Determinants of Multimedia, Entertainment, and Business Software Copyright Piracy Rates and Losses: A Cross-national Study

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Abstract

This article examines cross-national variations in piracy of U.S. copyright related products in the multimedia, entertainment, and software industry. The copyright piracy rates and losses exhibit considerable fluctuations between countries. To determine which economic and social factors cause the differences in the piracy rates and losses suffered by U.S. copyright industries in individual countries, we tested 4 industry models. One unique aspect of the present study is that we separately account for differences in piracy rates and actual estimated financial losses in US dollars. We find that for most industries piracy can be explained by the creditworthiness of the country involved (signalling economic stability and growth potential). Piracy losses are positively correlated with the size of the domestic market. In case of the motion picture video industry, we find that country's level of technology –expressed by the share of high-technology products in total exports - and a high penetration of TV-sets strongly influence the piracy level. The results furthermore suggest considerable variation among regions in piracy in particular industries.

Introduction

Copyright piracy has become a major issue in trade negotiations (for example within the World Trade Organization, Stegemann 2000) and in the strategies of entertainment, multimedia, and software companies. Copyright piracy not only hurts the economic position of these firms, but also affects the speed of innovations, trade, foreign direct investment, technology diffusion, and economic growth. The International Intellectual Property Alliance (IIPA), a coalition established in 1984 consisting of seven U.S. copyright industry representative trade associations, estimated that the revenue losses due to illegal copying experienced by the U.S. copyright-based entertainment and multimedia industries are more than eight billion US dollars every year (IIPA 2000). Furthermore, the European Commission believes that piracy and counterfeiting practices in the EU cause the loss of 100,000 jobs per year (Legrand 1998).

Although the US are particularly insisting on higher standards in developing countries (Markusen 2001), there appear to be considerable differences in piracy rates among industries and countries. Even among industrialized countries, such as those participating in the European Union, some countries have very good laws while other, such as Greece and Italy, are current hot spots of piracy (Legrand 1998). For decisions on strategic positioning, exports, and foreign direct investment behavior, copyright-based firms need to know what types of countries provide strong copyright protection. Surprisingly little is know, however, about how such protection is actually determined and which economic and cultural factors contribute to this protection. Studying the determinants of copyright piracy rates and revenue losses would furthermore be useful for understanding the strategy and policy initiatives to be undertaken by the copyright industries and the government. This study therefore carries out one of the first empirical studies of the cross-national variation in copyright piracy rates and losses suffered by U.S. companies producing and distributing copyright-protected materials throughout the

world and a range of social and economic variables. The main purpose of this study is therefore to determine which factors explain the copyright piracy rates and losses in a country. This current study extends existing studies by examining the cross-national variation in piracy in four US copyright industries: business software applications, records and music, motion picture videos, and entertainment software. An additional unique aspect of this study is that we not only look at piracy rates, but also at the estimations of the actual financial losses resulting from the piracy. We will concentrate on the US because of its huge interest in copyright protection. We will therefore first introduce the core US copyright industries. After that we will discuss the extent of piracy in several countries. We will continue with a discussion of the existing literature. We summarize the literature in a model with hypotheses that are tested for each copyright industry using actual piracy data from the IIPA. The results are discussed and conclusions are drawn in the final section.

The US copyright industries

The US core copyright industries broadly comprise of eight industries: motion pictures (television, theatrical, and home video); recording (records, tapes, and CDs); music publishing; computer software applications (both for business and entertainment); books, journals, and newspaper publishing; radio, television, and cable broadcasting; legitimate theater; and advertising (IIAP 2001). These industries create copyrighted works as their primary product. The economic contribution of these industries to the US economy is substantial. Siwek (2000) showed that those core copyright industries accounted for 4.9 percent of U.S. GDP in 1999, and that their share in GDP grew twice as fast annually as the remainder of the economy in the last two decades. Currently, 3.24 percent of all employees find work in these industries, amounting to 4.3 million workers. Furthermore, the copyright industries' foreign sales and exports (estimated to be at least $79.65 billion in 1999) continue

to be larger than exports of almost all other U.S. leading industries, such as chemicals and allied products, automobiles, aircraft, and agriculture (IIPA, 2001). The most important weakness of these industries relates to the ease with which their products can be (illegally) copied and sold.
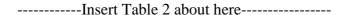
A Worldwide Piracy Problem

The growth of the size of the international market for copyright-protected materials and the increase in copying related innovations has prompted a desire for international copyright legislation. Creative companies, for instance entertainment and multimedia companies, are producing and distributing a vast range of copyright-protected materials throughout the world. These materials encompass all types of computer software including business applications and entertainment software; motion pictures, television programs, and videocassettes; music, CDs, and audiocassettes[i]. Unfortunately, markets worldwide are overflow by illegal copies of these products that form a serious threat to the continued growth and the sustainable competitiveness of the companies. This causes a huge problem for the involved firms that naturally want to be paid for their effort to develop, produce, and market their products. The actual loss due to piracy is estimated to be at least eight billion US$ each year (IIPA 2000).

To remain competitive and create sustainable and continued growth, the U.S. copyright industries therefore not only try to get access to free and open markets, but also force their trading partners to protect the copyrights on which the trade depends. As part of these efforts, the deficiencies of the copyright regimes of countries where the U.S. copyright-based industries suffered the most are annually reported. Furthermore, the International Intellectual Property Alliance (IIPA) releases studies on countries that continue to have high levels of piracy that directly affect the U.S. jobs and economic growth. These countries are ranked on the Special 301 lists according to the importance of monitoring their intellectual property

practices by the U.S.. These studies estimated that the counterfeiting of copyright protected materials have cost the creative industries at least $50 billion in lost revenue from 1995 through 1999 (IIPA, 1998, 1999, 2000, 2001).

------------Insert Table 1 about here-----------------

Table 1 presents a summary of the estimated piracy levels for four creative industries for the year 1999: motion pictures; sound recording and musical compositions; business software applications and entertainment software industry. As illustrated in this table, the piracy rates vary substantially between countries and industries. In some countries, virtually all motion/video products have been pirated. Vietnam, Costa Rica, Ukraine, and Latvia, for example, had piracy rates of 95% or more in 1999. Other countries, for instance, Greece, Korea, and Italy, in contrast, had piracy rates in these materials below 25%. However, looking at the business software applications piracy rate then Greece does no longer have the lowest rate but is positioned somewhere in the middle. Now the Czech Republic (39%), Israel (44%), and Italy (44%) have the lowest business software application counterfeiting level, while China (91%), Russian Federation (89%) and Vietnam (98%) have the highest. Overall, software piracy is at a higher level than that in other copyright industries. The average entertainment software piracy level is also relatively high in the monitored countries. The lowest rank country is Italy with a piracy level of 52% for entertainment software material. Malaysia (99%) and the former Soviet Union members are top-rank countries now. The average sound recordings and musical compositions piracy level of the countries listed in the 301 Report is approximately 50% but the standard deviation is high, with levels ranging from 8% for Czech Republic to 95% for Brazil and even 100% for Vietnam.

Although the four piracy rates differ significantly within and between countries, they give insufficient information to draw conclusions on the economic effects of unauthorized production and distribution of materials for personal and/or business purposes. We need to understand the actual financial loss to fully comprehend the damage done by illegal copying. The dollar losses accompanied by the piracy rates are different per country. In general, countries with high revenue losses due to piracy in one of the copyright-based industries tend to have lower piracy levels in others and vise versa. Furthermore, the average correlation between piracy rates and associated losses is only 0.15 and statistically not significantly different from zero. It is therefore possible that considerable actual financial losses due to piracy occur in countries that have only small piracy rates. To fully understand the total impact of piracy it is therefore necessary to compare the individual country's dollar losses as well as the piracy rates for each industry. The IIPA therefore also estimated the revenue losses for the four creative industries in the individual countries. The average losses are reported in table 2.

------------Insert Table 2 about here-----------------

Again we see that the largest losses occur in the software industries. The entertainment software industry both has the highest mean and the highest standard deviation, signaling considerable losses for US firms. The estimated worldwide loss in this industry amounts to at least 2.9 billion US$ (IIPA 2001). China creates the highest revenue losses for the entertainment software companies amounting to almost 1.4 billion US dollars, while countries as El Salvador and Guatemala show the lowest losses. Furthermore, the losses caused by unauthorized production and distribution of the business software applications are also the highest in China, although now closely followed by Italy and Brazil. The lowest ranked

country is Lebanon with a counterfeiting loss of only 0.1 million US$. However, looking at the sound recording and musical composition piracy losses then Brazil shows the highest unauthorized copyright production of 300 million US$. Other countries, for instance, Oman, Qatar, Jordan, in contrast created losses in these materials below 1 million US$ level. The average US motion picture / video counterfeiting loss level of the countries listed in the 301 Report is approximately 29 million US$ with the levels ranging from 0.5 million for Qatar to 250 million US$ for the Russian Federation.

Conceptual framework and hypotheses

Only recently have economists and policy analysts begun to explore the determinants of intellectual property right protection and violation. The existing literature on the determinants of intellectual property rights violation can be summarized in the following model (figure 1).

------------Insert Figure 1 about here-----------------

Broadly speaking four groups of variables influence the levels of piracy in an industry. First of all, many studies have investigated the relationship between the level of economic stability and development and intellectual property (in particular patent) protection. These studies include, among others, Rapp and Rozek (1990), Mansfield (1994), Lee and Mansfield (1996), Ginarte and Park (1997), Maskus (1998), and Marron and Steel (2000). Burke (1996) and Marron and Steel (2000), for instance, indicate that the higher the level of economic development (measured by market size or income), the less likely the event that piracy will occur. Patent protection is strongly and positively correlated with economic development, ever more so than with legislation (Burke 1996). High-income countries have stronger patent protection than low-income countries. This is also confirmed by Silva and Ramello (2000)

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who also found strong evidence of the presence of a buoyant market of unauthorized reproduction of sound recording products in emerging and less developed regions. Similar results are found in studies focusing on the influence of social and economic developments and the strength of economic institutions on software piracy. Likewise, Marron and Steel (2000) found that countries with high per capita income and strong institutions protecting contracts and property also tend to have lower piracy rates. Ginarte and Park (1997) emphasize that indicators of economic development, such as research and development, market freedom, and openness are important determinants of the provision of property right. The effect of market size must be analyzed carefully. Overall, piracy rates are expected to be substantially higher in small income countries. High-income countries tend to be more individualist and usually have stronger protections of intellectual property rights. However, even if the piracy rate in high-income countries is smaller, the overall revenue loss may be substantially higher. Counterfeiting in a large market size goes together with higher sales losses. For our present study we therefore hypothesize:

Hypothesis 1a:Countries characterized by a higher level of economic development will exhibit lower piracy rates

Hypothesis 1b:Countries characterized by a higher level of economic development will exhibit higher piracy losses

Hypothesis 2: Countries that are less creditworthy are more likely to exhibit high piracy rates and losses than countries that are credit worthy.

Secondly, we propose that the level of piracy is related to the spread of related products such as televisions, personal computers, CD-players and the like. Gallegos (1999) indicates that internet software piracy has increased considerably due to the explosive growth in the number of people that access the Internet and the advances in technology that have increased the ease and speed of access to the Internet. Unlike the physical distribution of pirated software, the Internet allows pirated products to be transferred from host computer to PC without anyone's knowledge. Similarly, Ostergard Jr. (2000) stresses that the great advances in technology have resulted in easier methods for duplicating that same technology and associated products. For instance, the introduction of video recorders in the consumer market have brought with it a capacity to duplicate videotapes, bringing about potentially massive violations of entertainment industry copyright protection (Ostergard Jr. 2000). Likewise, Sivla and Ramello (2000) indicate that the introduction of recording equipment by Philips and other producers in the late 1960s resulted in private music copying by individual consumers using their home equipment. We therefore hypothesize:

Hypothesis 3: Countries that are characterized by a high penetration of computers are more likely to exhibit high piracy rates and losses than countries that have fewer computers per 1000 inhabitants.

Hypothesis 4: A wider spread of television sets increases the likelihood of piracy in the motion picture video and entertainment industries.

The third group of variables is related to the importance of trade in the country and its effect on the protection of copyright-based materials and fair market access. Countries with high export shares have many firms that need safeguarding of their own unique assets to remain

competitive in the international arena. These countries are more careful in their international relations because they are more dependent on them for economic growth. Therefore, they will be more inclined to respect intellectual property of foreign firms due to the fear of repercussions (such as trade boycotts) in case they would violate international agreements. Even so, it has been noted that some countries characterized by high piracy rates export illegal copies to other areas in the world. Important examples are CDs from the Philippines (Gonzales da Newman 2001) and computer software from Hong Kong (Economist 1998).

Another interesting measure is the share of high technology exports in total exports. It is a good indicator of the technology level for that particular country. The higher the level of technology, the more likely that unauthorized production and distribution of copyright-based materials would take place since the skills and related technologies are available (see e.g. Marulidharan and Phatak, 1999; Ostergard, 2000). When countries lack a minimum technology base, they will not be able to copy high tech products. We would therefore expect a positive association between the piracy measures and the share of high technology exports. We suggest the following hypotheses:

> *Hypothesis 5: Countries that strongly depend on exports relative to GDP will exhibit lower piracy rates and losses than countries that export less.*

> *Hypothesis 6: Countries that have large high-technology exports will have higher piracy rates and losses than countries that have small high-technology exports.*

The last essential group comprises of legal factors. Intellectual property protection has two components: a statute component and an enforcement component. We need to consider both

the strength of the laws and the enforcement to comprise the extend of Intellectual property protection in a country (Ostergard Jr. 2000). The enforcement of intellectual property embodies two tasks: preventing their infringement by free-riders and disciplining attempts by the rights holders to extend them beyond the terms of the grant (Maskus 1998). For the enforcement of these laws, countries must have institutional structures and financial resources (Ostergard Jr. 2000). In empirical studies, intellectual property protection is frequently measured by the country's membership of international conventions on the subject. Burke (1996), for instance, has tested the importance of convention membership on piracy levels in the audio software industry. Several international conventions (such as Berne 1887, Rome 1961, Geneva Phonogram 1971) have tried to enforce copyright protection for artists and producers in the music industry. Burke (1996) finds that countries that are members of those convention agreements have lower piracy rates than countries that are not. We therefore suggest the following hypothesis:

Hypothesis 7: An extensive copyright protection system decreases the likelihood of piracy

Based on the preceding discussion of potential factors that influence the unauthorized production and distribution of copyright-based materials worldwide, the following general empirical regression models are formulated:

Piracy Rate = f (domestic market size [-], share of export of goods and services [-], share of high technology exports [+], Number of PC per 1000 persons [+], Number of TV per 1000 persons [+], country creditworthiness rating [-], country copyright protection system [-], Region [?]).

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Piracy Loss = f (domestic market size [+], share of export of goods and services [-], share of high technology exports [+], Number of PC per 1000 persons [+], Number of TV per 1000 persons [+], country creditworthiness rating [+], country copyright protection system [-], Region [?]).

The data

The dataset is composed of data from various sources. The primary sources we employ are from the International Intellectual Property Alliance and the World Bank. Both provide information regarding the characteristics of a country. The former provides data on the estimated copyright piracy levels and the associated trade losses suffered by U.S. based copyright industries in the countries that are listed on the 2001 special 301 report. The world development indicators database of the World Bank provides an extensive collection of data about social, financial, economic, and political indictors. For this study we use only those countries for which sufficient data are available from both sources. These countries are listed in table 3.

------------Insert Table 3 about here-----------------

The dependent variables are piracy rate and revenue loss due to piracy in each country in the analyses. In all regressions for the copyright losses we will use the log value of the dependent variable, piracy loss. Since piracy losses are defined as ≥ 0, use of the log value of specific piracy loss that restricts predicted losses to positive values, is an attractive feature.

We include domestic market size as the indicator of economic development. We proxy market size by the host country's gross domestic product (GDP) following Lee and Mansfield (1996)

and Marron and Steel (2000). Domestic market size will also be logged in all equations since we expect percentage differences in market size, rather than absolute dollar differences in (GDP), to be linearly related to piracy rates and log value of the piracy losses respectively.

Exports are measured by the share of exports of goods and services in GDP. High technology exports are measured as the percentage of total manufactured exports made up by high technology products. The values of number of PC and number of TV per 1000 persons are conversed into natural logarithm values. These procedures leave the relationships between rates and losses and each of the explanatory variables in percentage terms, either by definition of the variable itself as a percentage, or by transformation of the relationship to log values (Orr 1974).

The risk of a country was measured by the country risk rating published by Euromoney, in which countries are rated from 1 (worst) to 100 (best). Euromoney country creditworthiness ratings are based on nine weighted categories that access country risk, covering economic performance, political risk, debt, and access to financial and capital markets. The rates are composed of polls of economists and political analysts supplemented by quantitative data.

A variety of data sources on international legal protection for copyright-based materials were consulted to determine if subject matter protection is available in a particular country for either a U.S. or a foreign company. An index is constructed which indicates how strongly a country will provide intellectual property right protection. The variable meets one if the country in question meets all the following three criteria: (a) protection is available under the national copyright law of a particular country; (b) patent protection is available in national law; (c) the country belongs to the maximum number (5) of intellectual property rights treaties. The involved five convention memberships are Berne Convention, Universal Copyright Convention, Paris Convention, European Patent Convention and Patent Cooperation Treaty[ii]. The original index varies so that high numbers reflects high

protectionism. This index is converted to a scale from one (strong protection) to zero (very weak protection) for this study.

------------Insert Table 4 about here-----------------

Table 4 presents the descriptive statistics of the variables for the 44 countries in the sample. The mean of country's market size was 146.62 billion US dollar but the standard deviation is high (249.15), with market size values ranging from 5.2 (for Estonia) to 1190.00 billion US dollar (for Italy). The mean country creditworthiness rating was 0.52 but the standard deviation is high with values ranging from 0.23 (for Russian Federation) and 0.87 (for Italy). The reported number of PCs per 1000 persons was, on average, 52.07. This mean is low because a number of countries clearly demonstrate a low density of PCs. The minimum value belongs to India with less than 3 PCs per 1000 persons, while Israel shows the highest value of on average 217.39 PCs per 1000 persons. All countries have a significantly higher density of televisions. The minimum figure for the ratio is 47 TVs per 1000 persons (for Vietnam) as opposed to less than 3 computers per 1000 persons. Mean exports of goods and services (as a percentage of GDP) in 1999 is 34.53 percent. The country with the lowest export ratio in the sample is Paraguay, while Malaysia is the one with the highest export ratio. Malaysia even exports more than its gross domestic product, signaling an open economy that is very dependent on trade. However, looking at the share of high-technology exports in the total manufactured exports, Paraguay is not ranked as lowest but Pakistan is, with a high-technology share of 0.12. The Philippines replace Malaysia as the top-seeded country considering high technology exports. On average, the share of high-technology exports of the countries in the sample is 11.39 percent. The intellectual property protection index varies from no legislation protection (Kuwait) to strong protection (for instance, Greece, Italy, and Israel).

The sample includes a substantial number of countries from different regions: East Europe (10), Asia (11), Middle East (8) and Latin America (13). It is clear that countries from Western Europe (2) and Africa (0) do not have the highest monitoring priority by the U.S. government. In Western Europe, overall the countries adequately and effectively protect US intellectual property rights and provide fair and equitable market access to US companies which produce copyright-based materials.

Results

Table 5 shows the results of the model estimations for piracy rates. We have tested our model for four industries where intellectual property protection matters: business software applications, records & music, motion pictures videos, and entertainment software.

------------Insert Table 5 about here-----------------

Our first hypothesis tested the relationship between GDP and piracy. The results show no clear relationship between market size and piracy rates. We do find that for all industries higher creditworthiness results in significantly less piracy, although entertainment software shows a weak relationship. This result strongly supports hypothesis two. Regarding the presence of related products we find that the presence of a large number of television sets strongly and significantly influences the motion picture video piracy rates. On the other hand, we don't find a clear effect of the penetration of PCs in any industry. We therefore find support for hypothesis four but no support for hypothesis three in case of piracy rates. We find no conclusive evidence on the relationship between exports and intellectual property protection, nor on the role of high technology exports in total exports. We therefore cannot confirm hypotheses five and six. However, we do find that a sufficient legal system with

strong copyright protection results in lower piracy rates. This effect is particularly strong and significant in case of the entertainment software industry and business software application industry. This result strongly confirms hypothesis seven. Interestingly, we find strong differences in piracy rates between regions in the world. Our benchmark region is Latin America. We find that firms in Western European and Asian countries are more likely to illegally use business software applications than their Latin American counterparts. Furthermore, the Eastern Europeans show a larger inclination to copy entertainment software than countries in Latin America.

------------Insert Table 6 about here-----------------

Table 6 presents the results of the model estimations for actual financial losses due to piracy. When considering the actual dollar losses for US firms due to piracy in other countries we find related, though slightly different, results than for piracy rates. First of all, contrary to the results for piracy rates, we now find strong evidence of a positive influence of the level of economic development in the country and the losses resulting from illegal copying of software and music & videos. This result strongly supports hypothesis 1b. The results on creditworthiness are conflicting. Although in case of motion picture videos, they confirm our expectation that higher stability results in a decline of piracy losses, we find that in case of business software, it actually results in an increase in losses. This phenomenon can be explained by the fact that relatively developed and stable economies have enough resources to invest in business software. An increase in the number and spread of applications can result in increasing corporate piracy (where software is installed on a LAN server and then potentially used by many employees, both at home and at work) resulting in large financial losses. Naturally, low penetration of this software in less developed and unstable countries reduces

this risk. Regarding TV sets we again find evidence that supports hypothesis four in case of motion picture videos. Surprisingly we find that the spread of PCs negatively influences piracy losses, contradicting hypothesis three. This result is significant only at the 10 percent level. Furthermore, we find a positive and significant loss due to total exports' share in case of the business software applications industry. This result is not surprising considering that business software applications are mostly used in industrialized countries that have a higher export ratio. This effect is related to the overall effect of economic development as measured by GDP and discussed earlier. For motion picture videos we find that high technology exports significantly and positively influence the financial losses due to piracy. It is relatively easy to copy videos once a country has a basic level of technological development. Regarding hypothesis seven, in case of piracy losses we find no effect for legal issues. Again, we find considerable differences in the effect of specific regions. For US firms in copyright-based industries, the likelihood of a financial loss due to software piracy is significantly smaller in Western Europe, Asia, and the Middle East than in Latin American countries. In the entertainment industry we find evidence that countries in Eastern Europe show the highest likelihood of piracy losses in entertainment materials.

Discussion

The results of our estimations are important for several reasons. First of all, they clearly indicate that even though industrialized countries may have relatively low piracy rates, the overall loss due to piracy is not necessarily negligible. Our results clearly indicate that US companies suffer higher revenue losses due to piracy and unauthorized (re)production and distribution of their copyright-based materials in large and industrialized markets. At the same time, we find no relationship between GDP and piracy rates. Ginarte and Park (1997) point to the fact that it is not the level of economic development per se that influences the provision of

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patent rights, but rather the determinants of economic development, such as research and development, market freedom, and openness. Once these are controlled for, their per capita GDP variable no longer is important. This may also explain our insignificant result in this present study.

In general, we find that countries that are not creditworthy offer little protection of intellectual property. Creditworthiness proxies economic stability and growth potential in a market. It is measured as a combination of country risk, economic performance, access to markets, and the country's debt situation. Countries that are not very creditworthy are uninteresting locations for US firms in the copyright-based industries. Technological advantage is among their most important strength, as it is for most multinational enterprises. Slack intellectual property protection in host countries can lead to rapid erosion of this key advantage. Locating R&D in a host country with lower intellectual property protection levels increases the MNE's exposure to the possibility of losing technological secrets and advantages to local competitors (Muralidharan and Phatak 1999).

Our results also clearly indicate differences in intellectual property protection among regions. In Eastern Europe, the US entertainment software industry significantly suffers from piracy. US entertainment firms will therefore be more careful in doing business in those countries/regions.

Conclusion

For U.S. copyright-based industries, the overall annual estimated loss due to piracy of their products amounts to at least 8 billion US $. However, considerable differences exist between piracy rates and piracy losses between countries/regions and industries. The purpose of this study was to examine these cross-national variations in piracy of U.S. copyright related products in four industries: business software applications, records & music, motion picture

videos, and entertainment software. We considered four groups of country-specific variables: economic development and stability, legal issues, trade relations, and penetration of related products.

Our most remarkable finding concerns the differences among the determinants of piracy rates and the resulting financial losses due to piracy. We find that a larger market size in all industries results in higher losses, even if piracy rates are relatively low. Furthermore, for all industries we find that high creditworthiness of the country results in lower piracy rates and losses, with one exception: losses due to business application software piracy. Our results show significant differences in piracy among separate regions in the world. Our results confirm the overall perception that countries in Eastern Europe exhibit relatively high piracy rates in entertainment software.

We therefore conclude that the IIAP should focus its efforts regarding the enforcement of intellectual property protection both at countries with high piracy rates and at those where low piracy rates still result in huge actual financial losses.

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Figure 1: The model

Table 1					
Descriptive statistics of country copyright piracy rates in 1999					
	Number of Observations	Mean piracy rate	Standard Deviation	Minimum	Maximum
Business Software Applications	39	69.69	15.00	42.00	98.00
Records & Music	43	50.65	25.40	8.00	95.00
Motion Pictures Video	44	61.34	26.21	15.00	100.00
Entertainment Software	37	78.46	15.60	50.00	99.00

Table 2					
Descriptive statistics of country copyright piracy losses in 1999 (millions of US dollars)					
	Number of Observations	Mean Loss	Standard Deviation	Minimum	Maximum
Business Software Applications	39	69.06	98.04	1.60	437.20
Records & Music	43	37.40	66.60	0.10	300.00
Motion Pictures Video	44	28.64	48.34	0.50	250.00
Entertainment Software	37	80.63	226.82	0.10	1382.50

Table 3		
Overview of countries monitored by IIPA, grouped by region		
Latin America	**Eastern Europe**	**Asia**
Argentina	Czech republic	India
Bolivia	Estonia	Indonesia
Brazil	Hungary	Korea
Chili	Latvia	Malaysia
Colombia	Lithuania (OCR)	Pakistan
Costa Rica	Poland	People's Republic of China
Dominican Republic	Romania	Philippines
El Salvador	Russian Federation	Taiwan
Guatemala	Slovakia	Thailand
Paraguay	Ukraine	Turkey
Peru		Vietnam
Uruguay	**Middle East**	
Venezuela	Egypt	
	Israel	
Western Europe	Jordan	
Greece	Kuwait	
Italy	Lebanon	
	Oman	
	Qatar	
	Saudi Arabia	

		Number of Observations	Mean	Standard deviation	Minimum	Maximum
Table 4 **Descriptive Statistics of explanatory variables**						
Domestic market in Millions US dollars		44	146.62	249.15	5.20	1190.00
Country creditworthiness rating		44	0.52	0.13	0.23	0.87
Number of PC / 1000 persons		43	53.72	52.07	2.75	217.39
Number of TV / 1000 persons		42	285.76	167.11	47.00	675.00
Export of goods & Services (% of GDP)		42	34.53	21.88	2.22	115.24
High-technology exports (% of manufactured exports)		42	11.39	14.84	0.12	71.98
Country copyright protection system		44	0.57	0.19	0.00	1.00
Region						
	Western Europe	44	0.045	0.21	0.00	1.00
	Eastern Europe	44	0.23	0.42	0.00	1.00
	Asia	44	0.25	0.44	0.00	1.00
	Middle East	44	0.18	0.39	0.00	1.00
	Latin America	44	0.30	0.46	0.00	1.00

<table>
<tr><td colspan="6" align="center">Table 5
Results of the industry models explaining the country copyrights piracy rate in 1999</td></tr>
<tr><td>Variables</td><td></td><td>Business Software Applications</td><td>Records & Music</td><td>Motion picture video</td><td>Entertainment Software</td></tr>
<tr><td>Constant</td><td></td><td>130.795***
(12.681)</td><td>123.500***
(5.323)</td><td>39.658
(1.011)</td><td>103.558***
(3.476)</td></tr>
<tr><td>Domestic market</td><td></td><td>-1.969
(1.072)</td><td>0.125
(0.032)</td><td>-5.111
(1.463)</td><td>1.713
(0.739)</td></tr>
<tr><td>Country creditwurthiness rating</td><td></td><td>-72.601***
(3.312)</td><td>-93.248*
(1.858)</td><td>-89.349*
(1.963)</td><td>-37.011
(1.262)</td></tr>
<tr><td>Number of PCs per 1000 persons</td><td></td><td>-2.321
(0.881)</td><td>-979
(0.167)</td><td>-4.845
(0.791)</td><td>0.866
(0.215)</td></tr>
<tr><td>Number of TV per 1000 persons</td><td></td><td>-------</td><td>-------</td><td>19.328**
(2.691)</td><td>0.415
(0.082)</td></tr>
<tr><td>Export of goods & Services (% of GDP)</td><td></td><td>-0.067
(0.469)</td><td>-0.314
(1.008)</td><td>0.119
(0.398)</td><td>-0.062
(0.309)</td></tr>
<tr><td>High-technology exports (% of manufactured exports)</td><td></td><td>0.065
(0.399)</td><td>0.076
(0.207)</td><td>-0.011
(0.032)</td><td>0.102
(0.465)</td></tr>
<tr><td>Country copyright protection system</td><td></td><td>-22.581*
(1.881)</td><td>-22.158
(0.814)</td><td>-8.855
(0.338)</td><td>-44.368**
(2.638)</td></tr>
<tr><td>Region</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td>Western Europe</td><td>31.991***
(2.901)</td><td>22.584
(0.893)</td><td>-6.823
(0.293)</td><td>14.975
(0.982)</td></tr>
<tr><td></td><td>Eastern Europe</td><td>2.139
(0.347)</td><td>5.976
(0.458)</td><td>-15.552
(1.233)</td><td>20.717**
(2.536)</td></tr>
<tr><td></td><td>Asia</td><td>9.537
(1.386)</td><td>-6.221
(0.405)</td><td>20.050
(1.338)</td><td>15.617
(1.450)</td></tr>
<tr><td></td><td>Middle East</td><td>12.546**
(2.096)</td><td>0.970
(0.075)</td><td>6.422
(0.547)</td><td>-7.110
(0.904)</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Number of countries</td><td></td><td>35</td><td>39</td><td>38</td><td>34</td></tr>
<tr><td>R^2-adjusted</td><td></td><td>0.545</td><td>0.153</td><td>0.341</td><td>0.341</td></tr>
</table>

***   significant at 1 percent level;

**   significant at 5 percent level;

*   significant at 10 percent level

t-statistics in parentheses

<table>
<thead>
<tr><th colspan="6" align="center">**Table 6**
Results of the industry models explaining the trade losses of a country
due to copyright piracy in 1999</th></tr>
<tr><th>Variables</th><th></th><th>Business Software Applications</th><th>Records & Music</th><th>Motion picture video</th><th>Entertainment Software</th></tr>
</thead>
<tbody>
<tr><td>Constant</td><td></td><td>-1.239***
(3.347)</td><td>0.899
(0.709)</td><td>-2.761**
(2.552)</td><td>-1.595
(0.529)</td></tr>
<tr><td>Domestic market</td><td></td><td>0.994***
(15.094)</td><td>0.742***
(3.539)</td><td>1.109***
(11.510)</td><td>1.294***
(5.517)</td></tr>
<tr><td>Country creditworthiness rating</td><td></td><td>2.004**
(2.548)</td><td>-2.813
(1.026)</td><td>-3.368**
(2.683)</td><td>-1.558
(0.526)</td></tr>
<tr><td>Number of PCs per 1000 persons</td><td></td><td>-0.166*
(1.753)</td><td>0.264
(0.823)</td><td>-0.061
(0.361)</td><td>0.611
(1.502)</td></tr>
<tr><td>Number of TV per 1000 persons</td><td></td><td>----------</td><td>----------</td><td>0.417**
(2.105)</td><td>-0.308
(0.599)</td></tr>
<tr><td>Export of goods & Services (% of GDP)</td><td></td><td>0.010*
(1.947)</td><td>-0.023
(1.350)</td><td>0.006
(0.671)</td><td>-0.003
(0.143)</td></tr>
<tr><td>High-technology exports (% of manufactured exports)</td><td></td><td>0.002
(0.374)</td><td>0.031
(1.516)</td><td>0.018*
(1.959)</td><td>-0.001
(0.143)</td></tr>
<tr><td>Country copyright protection system</td><td></td><td>0.256
(0.595)</td><td>0.014
(0.009)</td><td>-0.537
(0.744)</td><td>-2.640
(1.552)</td></tr>
<tr><td>Region</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td>West Europe</td><td>-1.212***
(3.063)</td><td>-0.747
(0.541)</td><td>0.679
(1.058)</td><td>0.561
(0.364)</td></tr>
<tr><td></td><td>East Europe</td><td>-0.431*
(1.945)</td><td>0.182
(0.255)</td><td>0.252
(0.724)</td><td>1.497*
(1.812)</td></tr>
<tr><td></td><td>Asia</td><td>-0.791***
(3.202)</td><td>-1.770**
(2.111)</td><td>0.025
(0.061)</td><td>1.781
(1.635)</td></tr>
<tr><td></td><td>Middle East</td><td>-0.993***
(4.625)</td><td>-0.860
(1.225)</td><td>0.865**
(2.672)</td><td>-0.343
(0.431)</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Number of countries</td><td></td><td>35</td><td>39</td><td>38</td><td>34</td></tr>
<tr><td>R^2-adjusted</td><td></td><td>0.926</td><td>0.407</td><td>0.905</td><td>0.650</td></tr>
</tbody>
</table>

***   significant at 1 percent level;
**   significant at 5 percent level;
*   significant at 10 percent level
t-statistics in parentheses

Endnotes

[i] We exclude the creative industry that produces textbooks, professional publications, and journals (both in electronic and print media). The IIPA only publishes the estimated piracy losses and not the piracy rate for this industry.

[ii] Software can be protected against piracy by using copyrights and patents. When software related invention is only a mathematical algorithm, such as a computer program designed to convert binary-coded decimal numbers into binary numbers, then the invention is not eligible patent protection. However, if the invention utilizes the device to manipulate numbers that represent concrete, real world values then the invention is a process relating to those real world concepts and is patentable. However, copyrights are the strongest legal protection instrument to be used in the fight to globally reduce software piracy (Tysver, 2000).