Consistent.

4.2 Discussion of results and policy and further implications

Before discussing the results, we highlight once again the need for an understanding of the factors and forces that would determine the KE in SSA and MENA countries. The importance of link between KE and governance has been recognized.. The main idea behind this recognition is that the process of creation and diffusion of knowledge depends on appropriate governance policies that are the outcome of good governance. Therefore, it is

essential to identify the institutional factors that promote the creation and diffusion of knowledge in SSA and MENA countries which have been subject to less scholarly attention. The identification permits assessing how the enforcement of IP laws by formal institutions has affected the KEs in these countries.

The findings demonstrate that the enforcement of IPR reaties through good governance mechanisms is not a sufficient condition for greater KE in SSA and MENA countries. If any positive effect exists between formal institutions and KE in these nations, then other instruments besides the upholding of IPR treaties (laws) elucidate it. However, our findings may alternatively reflect the Chinese model of KE. For instance, though there has been a clear positive relationship between good governance and the creation of KE in much of East Asia, China has largely remained an exception to this rule. China's KE development appears to come from the country's FDI function. The country's success story in attracting FDI is attributed to its spectacular growth track record, relatively better executive power, good infrastructure, abundant educated labor force, and a large domestic market (Chandra & Yokoyama, 2011, p. 46). It seems likely that SSA and MENA countries are in the same paradigm as China with respect to the impact of good governance measures on KE.

From another standpoint, it has been well documented in the literature that the 'East Asian miracle' is largely indebted to less stringent IPRs at the early stages of the economic development of the region. This supports the thesis that the changing strength of IPR regimes depends on a nation's level of development and/or current technological ability. Evidence further suggests that the "East Asian miracle" could have been caused by weaker IPR 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 and KE tendencies. It has been further noted that as these countries became significant producers of new technologies and innovations,

their IPR regimes tightened (Nelson & Pack, 1999). Therefore, our findings are in line with Nelson & Pack's (1999) postulation that the assimilation of existing (foreign) productive techniques and technologies was a critical component of the success with KE of these countries as opposed to SSA and MENA nations. This view is perpendicular (contrary) to Maskus's (2000) caution that weaker protection of IPRs will not necessarily be beneficial for developing countries as it may cause them to remain dependent on older and less efficient technologies.

The findings are also consistent with the Chinese model insofar as they conform to some studies on wealth-effects that have established the existence of a non-linear relationship between income-levels and IPRs (Kim, 2004; Maskus & Penubarti, 1995). These studies substantiate that patent protection tends to improve as economies move from low to middle-income stages, but that eventually patent protection decreases with the ability to imitate new technologies. The substance of the matter in this line of thought is that IPRs are thought to be successful at spurring economic growth and activity only after a nation has acquired sufficient human capital and technology infrastructure for creative imitation to take place. Accordingly, strong IPR protection in the early stages of industrialization, when knowledge and technology can only be acquired through reverse engineering, duplication and/or imitation, may thus hamper technology transfers in SSA and MENA countries.

Examining the findings further in the light of very recent African IPR literature (Andrés & Asongu, 2013b), reveals that results from the education dimension of KE are compatible with the thesis that adoption of tight IPR regimes may negatively affect human development by diminishing the literacy rate and restricting diffusion of knowledge. Andrés & Asongu (2013b) however document that adherence to international IPRs protection treaties (laws) may not impede per capita economic prosperity and could improve life-expectancy.

Two major policy and, three further research implications emerge from our findings.

One, the enforcement of very tight IPR regimes through good governance mechanisms is not a sufficient condition for the KE in SSA and MENA countries. At their current level of development enforcement of strict IPR regimes in these countries could seriously undermine efforts towards KE by restricting the dissemination of knowledge, ICTs, and innovation. Two, there are other crucial determinants of KE besides the upholding of IPRs through good governance mechanisms; the Chinese model of the KE is an alternative example, and a better reflection of what is happening in MENA and SSA countries. One implication for further research is to subject the same data assembled in this paper to alternative estimation techniques. Another is to deploy alternative statistical techniques and estimation methods than PCA, acquire more and better data, and enlarge the sample of the countries to be investigated. Lucas and Moll (2013) proposed an intriguing model by which an economy uses its old knowledge to produce goods while at the same time "interacting with others in search for new, productivity-increasing ideas". In this sense economies do not necessarily have to abandon product-based activities for KEs. The last implication is to examine more directly the Chinese KE model to find out if it is the appropriate model of the SSA-MENA region.

5. Conclusion

Despite the growing importance of the KE, the debate has centered on Latin America and East Asian countries, leaving the situation surrounding MENA and SSA countries unexplained. This paper is a modest attempt to fill the gap in our understanding of factors responsible for stimulating KE in this group of nations. It assesses how the upholding to IPR laws (treaties) by formal institutions affects various components of the KE. The results show that the enforcement of IPR laws (treaties) is not a sufficient condition for a greater KE. One may conclude that tight IPR regimes are not a sufficient condition for KE in SSA and MENA countries. Such laws (treaties) could even seriously undermine efforts towards KE by

restricting dissemination of knowledge, ICTs and innovation. Obviously, this is not good news for countries wishing to stimulate their KEs. However, it might also be possible that the IPRs and their enforcement are not a necessary condition for the KE either, because there are other crucial determinants of the KE besides the upholding of IPRs. Indeed, the extent to which the control variables have stronger, more consistent and technically efficient short-run impacts on KE than governance variables implies that the Chinese model of the KE may be a relevant model of the experience with KE of MENA and SSA countries. Even so, both the findings and policy implications they recommend point toward a need for further research in this area. Until that is done, the results of this paper and their concluding implications should be interpreted cautiously.

Appendices

Table A1: Summary statistics and presentation of countries

Panel A: Summary Statistics

		Mean	S.D	Min	Max	Obs.
Knowledge Economy	Educatex(Education)	-0.038	1.370	-4.344	1.858	126
	ICTex(Information & Infrastructure)	0.028	1.440	-3.750	3.183	310
	Tradex(First Economic Incentive)	-0.058	1.143	-2.901	2.635	161
	Creditex(Second Economic Incentive)	0.118	1.224	-2.296	3.488	193
	Scientific and Technical Journals	2.142	0.676	0.518	3.821	284
	Foreign Direct Investment Inflows	3.119	3.908	-4.025	33.566	319
Governance	Voice & Accountability	-0.603	0.669	-1.960	1.009	264
	Rule of Law	-0.063	0.727	-1.606	1.258	264
	Regulation Quality	-0.224	0.740	-2.047	1.111	264
	Government Effectiveness	-0.082	0.644	-1.234	1.345	264
	Political Stability	-0.271	0.884	-2.222	1.169	264
	Corruption Control	-0.102	0.725	-1.322	1.680	264
Control variables	Population growth	2.759	2.668	-0.157	18.588	330
	Inflation	5.585	6.274	-9.797	43.073	296
	Government Expenditure	12.318	11.321	-34.88	80.449	295
	Economic Prosperity	4.689	3.450	-4.300	26.750	313
	Domestic Investment	20.531	6.910	-1.380	39.348	301
	Financial Size	0.851	0.216	0.124	1.609	261
	Financial Depth	0.523	0.291	0.121	1.279	240
	Financial Efficiency	0.751	0.288	0.143	2.103	308
Instrumental variables	Constitution	0.150	0.357	0.000	1.000	300
	Main Intellectual Property Law	1.366	1.534	0.000	7.000	300
	Intellectual Property Rights Law	1.130	1.793	0.000	7.000	300
	WIPO Treaties	2.453	1.219	0.000	6.000	300
	Multilateral Treaties	8.440	3.948	0.000	20.00	300
	Bilateral Treaties	0.380	0.806	0.000	4.000	300
	Lower Middle Income	0.363	0.481	0.000	1.000	330
	Middle Income	0.590	0.492	0.000	1.000	330
	High Income	0.318	0.466	0.000	1.000	330
	English	0.409	0.492	0.000	1.000	330
	Christian	0.227	0.419	0.000	1.000	330

Panel B: Presentation of Countries

Algeria, Bahrain, Botswana, Cameroon, Egypt, Israel, Jordan, Kenya, Kuwait, Lebanon, Libya, Mauritius, Morocco, Nigeria, Oman, Qatar, Saudi Arabia, Senegal, Tunisia, United Arab Emirates, Yemen, Zambia.

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

Table A2 : Correlation analysis

Knowledge Economy						Governance						Control variables								Instrumental variables											
E	ICT	Tra	Cre	Jrs	FDI	VA	RL	RQ	GE	PS	CC	Popg	Infl	Gov	Gro	DI	FS	FD	FE	Con	MIP	IPR	Wipo	Mul	Bil	LMI	MI	HI	Eng	Chr	
1	0.3	-0.3	-0.8	0.4	0.26	0.12	0.51	0.02	0.5	-0.06	0.50	-0.24	-0.33	0.60	0.11	0.07	0.53	0.61	0.22	0.0	0.4	-0.0	-0.1	-0.0	0.3	-0.3	-0.2	0.4	-0.0	-0.3	E
	1.0	-0.2	-0.4	0.4	0.16	-0.15	0.01	-0.19	0.0	-0.22	0.03	0.09	-0.15	0.17	0.05	0.01	0.45	0.26	0.18	0.1	0.3	0.2	0.1	0.2	0.3	-0.0	-0.0	0.1	-0.0	-0.2	ICT
		1.0	0.4	0.1	-0.42	-0.16	-0.58	-0.50	-0.5	-0.36	-0.54	-0.44	0.02	-0.28	-0.26	-0.18	-0.31	-0.33	-0.22	-0.0	0.0	0.1	-0.0	0.3	-0.0	0.4	0.4	-0.5	-0.2	0.0	Tra
			1.0	-0.5	-0.1	-0.2	-0.6	-0.18	-0.6	-0.04	-0.64	-0.08	0.46	-0.44	-0.11	-0.15	-0.55	-0.78	-0.39	-0.0	-0.4	-0.2	-0.1	-0.0	-0.3	0.0	0.0	-0.5	0.2	0.6	Cre
				1.0	0.07	0.03	0.16	-0.28	0.2	-0.34	0.13	-0.10	-0.18	0.1	-0.10	-0.11	0.2	0.3	0.3	-0.0	0.3	0.1	0.1	0.2	0.5	0.1	-0.1	0.1	-0.1	-0.3	Jrs
					1.00	-0.01	0.13	0.18	0.1	-0.01	0.07	0.12	0.09	0.1	0.19	0.16	0.05	0.2	-0.03	-0.0	0.4	0.1	0.2	0.0	0.1	-0.0	-0.0	0.0	0.0	-0.0	FDI
						1.00	0.47	0.20	0.5	0.14	0.47	-0.14	0.07	-0.08	0.001	0.20	0.2	0.1	0.1	-0.3	0.1	-0.0	0.1	0.0	0.1	-0.1	-0.0	-0.0	0.2	0.4	VA
							1.00	0.68	0.8	0.62	0.9	0.19	-0.27	0.23	0.13	0.38	0.3	0.5	0.4	-0.0	-0.1	-0.0	-0.1	-0.2	0.0	-0.3	-0.3	0.6	0.1	-0.1	RL
								1.00	0.5	0.71	0.61	0.25	-0.16	-0.08	0.13	0.49	0.3	0.3	0.16	-0.0	-0.3	-0.0	-0.2	-0.3	-0.3	-0.2	-0.1	0.3	0.2	0.0	RQ
									1.0	0.49	0.89	0.22	-0.30	0.173	0.08	0.37	0.4	0.5	0.47	-0.0	-0.0	-0.1	-0.0	-0.1	0.2	-0.3	-0.3	0.5	0.0	-0.1	GE
										1.00	0.59	0.25	-0.14	-0.007	0.15	0.38	0.09	0.08	0.26	-0.0	-0.4	-0.1	-0.3	-0.3	-0.4	-0.3	-0.2	0.3	0.2	0.1	PS
											1.00	0.31	-0.26	0.24	0.16	0.35	0.45	0.47	0.40	0.0	-0.1	-0.0	-0.1	-0.3	0.0	-0.3	-0.3	0.6	0.1	-0.1	CC
												1.00	0.07	0.10	0.40	0.17	0.02	-0.13	0.16	0.2	-0.2	-0.1	0.0	-0.3	-0.0	-0.1	-0.3	0.4	0.1	-0.1	Popg
													1.00	-0.20	0.13	-0.15	-0.37	-0.31	-0.19	-0.1	0.0	-0.0	0.0	0.0	-0.1	-0.0	-0.0	-0.2	0.2	0.3	Infl
														1.00	0.04	-0.03	0.21	0.26	0.09	0.2	0.1	-0.0	-0.1	-0.2	0.1	-0.3	-0.3	0.5	-0.0	-0.3	Gov
															1.00	0.15	0.08	0.005	0.12	0.1	-0.0	0.0	0.1	-0.0	-0.0	-0.0	-0.0	0.1	-0.0	-0.0	Gro
																1.00	0.27	0.29	-0.14	0.2	-0.0	0.0	0.1	0.0	0.0	-0.1	0.0	-0.0	-0.3	0.0	DI
																	1.00	0.37	0.33	0.2	0.0	0.0	0.0	-0.0	0.0	-0.0	-0.0	0.3	-0.0	-0.1	FS
																		1.00	0.12	-0.0	0.5	0.3	0.0	0.1	0.3	0.0	0.0	0.1	-0.1	-0.3	FD
																			1.00	-0.2	-0.1	0.0	-0.0	0.2	-0.0	0.1	-0.1	0.3	0.1	-0.1	FE
																				1.0	-0.2	-0.1	-0.1	-0.2	-0.1	-0.3	-0.1	0.2	-0.0	-0.2	Con
																					1.0	0.5	0.3	0.3	0.4	0.2	0.3	-0.3	-0.2	-0.1	MIP
																						1.0	0.1	0.2	0.0	0.5	0.4	-0.3	-0.1	-0.1	IPR
																							1.0	0.4	0.3	0.1	0.1	-0.2	-0.2	0.0	Wipo
																								1.0	0.2	0.5	0.4	-0.5	-0.3	0.0	Mul
																									1.0	0.0	-0.0	0.1	-0.3	-0.1	Bil
																										1.0	0.6	-0.5	-0.4	-0.1	LMI
																											1.0	-0.8	-0.4	0.0	MI
																												1.0	0.2	-0.3	HI
																													1.0	0.4	Eng
																														1.0	Chr

E: Educatex. ICT: ICTex. Trad: Tradex. Cre:Creditex. Jrs: Technical & Scientific Journals. FDI: Net Foreign Direct Investment Inflows. VA: Voice & Accountability. RL: Rule of Law. RQ: Regulation Quality. PS:Political Stability. CC: Corruption Control. Popg:Population growth. Infl:Inflation. Gov: Government Expenditure. Gro: Economic Prosperity. DI: Domestic Investment. FS: Financial Size. FD: Financial Depth. FE: Financial Efficiency. Con: IPlaws enshrined in countries' constitution. MIP: Main Intellectual Property law. IPR: Intellectual Property Rights law. Wipo: World Intellectual Property Organization. Mul: Multilateral treaties. Bil: Bilteral treaties. LMI: Lower Middle Income. MI: Middle Income. HI: Income Income. Eng: English. Chr: Christian.

Table A3: Variable definitions

Variables	Signs	Variable definitions	Sources
Panel A: Dimensions in Knowledge Economy(KE)			
Primary School Enrolment	PSE	Log of PSE	World Bank(WDI)
Secondary School Enrolment	SSE	Log of SSE	World Bank(WDI)
Tertiary School Enrolment	TSE	Log of TSE	World Bank(WDI)
Education in KE	Educatex	First PC of PSE, SSE & TSE	PCA
Internet Users	Internet	Log of Internet	World Bank(WDI)
Mobile Cellular Subscriptions	Mobile	Log of Mobile	World Bank(WDI)
Telephone lines	Tel	Log of Tel	World Bank(WDI)
Information & Infrastructure in KE	ICTex	First PC of Internet, Mobile & Tel	PCA
Trade Openness	Trade	Exports plus Imports of Commodities (% of GDP)	World Bank(WDI)
Tariff Barriers	Tariff	Tariff rate, most favored nation, weighted mean, all products (%)	World Bank(WDI)
1st Economic Incentive dimension in KE	Tradex	First PC of Trade & Tariff	PCA
Private domestic credit	Credit	Private domestic credit (% of GDP)	World Bank(WDI)
Interest rate spread	Spread	Lending rate minus deposit rate (%)	World Bank(WDI)
2nd Economic Incentive dimension in KE	Creditex	First PC of Credit and Spread	PCA
1st Innovation dimension in KE	Journals	Log of Number of Technical & Scientific Journals	World Bank(WDI)
2nd Innovation dimension in KE	FDI	Net Foreign Direct Investment (% of GDP)	World Bank(WDI)
Panel B: Good Governance Dynamics			
Rule of Law	R.L	Rule of Law (estimate)	World Bank(WDI)
Regulation Quality	R.Q	Regulation Quality (estimate)	World Bank(WDI)
Government Effectiveness	Gov. E	Government Effectiveness (estimate)	World Bank(WDI)
Voice and Accountability	V & A	Voice and Accountability (estimate)	World Bank(WDI)
Political Stability/ No Violence	PolS	Political Stability/ No Violence (estimate).	World Bank(WDI)
Control of Corruption	CC	Control of Corruption (estimate)	World Bank(WDI)
Panel C: Control Variables			
Government Expenditure	Gov. Exp.	Government final consumption expenditure (% of GDP)	World Bank(WDI)
Inflation	Infl.	Consumer Price Index (annual %)	World Bank(WDI)
Population Growth	Popg	Population Growth Rate (annual %)	World Bank(WDI)
Savings	Savings	Gross Domestic Savings (% of GDP)	World Bank(WDI)

Economic Prosperity	GDPg	GDP growth rate (annual %)	World Bank(WDI)
Domestic Investment	DI	Gross Domestic Investment (% of GDP)	World Bank(WDI)
Financial Depth	M2	Broad Money Supply (% of GDP)	World Bank(FDSD)
Financial Efficiency	BcBd	Bank Credit on Banking Deposits	World Bank(FDSD)
Financial Size	Dbacba	Deposit bank assets /(Deposit bank assets plus Central bank assets)	World Bank(FDSD)
Panel D: Instrumental Variables			
Constitution	Con	IPRs enshrined in country's constitution	WIPO
Main_IP_law	MIPlaw	Main Intellectual Property Law	WIPO
IP_rlaw	IPrlaw	Intellectual Property Rights Law	WIPO
Wipo_treaties	Wipo	World Intellectual Property Organization	WIPO
Mutilateral	Multiter	Multilateral Treaties	WIPO
Bilateral	Bilater	Bilateral Treaties	WIPO
Legal origins		English Common Law and French Civil Law Countries	La Porta et al. (2008, p.289)
Income levels		Low, Middle, Lower Middle, Upper Middle & High Income	World Bank(WDI)
Religious domination		Christians & Muslims	CIA The WFB(2011)

WDI: World Bank Development Indicators. FDSD: Financial Development and Structure Database. WIPO: World Intellectual Property Organization. GDP: Gross Domestic Product. PC: Principal Component. PCA: Principal Component Analysis. Log: logarithm. CIA: Central Intelligence Agency. WFB: World Factbook.

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