Digital Rights Management, Intellectual Property Rights Protection and Economic development: The case of digital piracy in the South Mediterranean countries

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Digital Rights Management, Intellectual Property Rights Protection and Economic development: The case of digital piracy in the South Mediterranean countries (*)

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Abstract:

The potential benefits that could be gained from information technologies in South Mediterranean economies are constrained by both DRM and institutional protection related to Intellectual Property Rights. But, pervasive piracy can appear to be a major obstacle to access these benefits. This paper through a simplified theoretical decision model attempts to suggest foundations to reveal levels of protection rates. This is followed by an empirical assessment of the likely effects of different macroeconomic variables in the context of selected South Mediterranean countries using software piracy data and the protection rates derived from the above model. This is intended to reveal the most important variables that drive software protection. The results attained show how protection should be strengthened through further investments in knowledge and through openness to foreign direct investments that lead to superior economic outcomes.

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Key words: DRM; Information and communication technologies; piracy; South Mediterranean economies.

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Introduction

This paper deals with piracy rates in relation to both institutional and technological protection including Digital Rights Management (DRM) with their effects on economic development in the South Mediterranean countries. The evidence shows the high levels of piracy rates in the South Mediterranean countries but does not indicate the extent of the likely factors that are behind it. In the present study, the insufficient level of protection and implementation of DRM is assumed to be the most important factor.

The South Mediterranean economies have been identified as countries that could benefit highly from Information and Communication Technologies (ICTs). These promised benefits include efficiency, productivity gains, and new business opportunities besides their contributions to the enlargement of further inclusion of the poor. But these benefits are not readily observable and are highly dependent on possibilities of access and affordability. The levels of investment in ICTs in these economies are potentially constrained by Intellectual Property Rights (IPRs) and the low level of protection. Evidence has shown that the levels of piracy in these economies are growing at a high rate compared to world figures (BSA, 2008). It has increased as they moved from 56 to 60% as in the last six years, while they were 36 to 38% in the European Union (Massaad, 2009). The high prevalence of digital piracy in the countries of the region is indeed an indicator of the magnitude of the IPRs cost burden. There is an important disagreement concerning the kind of impact stronger IPRs enforcement would have on the economies of such developing countries. For some, stricter IPRs would stimulate innovation and spur technological progress contributing to the economic growth. For others, IPRs are pointless in the case of developing countries because the absence of qualified human capital implies that there is no innovation to encourage in the first place. The controversy around IPRs has been further strengthened by the introduction of DRM by digital content copyright holders. DRM is described as the most radical form of IPRs protection because it does not rely on any institutional support but uses technology embedded in the product to monitor and control the access to the digital content. DRM thus adds an additional level of complexity to the IPRs dilemma in developing economies as the purchase of a legal copy of a digital content not only entails the cost of IPRs but also constitutes important constraints on the future use of the resource.

The most illustrative example is the case of libraries which are prevented from giving access to an educational material to as many users as possible due to DRM systems that grant the access to the content for only a limited number of times or on limited types of supports.

But DRM systems have been proved to be highly vulnerable to piracy implying that they can have no limiting effect on piracy rates in the South Mediterranean countries. They are more likely to affect

the demand for legal content by reducing the general willingness to embark in the purchase of legal copies given the additional costs in terms of freedom of use.

Within this framework, a special focus is placed on the macroeconomic determinants of software piracy and protection in the context of South Mediterranean countries.

This is achieved in three major sections that are respectively introduced in this paper. While the first section introduces the literature review on the matter of piracy, protection and DRM, the second provides the theoretical model suggested. The third section is based on empirical analysis that is aiming to test the rules attained under the suggested economic model.

I- Literature Review

The present literature review aims at showing how previous reports and publications dealt respectively with the issue of the role of ICTs in development, the dimension of developing economies and IPRs and with the role of IPR protection including DRM.

In relation with the first issue, the available literature indicates a growing consensus on the central role of Information and Communication Technologies (ICTs) may play with respect to economic development. According to Nandi (2002) ICTs are expected to promote economic development through acquiring and carrying information in a cost effective way as they allow overcoming distance and time obstacles. Barnett, Jacobson, Young and Sun-Miller (1997) described ICTs as a space-adjusting technology rendering the distance obsolete and transforming the world into a global village. Interestingly, ICTs have irreversibly transformed the way individuals, businesses and society work, communicate and interact (International Telecommunication Union, 2006).
The digital revolution brought by ICTs has thus opened up endless business and human development opportunities of which the developing world could benefit yet one is to be careful not to oversee the potential pitfalls of ICTs. Drine & Guetat (2007) and Abdel-Kader (2006) emphasize the existence of other aspects of ICTs' implications on economic development. Accordingly, ICTs appear to be contributing to the strengthening of the developed countries' competitive advantage relative to the less developed countries. In comparison with developed economies, less developed countries face the economic consequences of the technological gap as well as the difficulties of universal access and affordability.
The South Mediterranean countries have been recognized as countries that can largely benefit from of education, knowledge and ICTs have been subject to a number of studies attempting to verify the

impact of ICTs. Driouchi A., El. Azelmad and G. Anders (2006) estimated the effects of different components of the knowledge economic index on GDP. They confirmed the role of ICTs as major drivers of economic development and growth mainly in developing economies. Abdel-Kader (2006) examined the extent to which the accumulation of ICTs has contributed to economic GDP growth in MENA (Middle East and North Africa) countries and this compared with other different groups of countries. The author finds that ICTs indices play a significant role in explaining cross-country variations in per capita income in all groups of countries including the MENA. Drine & Guetat (2007) estimated the direct and indirect contribution of ICTs to economic growth across six world regions including 14 MENA countries. The study highlights that the regional leader in terms of ICTs contribution to growth is East and South Asia and the looser region is the Sub Saharan Africa. Yet, as far as the MENA in concerned, no specific effect of ICTs on growth was revealed. Drine & Guetat (2007) argue that the MENA region as a whole needs sustained increases in human capital volume and quality and in investment in ICTs infrastructure to catch-up with the East and South Asian country performance in ICT profitability for growth. The authors establish as well that a significant growth payoff from ICTs in MENA countries is valid only for the oil-MENA countries.

With regard to the second issue, access, affordability, and ICTs investment were thus identified as key elements in the success or the failure of ICTs in bringing about economic development. This has led the literature to focus the impact of Intellectual Property Rights (IPRs) on the achievement of the expected benefits of ICTs. In this sense, the adoption of the Trade-Related Aspects of Intellectual Property Rights (TRIPs) represented the main signal of the changing global attitudes with respect to IPRs. The TRIPs agreement signaled more especially the beginning of a long debate between the developing and the developed countries concerning the real costs and benefits of a strengthened IPRs international legislation.

According to Pei (2005), several factors that have emerged during the 1990s are responsible for causing IPRs to become a strategic aspect of international trade. First, the accelerated flow of capital, technologies, and skills between developed and developing economies following, due to globalization, has increased both the value and the vulnerability of IPRs. Second, the information revolution along with the emerging advanced technologies has rendered IPRs infringement easier. Third, the growing role emerging economies are starting to play in the globalized economy has coincided with their weak IPRs tradition. In fact, the developing countries lacked the very incentive to protect IPRs as long as product affordability in these countries is a priority that precedes the protection of another countries' IPRs.

The arguments presented in favor of IPRs protection in developing countries tend to be long-term oriented. Zavin (1997) suggests that by enforcing IPRs, developing countries would create a foreign investment-friendly environment that would attract more multinational corporations and thus increase jobs and exports supply. For instance, a music record company would refuse to take the risk of expanding in a country with piracy rates. Also, export firms are reluctant to marketing their products in countries where IPRs enforcement and protection are weak and consequently consumers in the country in question have no choice but resort to counterfeit products that represent serious product safety issues (Zavin, 1997). According to Jorda (1997), IPRs protection in developing countries does not benefit exclusively the foreign firms, it is meant to benefit the local economy as well. IPRs offer the guarantee for domestic producers to appropriate fully the financial gains of their R&D efforts. This way, IPRs constitute a long-term guarantee of general welfare and scientific progress (Saffer, 1997). Further, developed countries justify the need to enforce IPRs on the ground that the R&D investments undertaken by their firms are to benefit the whole world population and not only the developed world (Rothbard, 1993).

Opponents of IPRs contend however that IPRs protection entails an array of disadvantages to the developing countries. Mfuka (2004) explains how patents legalize monopoly and favour monopoly practices such as unjustified increases in prices and rents leading to the decrease in general welfare. Also, the observed surge in patents in the developed countries contributes to amplifying the gap vis-à-vis developing countries in research fields such as ICTs or biotechnology. In this sense, IPRs contribute to establishing a North-South dependency by increasing the financial outflows from developing countries towards developed countries in form of royalties for instance (Moustapha, 2006). IPRs protection, by artificially increasing prices, is believed to challenge developing countries' ability to acquire essential products such as seeds, education material, software, pharmaceuticals, and so on. Consequently, populations in these countries are deprived from their fundamental rights to healthcare, education and development (ASTM, 2002). For instance, education systems remain highly sensitive to the acquisition of foreign publications (Morin, 2003).

Given the complexity and the controversy surrounding the impact IPRs can have on the economic development, researchers such as Tansey (1999) argue that due to the fundamental economic disparities between developed and developing countries, similar and equal levels of IPRs protections in both groups is not feasible. According to Balasubramaniam (2004), in the absence of a trans-national redistribution of innovation and IPRs, the developed countries group would ultimate continue to alone harvest the benefits of IPRs, that is why developing countries should at least benefit from a certain flexibility in IPRs enforcement commitments in order to prevent the costs of IPRs enforcement from exceeding the benefits. It is important to mention that developed countries in the

past have benefited from such flexibility which has undeniably helped them throughout earlier development stages.

The third issue besides IPRs as a potential obstacle to a wider access to ICTs is Digital Rights Management (DRM) ought to be pointed out as an additional constraint. DRM refers to "protecting ownership/copyright of electronic content by restricting what actions an authorized recipient may take in regard to that content" (Noakes-Fry, 2000). DRM thus concerns digital content products such as periodicals, books, photographs, educational material, research, video and audio content. (Noakes-Fry, Oct 2000, cited in SANS Institute, 2001). DRM is also described as a wider system of information technology components, services, corresponding law, policies and business models, aimed at the controlled distribution of IPRs (Nicholson, 2009). DRM systems perform a variety of actions to control access and use of digital content. Typically, DRM systems control whether a digital item can be reproduced or not. It controls the number of allowed copies, the length and the number of times for which the content may be accessed, and whether the work can be loaned or re-sold. DRM systems dictate as well the digital platforms on which the product content may be accessed (Stratton, 2005).

A major critique of DRM system is emphasized by Cameron (2007) who explains that DRM systems radically alter traditional transactions in the copyright market. For instance, when purchasing a book from a bookstore neither the owner of the bookstore, nor the owner of copyright, will be able to know or control how the consumer will use the book. With DRM however, this whole dynamic is altered as the copyright holder extends his control to the post-sale phase forcing an ongoing relationship between the copyright owner and the users. Also, DRM allows copyright owners to infringe consumer privacy by observing and storing usage characteristics and patterns. The collected usage patterns stand indeed for valuable marketing information on which copyright distributors can base successful business models with continual revenue streams.

An additional distortion caused by DRM was emphasized by the Electronic Frontier Foundation (2005). As a matter of fact, DRM as a system designed to combat piracy targets and affects only the legitimate users of the product who have actually purchased it from the original copyright holder. The real offenders who are the pirates capable of circumventing DRM protections are never targeted while law-abiding consumers are left with a product of lower quality given the embedded usage constraints.

As far as developing countries are concerned, the available literature provides an interesting survey on the dangers of DRM that are specific to developing countries. More importantly, DRM challenges rational copyright policy that is meant to reflect, above all, the country's development priorities. A rational IPRs policy is one that seeks to add 'just enough' exclusive right so as to maximize the incentive to create and should not merely reinforce exclusive rights over time. Accordingly, the developing economies ought to rationally select both what needs to be protected and the optimal protection mechanism. To illustrate that, a developing economy which aims at forming a domestic software industry may opt for supporting free/open source software business models, rather than protect market imperfections. Thus, while IPRs regimes tend to differ from an economy to another in relation to development priorities, DRM systems are used to overrule such priorities (Nicholson, 2009).

The literature refers to a number of ways DRM systems have indeed overruled development priorities. For instance, distant education as a promising means of widening education scope in the developing world is negatively affected by DRM. DRM restrictive characteristics have raised the cost of providing instructional materials and placed barriers to storing, transferring and using distance education materials (Electronic Frontier Foundation, 2006). Also, DRM is believed to interfere with libraries central role of human capital formation in the developing economies. ICTs have opened up valuable opportunities to access essential knowledge and education content and libraries in developing countries are increasingly gaining affordable access to international academic journals and databases. At the same time, these llibraries are expected to experience real problems caused by DRM. For instance, material is simply removed from the library collection as it become inaccessible after a certain time. Restrictions on copying or sharing or lending are placed by DRM implying that libraries have less rights in the digital environment than in the print world (Nicholson, 2009). One more aspect of the DRM systems controversy is their impact on the disabled. ICTs have lately made it possible for blind people to hear a book read aloud by a blind user's computer or to read newspapers by exporting articles via a Braille terminal. DRM systems however undermine such new opportunities by preventing interoperability with third party software such as text-to-speech programs (Nicholson, 2009).

This literature review shows that, while South Mediterranean countries can enhance their economic and social benefits through larger access to ICTs, institutional and technical constraints such as DRM can lower the levels of such gains. Higher levels of piracy can be among the responses to such constraints.

II- Theoretical model

This model aims at setting a functional form for the piracy rate in relation to variables that include the protection rate.

The theoretical decision model selected combines features from frameworks developed respectively by J. Jaising (2004), and R. Gil (2006). It adopts Gil's approach following the model developed in Tirole (1991), by using similar formulation of the utility function and modifying it following Jaising's approach through integrating the effect of protecting the legal product.

1. Definitions & Assumptions:

The proposed model assumes an economy where consumers could choose either a legal or an illegal one. They could also enjoy not to choose any of these two options. The following assumptions and definitions are used in order to clarify the model components:

- Consumers differ in their tastes for quality x, of the good assumed to be represented in $[0,1]$ interval,
- The two products have different quality levels represented by the relative parameter θ defined as the quality of the illegal product relative to the legal one.
- The firm producing the legal product charges a price p_2.
- If the consumer chooses to search an illegal version, this will found with a probability (1 – α), with search cost s, with $s < p_2$.
- ρ denotes the level of protection, including both institutional (for ex. governmental policy and actions), and technological (for ex. DRM set by the firm) protections.
- A simple functional form for $\alpha(\rho) = \frac{\alpha}{2}(1+\rho)$, that is an adjustment of Jaisingh's model. It is also reasonable to consider $\alpha < 0.5$.
- If a level of protection $\rho > 0$ is set, then the utility to the buyer of the legal product increases as: $x(1+\rho) - p_2$.

Under these assumptions, the decision model can be formulated as in the following.

2. Model formulation:

The utility functions for the two types of consumers are given as:

$x(1+\rho)-p_2$	For a buyer of the legal product
$\theta x(1-\frac{\alpha}{2}(1+\rho))-s$	For the user of the illegal product
0	Outside these two categories

These utilities, define three intervals separating different categories of consumers, and thus, at the same time, define the corresponding demand functions (Appendix 1).

Consumers having a greater utility from the legal product are those having a taste for quality higher than x^*, where:

$$x^* = \frac{p_2 - s}{(1+\rho)-\theta[1-\frac{\alpha}{2}(1+\rho)]}$$

Those that would choose the pirated product would have a taste for quality $\bar{x} < x < x^*$, where:

$$\bar{x} = \frac{s}{\theta[1-\frac{\alpha}{2}(1+\rho)]}$$

The demand functions (D_2 for the legal product, and D_1 for the illegal one) are:

$$D_2 = 1 - x^* = 1 - \frac{p_2 - s}{(1+\rho)-\theta[1-\frac{\alpha}{2}(1+\rho)]}$$

And $$D_1 = x^* - \bar{x} = \frac{p_2 - s}{(1+\rho)-\theta[1-\frac{\alpha}{2}(1+\rho)]} - \frac{s}{\theta[1-\frac{\alpha}{2}(1+\rho)]}$$

These functions could be rearranged as:

$$D_2 = 1 - \frac{p_2 - s}{[1-\theta(1-\frac{\alpha}{2})]+\rho(1+\theta\frac{\alpha}{2})}$$

Setting, $A = 1-\theta(1-\frac{\alpha}{2})$ and $B = 1+\theta\frac{\alpha}{2}$, then:

$D_2 = 1 - \frac{p_2 - s}{A+B\rho}$ and, $D_1 = \frac{p_2 - s}{A+B\rho} - \frac{s}{\theta[1-\frac{\alpha}{2}(1+\rho)]}$.

These demands are effective under the following conditions (negative own price effects where s is treated as the price equivalent of the illegal product):

$\frac{\partial D_2}{\partial p_2} = -\frac{1}{A+B\rho} < 0$ and $\frac{\partial D_1}{\partial s} = -(\frac{1}{A+B\rho} + \frac{1}{\theta[1-\frac{\alpha}{2}(1+\rho)]}) < 0$.

The piracy rate R_p is defined as: $R_p = \frac{D_1}{D_1 + D_2}$.

Or: $R_P = \frac{(p_2 - s)\theta(1-\frac{\alpha}{2}(1+\rho))}{(A+B\rho)(\theta(1-\frac{\alpha}{2}(1+\rho))-s)} - \frac{s}{\theta(1-\frac{\alpha}{2}(1+\rho)-s}$.

That is: $R_p = \frac{(p_2 - s)\theta[1-\frac{\alpha}{2}(1+\rho)] - s(A+B\rho)}{(A+B\rho)[\theta(1-\frac{\alpha}{2}(1+\rho))-s]}$.

Development of this relationship (see Appendix) leads to a second order equation of the form:

$a\rho^2 + b\rho + c = 0$, where: $a = a(R_p) = \frac{\alpha}{2} B\theta R_p$;

$b = b(R_p) = B\theta(1-\frac{\alpha}{2})R_p + BsR_p + A\theta\frac{\alpha}{2}R_p - Bs - (p_2 - s)\theta\frac{\alpha}{2}$

$c = c(R_p) = [As - A\theta(1-\frac{\alpha}{2})]R_p + \theta(p_2 - s)(1-\frac{\alpha}{2}) - As$.

Solving this quadratic equation for ρ will lead to a straight relationship between ρ and R_p expressed in term of the parameters α, θ, and s, and study of the sign of $\frac{\partial R_p}{\partial \rho}$ would clarify how piracy rate (or rate of consumers buying the illegal product to the total consumers) changes when changing the level of protection. Unfortunately, given the complexity of the expressions of a, b, and c, no straight rigorous solution can be obtained.

2. **Special cases**

The introduction of numerical values for the search costs confirm the existence of situation where the piracy rate can be positively related to the protection rate. This can be easily checked under s=0.5. Otherwise, s=0 is an important special case where access to piracy in feasible.

When s is set to zero and p_2 to one, $R_p = \frac{1}{A+B\rho}$ and, $\rho = \frac{1}{B}(\frac{1}{R_p} - A)$ with $\frac{\partial R_p}{\partial \rho} = \frac{-B}{(A+B\rho)^2} < 0$ implying that piracy rates increase (decrease) with decreasing (increasing) protection. But this is only a simplification of the general model as no straightforward conclusion can be inferred with regard to relative magnitudes of piracy and protection.

III- Empirical evidence

The piracy rate as the ratio of demand of pirated versus total copies can be seen from the above model to be not well defined with regard to changes in the protection rate ρ. This is seen also when expressing the protection rate as a function of the piracy rate. The core of the empirical analysis is based on this fact.

It consists in simulating and revealing the likely protection rates of different countries with a focus on South Mediterranean economies. The hypothesis is that the latter countries will be expected to exhibit very low values of ρ relative to developed economies. Besides that, descriptive statistics and regression analysis are conducted to better understand the effects of piracy on different measures of economic and social performance of these economies.

The analysis isolates and focuses on a sample of South Mediterranean countries composed of Algeria, Bahrain, Egypt, Israel, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, Turkey and the United Arab Emirates, and Yemen. This is also the group of South Mediterranean countries for which piracy rates were compiled and made available by the Business Software Alliance (BSA). Hence, piracy rates data from 2003 to 2007 for these countries is the first input in the regression analysis which aims at the tracing the interaction of various aspects of economic development with piracy. Following the theoretical model presented earlier, the levels of protection ρ were calculated for each country based on its piracy rates and under the different assumptions about α (α = 0, α = 1/4, α = 1/2) and θ (θ = 0, θ = 1/4, θ = 1/2, θ = 3/4 and θ = 1). The different values of ρ (Ro1, Ro2, Ro3…Ro15) are obtained for the years 2003, 2004, 2005, 2006 and 2007 and presented in a way that the first five values correspond to α = 0 associated to the five values ofθ. The second five values, correspond to α = ¼ and the last five values correspond to α = ½. The values of ρ presented in table 6, are calculated as the averages of all values of ρ for different years.

Hence, fifteen values were obtained for ρ given the different combinations of θ and α as ρ is a function of piracy rates (R):

$$\rho = \frac{1}{B}\left(\frac{1}{R_p} - A\right)$$

and both A and B are a function of θ and α as:

$$A = 1 - \theta\left(1 - \frac{\alpha}{2}\right)$$

and $B = 1 + \theta\frac{\alpha}{2}$

Both the piracy rates and their corresponding values of ρ are introduced as dependent variables in the second stage of analysis.

In order to measure the impact of software piracy on trade, the foreign direct investment (FDI) flow and stock as well as the export value index for 2003- 2006 period are included as explanatory variables. The latter indicators were retrieved from the Word Bank World Development Indicator database (WDI). Corruption is another dimension that was added to the model by including as an explanatory variables the freedom from corruption sub-indicator of the index of economic freedom (IEF) compiled by the Heritage Foundation and the Corruption Perception Index (CPI) published by Transparency International. The model further incorporates the value of the knowledge economy index (KEI) values for 2008 as the latter index is not calculated on a yearly basis. Additional variables are the GDP Index corresponding to each country of the sample for 2003 and the estimated monetary piracy losses obtained from the BSA.

1. Descriptive statistics and regression analysis

To evaluate the strategies made by domestic institutions in the domain of protection of intellectual property rights in the form of software, the case of software piracy is used. The MENA countries considered in the sample are Algeria, Bahrain, Egypt, Israel, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, Turkey and the United Arab Emirates..

As per BSA (2007) the levels of piracy rates and losses (million US dollars) are introduced in Table 1. This shows that the piracy rates are high and range from 34 to 84 percent. But the losses do not all the time vary in the same direction with the highest level of losses attained in Turkey, Saudi Arabia, Israel and Egypt.

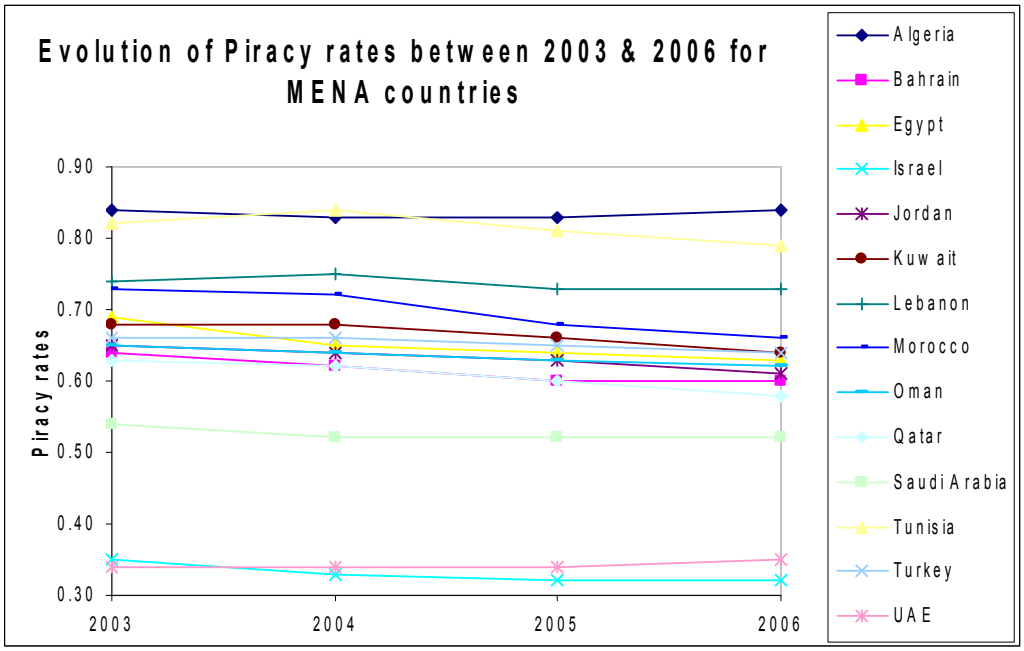
Table 1: Piracy rates and losses (BSA, 2007)

Countries	Piracy rates				Losses ($M)			
	2003	2004	2005	2006	2003	2004	2005	2006
Algeria	0.84	0.83	0.83	0.84	59	67	66	62
Bahrain	0.64	0.62	0.6	0.6	18	19	22	23
Egypt	0.69	0.65	0.64	0.63	56	50	80	88
Israel	0.35	0.33	0.32	0.32	69	66	84	102
Jordan	0.65	0.64	0.63	0.61	15	16	19	19
Kuwait	0.68	0.68	0.66	0.64	41	48	65	60
Lebanon	0.74	0.75	0.73	0.73	22	26	34	39
Morocco	0.73	0.72	0.68	0.66	57	65	55	53
Oman	0.65	0.64	0.63	0.62	11	13	22	25
Qatar	0.63	0.62	0.6	0.58	13	16	21	23
Saudi Arabia	0.54	0.52	0.52	0.52	120	125	178	195

Tunisia	0.82	0.84	0.81	0.79	29	38	54	55
Turkey	0.66	0.66	0.65	0.64	127	182	268	314
UAE	0.34	0.34	0.34	0.35	29	34	45	62

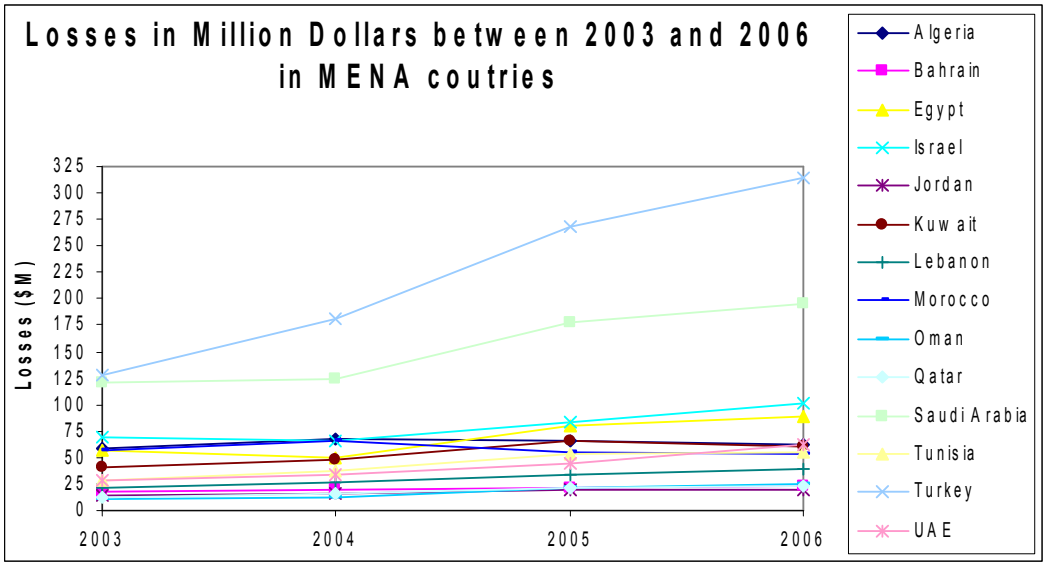
The software piracy rate variable (BSA, 2007) shows the evolution of the rate of piracy of the above countries individually from 2003 to 2006 (Figure 1). It is clear from Figure 1 that the countries that suffer most from software piracy are Algeria, Egypt, Lebanon, Morocco and Kuwait while Israel and the United Arab Emirates have the lowest piracy rates among the countries of the sample.

Figure 1: Evolution of piracy rates in MENA countries (2003- 2006)



The second variable concerns the losses (BSA, 2007) that result from software piracy between 2003 and 2006 (Figure 2). The graph shows the importance of losses in Turkey and Saudi Arabia which are increasing through the period studied. For the other countries in the sample, the losses are rather stagnant or slight increasing/ decreasing through the years.

Figure 2: Evolution of Losses ($Million) related to piracy in MENA (2003- 2006)



The net foreign direct investment (FDI) and the export value index for 2003- 2006 period are also considered to measure the impact of software piracy on trade operations and agreements. However, these values are not available for Algeria, Qatar and the United Arab Emirates (Table 2). In 2006, there is a lack in many countries data which will make it difficult to use in the measurement of software piracy impact.

Table 2: Net FDI and Export value index for MENA countries (2003- 2006)

Countries	Net FDI ($Million)				Export value index (2000 = 100)			
	2003	2004	2005	2006	2003	2004	2005	2006
Bahrain	-225	-170	-74.8	-	107.05	121.37	161.82	193.81
Egypt	217	1090	5280	-	134.60	160.58	227.60	293.29
Israel	1800	-2460	1430	517	101.08	122.52	136.04	148.86
Jordan	436	651	1530	-	155.25	215.66	238.24	-
Kuwait	4890	-2500	-4460	-	104.38	147.14	232.44	299.58
Lebanon	2250	1070	1860	-	213.33	244.56	257.08	322.41
Morocco	2300	862	1520	-	118.02	133.52	142.27	-
Oman	336	-49.4	671	-	103.09	117.87	165.14	194.62
Saudi Arabia	-587	-334	-2350	-	120.35	162.62	214.76	-
Tunisia	539	592	713	-	137.21	165.55	179.37	196.80
Turkey	1250	2070	8730	-	181.62	242.29	283.38	319.49

In general, there is an increase in the net foreign direct investment (FDI) data and export value index from 2003 through 2006. The property rights as well as the freedom from corruption sub-indicators of the index of economic freedom (IEF) are also considered in the measurement of impact of software piracy (Heritage Foundation, 2008). The property rights values show stagnant and decreasing values from 2003 to 2006.

Table 3: Property rights, freedom from corruption (Both sub-indicators of IEF), KEI and GDP index values for MENA countries

Country	Property Rights (IEF)				Freedom from Corruption (IEF)				KEI 2004	KEI 2006	GDP Index 2003
	2003	2004	2005	2006	2003	2004	2005	2006			
Algeria	30	30	30	30	50	50	26	27	2.80	3.20	0.51
Bahrain	70	60	70	70	70	70	61	58	5.19	6.00	0.73
Egypt	50	50	50	50	36	34	33	32	3.77	4.01	0.42
Israel	70	70	70	70	76	73	70	64	7.81	8.36	0.76
Jordan	50	50	50	50	49	45	46	53	5.02	5.35	0.44
Kuwait	70	50	50	50	70	70	53	46	5.52	6.09	0.74
Lebanon	30	30	30	30	10	10	30	27	5.11	5.00	0.47
Morocco	30	30	30	30	47	37	33	32	3.21	3.40	0.42
Oman	50	50	50	50	70	70	63	61	3.51	5.33	0.68
Qatar	50	50	50	50	70	70	56	52	4.89	6.01	-
Saudi Arabia	50	50	50	50	50	50	45	34	4.82	5.07	0.67
Syria	-	-	-	-	10	10	34	34	2.71	-	0.40
Tunisia	50	50	50	50	53	48	49	50	4.11	4.69	0.54
Turkey	50	50	50	50	36	32	31	32	5.02	5.68	0.53
UAE	70	70	50	50	90	70	52	61	5.94	6.32	-
Yemen	-	-	-	-	10	10	26	24	1.17	-	0.10

The freedom from corruption is decreasing in many countries. However, other countries know some increases between 2003 and 2006 especially Jordan and Syria (Table 3).

The knowledge economy index (KEI) is also an indicator of the impact of software piracy and is included in the case study fro both year 2004 and 2006 (Table 4). In addition, Table 4 lists the values of GDP Index for different MENA countries in 2003.

The MENA average concerning the piracy rates, the losses in Million dollars, the property rights sub-indicator of IEF, the net FDI and the export value index are summarized in the following table. Table 4 shows a decrease in piracy rates from 2003 to 2006. However, in average, there is an increase in the total piracy losses for the same period. The property rights sub-index is decreasing during the same period while the net FDI and export value index are unstable (Table 4).

Table 4: MENA Average in Piracy Measures and related variables (2003- 2006)

MENA Average	2003	2004	2005	2006
Piracy rates	0.64	0.63	0.62	0.61
Losses ($M)	47.57	54.64	72.36	80.00
Property rights (IEF)	51.43	49.29	48.57	48.57
Net FDI	1200545455	74690909	1349927273	517000000
Export value index (2000 = 100)	134.18	166.70	203.47	178.99

This study will not only stress the effectiveness of protection but also the economic implications on foreign direct investments (FDI), trade, enterprise creation, economic performance in the South Mediterranean countries and bilateral and multilateral agreements.

To evaluate the efficiency of IPR protection, the internationally available data on piracy rates and economic losses will be needed as well as data on FDI, Exports, KEI, property rights indicator of the IEF and GDP index.

Table 5 provides a summary of the most significant results of the log linear regressions attained.

Table 5: Regression results related to piracy rates

Relationships	R^2	Obs.
$\text{Ln(Losses \$M, 2006)} = \underset{(0.15)}{0.02} + \underset{(25.99)}{1.01}\left[\text{Ln(Losses \$M, 2005)}\right]$	0.98	14
$\text{Ln(Losses \$M, 2005)} = \underset{(1.33)}{0.33} + \underset{(14.98)}{0.98}\left[\text{Ln(Losses \$M, 2004)}\right]$	0.95	14
$\text{Ln(Losses \$M, 2004)} = \underset{(1.03)}{0.17} + \underset{(22.27)}{0.99}\left[\text{Ln(Losses \$M, 2003)}\right]$	0.98	14
$\text{Ln(Piracy Rate, 2006)} = -\underset{(-2.50)}{0.03} + \underset{(52.61)}{0.97}\left[\text{Ln(Piracy Rate, 2005)}\right]$	0.99	14
$\text{Ln(Piracy Rate, 2005)} = -\underset{(-2.89)}{0.03} + \underset{(57.429)}{0.98}\left[\text{Ln(Piracy Rate, 2004)}\right]$	0.99	14
$\text{Ln(Piracy Rate, 2004)} = -\underset{(-0.19)}{0.002} + \underset{(42.12)}{1.03}\left[\text{Ln(Piracy Rate, 2003)}\right]$	0.99	14
$\text{Ln(Piracy Rate, 2005)} = \underset{(1.99)}{0.64} - \underset{(-3.64)}{0.76}\left[\text{Ln(KEI, 2004)}\right]$	0.52	14
$\text{Ln(Piracy Rate, 2006)} = \underset{(2.03)}{0.73} - \underset{(-3.54)}{0.76}\left[\text{Ln(KEI, 2006)}\right]$	0.51	14
$\text{Ln(Property Rights, 2005)} = \underset{(25.47)}{3.55} - \underset{(-2.43)}{0.58}\left[\text{Ln(Piracy Rate, 2006)}\right]$	0.33	14
$\text{Ln(Property Rights, 2004)} = \underset{(3.01)}{2.30} - \underset{(-3.69)}{0.73}\left[\text{Ln(Piracy Rate, 2005)}\right]$	0.53	14
$\text{Ln(Property Rights, 2006)} = \underset{(2.37)}{1.43} + \underset{(4.01)}{0.64}\left[\text{Ln(Freedom from Corruption, 2006)}\right]$	0.57	14
$\text{Ln(Property Rights, 2005)} = \underset{(2.19)}{1.27} + \underset{(4.49)}{0.68}\left[\text{Ln(Freedom from Corruption, 2005)}\right]$	0.63	14

t-stat are indicated below each coefficient

The results of table 5 confirm the stationary piracy rate series as expressed by the six first estimated equations. Equations 7 and 8 show how piracy rates are negatively related to KEI (knowledge economic index) with the same level of elasticity of -0.76. Any increase (decrease) in the level of this index decreases (increases) the level of piracy in these economies. As per the 9th and 10th equations of table 5, property rights as a component of the Index of Economic Freedom (IEF), is negatively related to piracy rate. This variable is also significantly and positively related to the other IEF component that is freedom from corruption (11th and 12th equations).

2. Protection rates and relationships to macroeconomic variables

Based on the theoretical and simplified model, the level of piracy as obtained from BSA data for each country is transformed into the corresponding protection rate. The latter rate is understood to correspond to situations where software piracy is largely possible because search costs are set to equal zero (table 6).

Table 6: calculated protection rates under

Country	P	Ro1	Ro2	Ro3	Ro4	Ro5	Ro6	Ro7	Ro8	Ro9	Ro10	Ro11	Ro12	Ro13	Ro14	Ro15
Algeria	0.84	0.20	0.30	0.70	0.95	1.20	0.20	0.36	0.60	0.78	0.95	0.20	0.36	0.51	0.64	0.76
Bahrain	0.61	0.65	0.75	1.15	1.40	1.65	0.65	0.81	1.03	1.20	1.36	0.65	0.79	0.91	1.02	1.12
Egypt	0.64	0.56	0.66	1.06	1.31	1.56	0.56	0.72	0.94	1.11	1.28	0.56	0.70	0.83	0.95	1.05
Jordan	0.63	0.60	0.70	1.10	1.35	1.60	0.60	0.75	0.98	1.15	1.31	0.60	0.74	0.87	0.98	1.08
Kuwait	0.66	0.53	0.63	1.03	1.28	1.53	0.53	0.68	0.91	1.08	1.25	0.53	0.67	0.80	0.92	1.02
Lebanon	0.74	0.36	0.46	0.86	1.11	1.36	0.36	0.52	0.75	0.93	1.10	0.36	0.51	0.65	0.78	0.89
Morocco	0.69	0.45	0.55	0.95	1.20	1.45	0.45	0.61	0.83	1.01	1.18	0.45	0.60	0.73	0.85	0.96
Oman	0.63	0.59	0.69	1.09	1.34	1.59	0.59	0.74	0.97	1.14	1.30	0.59	0.73	0.86	0.97	1.07
Qatar	0.59	0.69	0.79	1.19	1.44	1.69	0.69	0.84	1.06	1.23	1.39	0.69	0.82	0.95	1.05	1.15
S.Arabia	0.52	0.92	1.02	1.42	1.67	1.92	0.92	1.06	1.27	1.44	1.59	0.92	1.04	1.15	1.25	1.33
Tunisia	0.80	0.25	0.35	0.75	1.00	1.25	0.25	0.41	0.64	0.82	1.00	0.25	0.41	0.55	0.68	0.80
Turkey	0.65	0.53	0.63	1.03	1.28	1.53	0.53	0.69	0.91	1.09	1.25	0.53	0.68	0.81	0.92	1.03
UAE	0.34	2.11	2.26	2.66	2.91	1.91	2.06	2.18	2.34	2.47	1.91	1.97	2.03	2.08	2.13	1.90

This empirical part attempts to replace the piracy rates that are effectively observed with protection rates that are calculated through the model to see how improvements can be made to better show the most important macroeconomic factors that could support technological and institutional protections. The obtained results (table 7) show clearly and with statistical significance with 14 degrees of freedom that the levels of protection are highly sensitive to the level of knowledge as represented by the Knowledge Economic Index as an aggregate variable accounting for education, research and attainment in ICT among others. Also all levels of protection are also sensitive to another important macroeconomic variable that is FF (Net Foreign Direct Investment). The sample of countries included has not consequently shown any effects of the other macroeconomic variables.

Table 7: Results of protection rate regressions

Ro4= 0.09 FF + 0.79 KEI -7.34 (2.18) (3.10) (-3.13)	R^2= 0.58
Ro6= 0.18 FF + 0.79 KEI -2.13 (2.14) (3.59) (-4.61)	R^2= 0.62
Ro9= 0.1 FF + 0.82 KEI -8.40 (2.20) (3.18) (-3.53)	R^2= 0.59

Ro10= 0.05 FF - 0.56 KEI -0.48 (2.22) (3.49) (-3.29)	R^2= 0.62
Ro12= 1.38 FF – 1.29 KEI -1.52 (2.20) (3.45) (-4.41)	R^2= 0.61
Ro13= 0.11 FF + 1.03 KEI – 1.18 (2.21) (3.34) (-4.15)	R^2= 0.60

t-stat are indicated below each coefficient

Conclusion

This paper deals with the determinants of piracy and IPR protection rates including DRM in the case of South Mediterranean economies. This exercise focuses on the example of software as ICTs as major engines for growth and development in the selected countries. Piracy, DRM besides institutional protection can be considered as constraints to enlargement of benefits from ICTs. The knowledge of the determinants is considered to be likely important in generating further economic and social policies that permit higher levels of adoption and use. The objectives of the current paper are attained through the use of a dual approach using both published piracy rates and calculated protection rates. These latter are simulated based on the existing piracy data, through a decision model that accounts for both legal and illegal software copies. The results attained show the important role of education, research and technology through the highly significant level of KEI in both piracy and protection rates regressions. Major gains in the studied economies can be attained under indirect economic and social policies focusing on knowledge development.

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Appendix

1. Utility functions thresholds

Consumers who will prefer to buy the legal product are those with higher utility function of the legal product: $U_2 > U_1$

Those are consumers with a taste for quality x such that:

$$x(1+\rho) - p_2 > \theta x(1-\frac{\alpha}{2}(1+\rho)) - s$$

Thus, they are consumers with a taste for quality $x > x^*$, where x^* is a threshold found by solving:

$$x(1+\rho) - p_2 = \theta x(1-\frac{\alpha}{2}(1+\rho)) - s .$$

Therefore we get: $$x^* = \frac{p_2 - s}{(1+\rho) - \theta[1-\frac{\alpha}{2}(1+\rho)]} .$$

Similarly, consumers who will choose to buy the illegal copy are those having a taste for quality such that: $0 < U_1 < U_2$.

Meaning they are consumers with a taste for quality x such that: $\bar{x} < x < x^*$.

Where: $$\bar{x} = \frac{s}{\theta[1-\frac{\alpha}{2}(1+\rho)]} .$$

Which is found by solving for x the following equation: $\theta x(1-\frac{\alpha}{2}(1+\rho)) - s = 0$.

In addition, as demand function for the legal product is:

$$D_2 = 1 - x^* = 1 - \frac{p_2 - s}{(1+\rho) - \theta[1-\frac{\alpha}{2}(1+\rho)]} .$$

This expression can be rearranged:

$$D_2 = 1 - \frac{p_2 - s}{1 - \theta(1-\frac{\alpha}{2}) + \rho + \theta\frac{\alpha}{2}\rho}$$

So, $$D_2 = 1 - \frac{p_2 - s}{1 - \theta(1-\frac{\alpha}{2}) + (1+\theta\frac{\alpha}{2})\rho} = 1 - \frac{p_2 - s}{A + B\rho} .$$

Where: $A = 1 - \theta(1-\frac{\alpha}{2})$ and $B = 1 + \theta\frac{\alpha}{2}$.

As, $0 < \theta < 1$, and $0 < \alpha < \frac{1}{2}$, and then, $A > 0$, $B > 0$, and thus, $A + B\rho > 0$.

Therefore, it is clear that $\frac{\partial D_2}{\partial p_2} = -\frac{1}{A + B\rho} < 0$,

and that $\frac{\partial D_1}{\partial s} = -(\frac{1}{A + B\rho} + \frac{1}{\theta[1-\frac{\alpha}{2}(1+\rho)]}) < 0$.

2. Piracy rate

As the piracy rate is define as: $R_p = \frac{D_1}{D_1 + D_2}$.

Then, as $D_1 = \frac{p_2 - s}{A + B\rho} - \frac{s}{\theta[1 - \frac{\alpha}{2}(1+\rho)]}$

$D_1 = (1 - D_2) - \frac{s}{\theta[1 - \frac{\alpha}{2}(1+\rho)]}$, so $D_1 + D_2 = 1 - \frac{s}{\theta[1 - \frac{\alpha}{2}(1+\rho)]}$.

Hence, $R_p = \frac{\frac{p_2 - s}{A + B\rho} - \frac{s}{\theta[1 - \frac{\alpha}{2}(1+\rho)]}}{1 - \frac{s}{\theta[1 - \frac{\alpha}{2}(1+\rho)]}}$.

Then, $R_P = \frac{(p_2 - s)\theta(1 - \frac{\alpha}{2}(1+\rho))}{(A + B\rho)(\theta(1 - \frac{\alpha}{2}(1+\rho)) - s)} - \frac{s}{\theta(1 - \frac{\alpha}{2}(1+\rho) - s}$,

And, $R_p = \frac{(p_2 - s)\theta[1 - \frac{\alpha}{2}(1+\rho)] - s(A + B\rho)}{(A + B\rho)[\theta(1 - \frac{\alpha}{2}(1+\rho)) - s]}$.

Developing gives:

$$R_p = \frac{-((p_2 - s)\theta\frac{\alpha}{2} + sB)\rho + ((p_2 - s)\theta(1 - \frac{\alpha}{2}) - sA)}{-B\theta\frac{\alpha}{2}\rho^2 + (-B\theta(1 - \frac{\alpha}{2}) - Bs - A\theta\frac{\alpha}{2})\rho + A\theta(1 - \frac{\alpha}{2}) - As}.$$

Rearranging by multiplying by R_p leads to the equation: $a\rho^2 + b\rho + c = 0$, where:

$a = a(R_p) = \frac{\alpha}{2} B\theta R_p$

$b = b(R_p) = B\theta(1 - \frac{\alpha}{2})R_p + BsR_p + A\theta\frac{\alpha}{2}R_p - Bs - (p_2 - s)\theta\frac{\alpha}{2}$

$c = c(R_p) = [As - A\theta(1 - \frac{\alpha}{2})]R_p + \theta(p_2 - s)(1 - \frac{\alpha}{2}) - As$.