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Information Economics and Policy

journal homepage: www.elsevier.com/locate/ieop

A survey on software piracy empirical literature: Stylized facts and theory

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ARTICLE INFO

Article history:

Available online 5 August 2015

JEL classification:

C50
L86
O34

Keywords:

Software piracy
Copyright
Intellectual property rights

ABSTRACT

As software is central in today's world, the problem of software piracy is of increasing importance. It reduces the revenues of firms that develop new software and, therefore, it may hinder innovation and growth. To understand better the causes of this phenomenon this paper presents a survey of the empirical literature regarding software piracy and discusses if the findings are coherent with the theoretical literature. Overall we are able to identify eight stylized facts in five dimensions: the Economic, Cultural, Educational, Technological and Legal. Moreover we argue that most of these findings are coherent with that which the theoretical models imply.

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1. Introduction

Technology has evolved over the years and is present in almost everything we use. The areas where this influence is most evident are those that involve the use of computers and the Internet. They increase the productivity of firms and make life easier for households allowing, for instance, home banking or online shopping. Other examples can be added; perhaps one of the events that improved most significantly the productivity of enterprises was the replacement of the typewriter by the computer. However, computers (and related devices such as tablets and smartphones) cannot be used without the proper software and only with it can we exploit their full potential. An operating system starts and controls these machines, but tools such as the productivity packs, to produce professional documents, are also required.

Copyright laws protect software and hardware and it is in the case of software that the protection of intellectual property is more challenging due to its nature: (i) it can be reproduced at virtually no cost and with the same quality as the original, (ii) it is easily modified by hackers that break its protective barriers and (iii) it is easily distributed.

Infringement of the intellectual propriety of software products, usual known as software piracy, occurs when there is an unauthorized use or sale of commercially available software (Moores and Dhillon, 2000) that is protected under national and international copyright laws. This piracy comes in many forms.¹

¹ Softlifting: purchasing a single licensed copy of software and loading the same copy onto several computers, contrary to the license terms; Internet: making unauthorized copies of copyrighted software available to others electronically; Software counterfeiting: the illegal duplication and distribution of copyrighted software in a form designed to make it appear to be legitimate; OEM unbundling: selling stand-alone software that was intended to be bundled with specific accompanying hardware; Hard disk loading: installing unauthorized copies of software onto the hard disks of personal computers, often as an incentive for the end user to buy the hardware from that particular hardware dealer, and Renting: unauthorized rental of software for temporary use as if it were a video.

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Software piracy affects first of all firms' profits, as the sales of legal software units tend to decrease. These losses are reported annually by the *Business Software Alliance* (BSA) and, although the complete methodology applied is not publicly available, the estimates reported are based on confidential information provided by BSA members such as Adobe®, AVG®, Intel®, Microsoft® or Symantec®, for instance, covering both the hardware and software industry.² However software piracy does not affect only the firms, the medium and long run impact in the economy is also important. If the copyright laws are not enforced it reduces the incentive to innovate and, therefore, to produce newer and better software tools which would improve productivity. Therefore, this impact may hinder the medium and long term growth of economies as shown by [Andrés and Goel \(2012\)](#).

To have a better understanding of how to fight this phenomenon we must separate two types of piracy: the commercial type in which we buy a DVD on the black market – in this case the reseller has profits and compete with the “legal” firms (the competition is asymmetrical³); and the end-user piracy, when consumers use, at home or work, software that was not “legally” sold, which is more difficult to detect as it does not involve physical means. There are some actions that firms and governments can implement to protect from these two forms of piracy. Either in the courts, enforcing anti-piracy laws, or by introducing mechanisms that can detect pirated products making them unusable to the user.

However, without knowing why people engage in this illegal activity, the effectiveness of the actions taken by companies or governments is reduced. With this in mind, and in order to get a better understanding of what causes software piracy, this paper offers a survey of the empirical literature. It classifies the factors in five dimensions (Economic, Cultural, Educational, Technological and Legal), analyses how each of these dimensions affect software piracy and systemizes the findings into eight stylized facts. Furthermore, this paper also analyses how these stylized facts relate to the theoretical literature,⁴ this is, if they are coherent or in the case of different theoretical results, which one seems to prevail. By doing this, we hope to offer a systematic view which can help companies and governments to design policies and actions to better deal with the issue.

The paper is organized as follows: Section 2 reviews the empirical literature on software piracy, describing the methods used and their limitations, the stylized facts found and how they can be anchored in the existent theoretical models and finally, Section 3 concludes and gives advice on how to overcome the limitations found.

2. Empirical literature

The empirical literature on piracy software has used an array of methodologies: surveys using respondents from universities and from the labor market; or cross-country analysis using panel or cross-section data relying on macroeconomic sources.

Empirical literature that uses surveys can obtain richer results, being able to model each parameter (age, sex, income), but it has some drawbacks. First, results rely on the willingness of the respondents to answer truthfully and even if the inquiry is anonymous, due to the nature of the crime, the respondents may underreport their activity. Also, surveys are used in a particular group of the population in a particular city (for instance [Gopal and Sanders \(1998\)](#), [Butt \(2006\)](#), [Higgin \(2006\)](#) or [Gan and Koh \(2006\)](#) survey college students and [Lau \(2004\)](#) surveys business users) which leads to the well-known population bias problem, which can influence the main findings and make the extension of the results problematic. Finally, most of the questionnaires rely on a Likert scale.⁵ When respondents answer questions it is possible that they go to the extremes or the middle, which can bias the conclusions.

To overcome these problems, authors such as [Gopal and Sanders \(1998\)](#) or [Holm \(2003\)](#) used a cross-sectional model that explains the phenomenon at a country level, complementing the results from the surveys.

Other studies make cross-country analysis, using either panel or cross-section data and related methodologies. Before we discuss the advantages and problems of each methodology we should refer that most of these studies, regarding the software piracy level, use data from the *Business Software Alliance*. To our knowledge, these estimates are the only ones that provide a historical view of software piracy from 1994 to 2014. In spite of this, these estimates suffer from some drawbacks, which begin in the computation itself of their rates.

The *Business Software Alliance* relies on external consultants to do surveys, such as the *International Data Corporation* (BSA, 2014) and *Ipsos Public Affairs* (BSA, 2012). As part of the estimations rely on surveys, at least part of the data will suffer from the same problems previously described. Another set of important variables that serve to compute piracy rates derives from the proprietary information of its members. This complements the surveys. Again, in this case, external individual/corporate consultants cannot verify information concerning their validity. Additionally, these input variables are only available for a small group of countries, and vary over time. For the remaining countries of the world, estimates are projected based on macroeconomic variables, such as income.

Another drawback of these estimates is derived from their lack of clarity and consistency over the years. It is

² We should note that some findings suggest that some level of piracy can be beneficial for the software developer. See, for instance, [Lahiri and Dey \(2013\)](#) or [Lu and Poddar \(2012\)](#).

³ Some authors that model this phenomenon are [Peitz and Waelbroeck \(2004\)](#), [Peitz and Waelbroeck \(2006a\)](#), [Duchêne and Waelbroeck \(2005\)](#) and [Zhang \(2002\)](#).

⁴ For surveys on the theoretical literature see [Peitz and Waelbroeck \(2006b\)](#) or [Belleflamme and Peitz \(2010\)](#).

⁵ A Likert scale is a psychometric scale commonly involved in research studies employing questionnaires. It is the most widely used approach to scaling responses in survey research, such that the term is often used interchangeably with rating scale. Usually it is divided into 5 ordinal values: 1. Strongly disagree, 2. Disagree; 3. Neither agree nor disagree; 4. Agree and 5. Strongly agree. See [Wuensh \(2005\)](#).

impossible to know the full methodology used in one report; furthermore, countries in which these surveys are conducted are not always identified. Additional to this, the projections based on macroeconomic variables are not clearly defined. In spite of this, these estimates are one of the most reliable, due to the volume of information required to estimate piracy rates and losses on such a large scale.

Regarding the methodologies, authors such as [Andrés \(2006a\)](#) and [Gomes et al. \(forthcoming\)](#) used panel methods. Although a panel gives us a picture of the evolution over time, it has some limitations such as: data limitation (as data is not available for all countries in all periods), not be able to identify the impact of time-invariable or almost invariable variables and cross-country dependence. The most important of the three is the country dependence over time as it can give the wrong inference (see [Baltagi, 2013](#)).

Regarding cross-sectional analysis used, between others by [Andrés \(2006a\)](#) or [Goel and Nelson \(2009\)](#), the main advantage is that it is able to identify the impact of time-invariant variables such as the impact of institutions and religion and to include a broader number of countries that have very sparse data. The main disadvantage is that it loses the time dimension and the dynamics of the problem.

However, both approaches on cross-country analysis have some limitations as stated by [Durlauf \(2009\)](#). These regressions might suffer from endogeneity, model uncertainty and exchangeability. As for endogeneity, some explanatory variables can be seen at the same time as an explanatory factor, but also explained by software piracy (one example is GDP growth that influences piracy and at the same time is influenced by it). The second criticism is that the explanatory variables come from ad hoc regressions and so we cannot be certain of the correct form of the model. The last criticism is that countries do not represent random draws from a population (exchangeability) and so heterogeneity across countries cannot be reduced to differences in the values of control variables.

That said, as the empirical literature is an important source for both policymakers and researchers, and not forgetting the limitations pointed before, we compiled the major findings that are common across the literature splitting them into five dimensions: Economic, Cultural, Educational, Technological and Legal. These will be discussed in the next subsections, first describing the stylized facts found and next analyzing their coherency with the theory.

2.1. Economic dimensions

2.1.1. Stylized facts

Stylized fact 1: Gross Domestic Product per capita affects negatively software piracy.

One measure that is present in many studies of the determinants of software piracy is the *Gross Domestic Product per capita* (GDPpc). [Gopal and Sanders \(1998\)](#), [Marron and Steel \(2000\)](#) and [Goel and Nelson \(2009\)](#) show that an increase in GDPpc decreases software piracy. Other

authors used different variables or different approaches such as [Holm \(2003\)](#) which used the *Gross National Income per capita* (GNIpc) with the same result or [Shin et al. \(2004\)](#) who split the GDPpc into two subsamples: one which represents income less than 6000\$ and other that represents more than 6000\$. In countries with GDPpc less than 6000\$, income affects negatively software piracy, but when GDPpc is higher than 6000\$, this negative effect becomes marginal. This result indicates that the income effect is non-linear and is by increasing income in the poorest households that we can reduce software piracy.

It is important to notice that in spite of attempts to disaggregate the sample as for instance in [Shin et al. \(2004\)](#), GDPpc reflects only the wealth of a country as a whole, not reflecting the microstructure of how income is distributed nor the global well-being of the population. These two dimensions are detailed in the next stylized facts.

Conversely, other authors studied the effects of piracy on economic growth. [Andrés and Goel \(2012\)](#) found that the existence of some level of software piracy might increase economic growth and the studies of [Park and Ginarte \(1997\)](#) and [Falvey et al. \(2006\)](#) found that higher enforcement of intellectual property rights promotes growth.

Stylized fact 2: Income inequality affects negatively software piracy.

Additional work was done in explaining these differences using the *GINI* Index. To check this, [Fischer and Andrés \(2005\)](#) used a sample of 71 countries to analyze the relationship between income distribution and software piracy rates. To analyze this income inequality they used quintile shares. This quintile analysis is divided into three classes: Q1 is the low-income class; Q2–Q4 is middle-income class and Q5 is upper-income class. Their results show that software piracy is a middle class crime in Latin America, Caribbean, East Asia and the Pacific Regions. Software piracy is a crime committed by middle and lower class in the Central Asia and Eastern Europe and is an upper class crime in Western Europe and North America.

Their analysis also found that, as a whole, income inequality is negatively related to software piracy. [Andrés \(2006b\)](#) confirms this result.

Stylized fact 3: HDI affects positively software piracy.

A different dimension studied was the *Human Development Index* (HDI) which measures global welfare rather than wealth alone. [Bezmen and Depken \(2005\)](#) used a simultaneous equation model using panel data combining three years (1995, 2000 and 2002). In the first equation, the piracy rates were the dependent variable and, in the second, the HDI was the dependent variable. Their results, confirmed latter by [Boyce \(2011\)](#), showed that this variable is positively correlated to software piracy rates.

2.1.2. Theory

Summing up, the empirical findings show that the richer and the less equal a country is, the less software piracy exists. On the contrary, higher levels of

development (measured by the HDI) are correlated with higher levels of software piracy.

The first fact is coherent with models of single-product strategies as the ones described by Belleflamme (2003), Yoon (2002) or Bae and Choi (2006). If the consumer utility of an original product is given by: $\phi q - p$ (where ϕ is a consumer taste parameter, q the quality and p the price of the product) and the utility from a copied product is given by: $\alpha\phi q - c$ (where $1 - \alpha$, with $0 < \alpha \leq 1$, is the quality degradation and c the copy cost), then if the consumers are relatively poor and, as usually, copy software degradation is minimal and the cost is close to zero, it is normal that poor consumers will prefer to get illegal copies rather than buy the original. Of course, companies can set prices targeted to market (setting prices lower in these markets) but, as software is easily transferred across countries, this strategy is unfeasible.

The higher inequality impact depicted in the empirical literature is not coherent with the previous models (as usually there will be more poor consumers in countries with higher inequality), but also with the theoretical model developed by Poddar (2005) who reached the conclusion that a higher inequality is associated with higher software piracy rates. However, the theoretical models assume that all consumers have access to hardware to use pirated software, which might not be the case. Higher inequality might mean that a higher share of the population is unable to buy the hardware and, so, they will not engage in software piracy.

Finally, regarding the impact of HDI on piracy, this will probably act in terms of the cost of pirating the software. Although we can assume the cost to be close to zero, there is a level of knowledge and infrastructures necessary to do it. A higher HDI is reflected not only in individual characteristics but also in terms of infrastructures (in this case the Internet speed connections). So, probably, and taking into consideration the previous model, a higher HDI reduces the level of cost of pirating and, therefore, it may foster this behavior.

2.2. Cultural dimensions

2.2.1. Stylized facts

Stylized fact 4: Hofstede cultural dimensions explain levels of software piracy across countries.

The Hofstede cultural dimensions (see Hofstede (1984)) cover several dimensions: power distance (PDI),⁶ individualism (IDV), uncertainty avoidance (UAI)⁷ and masculinity (MAS).⁸ They represent “four anthropological areas that different national societies handle differently: ways of coping

with inequality, ways of coping with uncertainty, the relationship of the individual with her or his primary group and the emotional implications of having been born a girl or a boy”. Later a fifth dimension was introduced: the Long-Term Orientation (LTO).⁹ This dimension was developed by Minkov (2007). More recently, in 2010, a sixth dimension was introduced: the Indulgence versus Restraint (IVR)¹⁰ developed by Hofstede et al. (2010). Although these dimensions have some drawbacks (they do not vary over time, and the available time span is relatively short), they allow a comparative analysis between the national culture and the levels of software piracy like the ones done by Marron and Steel (2000), Moores (2003), Shin et al. (2004) and Kovačić (2007). These studies used a cross-sectional analysis, covering at most 72 observations. Overall, their results show that IDV and MAS are positively correlated with software piracy, while PDI is negatively correlated.

Al-Rafee and Rouibah (2010) analyzed religion on the decision to pirate, through a questionnaire, and found that the religious treatment contributes to a decline in digital piracy.

2.2.2. Theory

First, it should be said that it is difficult to relate the cultural facts with pure economic models; nevertheless, we can put forward some hypothesis.

Related to the IDV dimension, the results obtained can be interpreted in terms of indirect appropriation and clubs theory, network effects or consumer information. Regarding indirect appropriation and clubs, societies with lower individualism are more prone to form clubs between agents that share the products. In this case, as clubs share the products between its members, the valuation of a product might be higher (so price increases) and for a firm, the fact that part of the licenses are pirated across members might still be profitable because the firm gets higher profits, due to higher prices charged for legal copies.¹¹ In this case the indirect appropriation through clubs might lead to higher levels of piracy, and that results in a profitable strategy for firms.¹²

Also, the network effects increase the value of the product. So the more people use the product and share its outputs between them (which is more likely in less individualistic societies) the higher the value of it. So, less individualistic societies will share the outputs more, thereby increasing the product price. In this case, firms can even incentivize piracy in order to charge higher prices to the consumers that buy them (a more detailed analysis can be found in Peitz (2004)). So, in either case, whether through clubs or network effects, the software price and the profit of the firms might increase just because more people use it. In this case the firms might not care about piracy, and even incentivize some.

⁶ This dimension expresses the degree to which the less powerful members of a society accept and expect that power be distributed unequally.

⁷ The uncertainty avoidance dimension expresses the degree to which the members of a society feel uncomfortable with uncertainty and ambiguity.

⁸ The masculinity side of this dimension represents a preference in society for achievement, heroism, assertiveness and material reward for success.

⁹ The long-term orientation dimension can be interpreted as dealing with society's search for virtue.

¹⁰ Indulgence stands for a society that allows relatively free gratification of basic and natural human drives related to enjoying life and having fun.

¹¹ We should note that in this case the software company could consider selling licenses to groups instead of the individual ones. However, for certain types of software this might be unfeasible. Think the case of videogames where the original copy might be shared between friends.

¹² For more details see Bakos et al. (1999) between others.

Finally, less individualistic societies (IDV) share more information and so, pirating, in order for consumers to get a better assessment of the value of the product (and thus overcoming the adverse selection problem), is less needed. Through this scenario, IDV should increase piracy. From the results it seems that the first and second effects (clubs and networking) are stronger than the third one, therefore more IDV societies have lower levels of piracy.

As for MAS, the dimension of material reward for success might decrease the value of the α parameter of the model described in Section 2.1.2, as people will see pirated copies as of inferior quality in terms of personnel success and that will lead to less people pirating it. Alternatively, as MAS dimension gives more weight to material achievement, then it is natural that the parameter ϕ increases. If that is the case, the difference between utility derived from buying and copying [$\phi q - p - (\alpha\phi q - c) = (1 - \alpha)\phi q - (p - c)$] increases, and so, it is more likely that people with a higher degree of MAS in their behavior are more prone to buy rather than pirate. Therefore, translating to the society as a whole, as more people are inclined to buy, the overall level of software piracy decreases.

The power distance dimension (PDI) is less obvious. However, this variable is highly correlated with a poor legal system and/or corruption. So the effect of this variable (higher PDI leads to more piracy) is just another way to capture the effect of the legal dimensions as discussed below in Section 2.5.

Finally, religion increases the moral cost of pirating, so the utility derived from pirating given by $\alpha\phi q - c$ decreases as the cost includes some moral disutility. Thus, as the piracy utility decreases, it makes sense that the software piracy level in society diminishes.

2.3. Educational dimensions

2.3.1. Stylized facts

Stylized fact 5: Overall level of education affects negatively the levels of software piracy.

Education plays an important factor in the construction of the perception of an individual towards using or not legal or illegal software. Several questions are raised by this respect: (i) More education can affect the levels of software piracy? (ii) Education can bring an increased use of legal, illegal or both types of software?

Several dimensions related to education can be used, from the literacy rate to the level of education attained. The World Bank, namely the *World Development Indicators* (WDI), has information on several dimensions related to education from the school enrolment ratio (primary, secondary, and tertiary), expenditure on education and years of primary and secondary schooling. The Eurostat provides a broader picture, introducing additional financial and non-financial measures, but information is only available for a small group of countries (the European Union).

In spite of a broad range of variables being available in this dimension, most of the research has used only cross-sectional data. Marron and Steel (2000) and Andrés (2006b) used the average years of secondary education of

people with more than 25 years old data from Barro and Lee (2013). Their results show that more education reduces software piracy. Goel and Nelson (2009) and Andrés and Goel (2011) used literacy rate however its significance across studies is not robust.

Another question that can be asked is if software piracy receives enough coverage from textbooks. MacDonald and Fougere (2003) analyzed this in the context of Management Information Systems (MIS) textbooks. They found that the words *Software piracy* is present in 72% of the textbooks; *Ethics* in 67%, *software license* in 50%, *copyright* 50% and *Intellectual Property* 39% and concluded, overall, that they do not give software piracy the depth of coverage warranted by its significance.

2.3.2. Theory

At first glance seems that the empirical results are not consistent with theory as more educated people have a higher knowledge of how to pirate software, so the cost of pirating is smaller. If this is the case, then piracy should increase. However we should also take into account two other factors. First, even if the short term cost decreases, more educated people might have a better awareness of the long-run cost of doing it (getting caught and facing legal penalties). So, if this perception increases with education, as studied by MacDonald and Fougere (2003), than the net effect of education on the total cost of pirating (direct cost plus long run perceived cost) is dubious. It can increase or decrease.

Furthermore, more educated people are also more demanding in terms of product quality and, in that case, they might perceive a lower level of quality in an illegal copy. Through this channel, piracy should decrease as pirated software utility decreases.

Overall, although the education dimension can, at least theoretically, go either way in terms of piracy levels, from the previous studies it seems that either the awareness of long-run costs or quality demand are strong enough to counterbalance the positive effect of more knowledge to pirate.

2.4. Technological dimensions

2.4.1. Stylized facts

Stylized fact 6: Types of software protection affects levels of software piracy. The choice of the type of Internet access and associated services will depend on its price, availability and the utility given by additional services, which will affect the availability of software.

Before the rise of the Internet, software piracy was done by the replication of the original software, from its original physical support to another. Protection was both in the software itself in the form of serial keys and in the support itself. With the internet and the online distribution of software, other than the licenses, protection of the software comes with online activation and monitoring.¹³ In spite of these protections software was usually hacked and pirate copies distributed.

¹³ For more details see Anckaert et al. (2004).

The impact of these protections on software piracy was studied by Djekic and Loebbecke (2007). Following Gopal and Sanders (1997), Prasad and Mahajan (2003) and Anckaert et al. (2004), they analyzed separately software-based and hardware-based technical copy protections by conducting a survey using 219 professional users and an amateur group of 575 individuals. Their results, regarding software and hardware base protections, revealed that none of the protections had a significant influence on the level of piracy. The only positive result was that some hardware-based protection integrated into computer systems (namely expansion cards) may be a better solution to the software piracy problem and are more efficient for the professional than for the amateur group.

When the hardware protection and software protection is overcome by hackers, the next step is to upload the software, which will depend on the type of Internet access and upload speeds. Broadband Internet access plays an important role in the decisions to download legal or illegal software by potential pirates and to have an idea of broadband demand is important in the setup of effective policies to fight the upload/download of illegal content. One of the first studies in Europe that focuses on the demand for broadband Internet was conducted by Cardona et al. (2009). They surveyed 3000 Austrian households and analyzed four types of Internet access: narrowband, cable, DSL and mobile. They found that demand for DSL is elastic and cable networks are likely to be in the same market as DSL connections. This study must be contextualized; narrowband was the first to arrive and it is not an option anymore. The three remaining services will strongly depend on the development of infrastructures.

However the choice of alternative types of Internet access will depend not only on price, but also on the consumer's informatics knowledge as some are willing to pay more for the same service. Using a large sample of individuals, Rosston et al. (2010) studied this phenomenon comparing experienced users with inexperienced users and estimated their willingness to pay, which is represented by the marginal utility of changing from one Internet service to another with higher interconnection speed. They included several measures in their analysis: cost, connection speed, reliability, use of Internet away from home, watching high definition content, interaction with health specialists and being able to perform free videophone calls. An experienced household is willing to pay \$59 for a basic service,¹⁴ \$85 for a premium service¹⁵ and \$98 for a premium plus service,¹⁶ while an inexperienced user is only willing to pay \$31, \$59 and \$71 respectively. These results show that being able to work with Internet will affect its utility, and that the willingness to pay for additional services depend on the consumer experience.

Although these estimates cannot be easily extended to other countries, they give us an idea of Internet demand and elasticities and how they vary, not only between

different services, but also according to the ability of households to use them.

2.4.2. Theory

The impacts described above concerning the technological dimensions are well explained by theoretical models, such as the one purposed by Shy and Thiesse (1999), that depict strategic interaction and the existence of different kinds of consumers (being professionals vs. amateurs or experienced vs. inexperienced). These models usually show that it is profitable for the companies to sell to consumers that put a higher value on the product and let the others pirate the software, and so software managers will put different levels of software protection in order to get a higher profit from the first set of consumers and let the second type to free-ride on them.

Also, lower levels of software protection can also be used to overcome the problems of adverse selection when consumers have to choose between alternative software. In this case, by pirating, they can try them before they commit to buy it for professional use.

So, these different levels of protection, and the absence or weak correlation with software piracy, can be a result of a strategic decision by the firms in order to maximize profits.

2.5. Legal dimensions

2.5.1. Stylized facts

Stylized fact 7: Rule of Law/Corruption affects levels of software piracy.

Some of the World Governance Indicators (WGI) that measure several dimensions like the effectiveness of the legal system were used both in cross-sectional and panel data studies. They represent six dimensions: Voice and Accountability,¹⁷ Political Stability and Absence of Violence/Terrorism,¹⁸ Government Effectiveness,¹⁹ Regulatory Quality,²⁰ Rule of law²¹ and Control of Corruption.²² Rule of Law was used by Andrés (2006a), Goel and Nelson (2009), Png (2010) and Boyce (2011) and

¹⁷ Voice and accountability captures perceptions of the extent to which country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.

¹⁸ Political stability and absence of violence measures the perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including domestic violence and terrorism.

¹⁹ Government effectiveness captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.

²⁰ Regulatory quality captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.

²¹ Rule of law reflects perceptions of the extent to which agents have confidence in and abide by the rules of society and, in particular, the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.

²² Control of corruption captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests.

¹⁴ "Basic" Internet service has fast speed and less reliable service.

¹⁵ "Premium" service has fast speed, very reliable service and the ability to designate some downloads as high priority.

¹⁶ "Premium Plus" service has fast speed, very reliable service plus all other activities bundled into the service.

revealed mixed signs. Moreover, these indicators are not important if we consider homogeneous countries such as those of the European Union.

Recently [Andrés and Goel \(2011\)](#) analyze the impact of corruption on the levels of software piracy. They construct a corruption perception index based on a nonlinear transformation of the one provided by the World Bank²³ and found a positive correlation between corruption and software piracy.

Stylized fact 8: International organizations can prevent software piracy, enforcing copyright treaties, making pressure and improving legal awareness.

To fight software piracy the *Business Software Alliance* serves as a pressure group to ensure property rights protection. This can come in the form of trade secrets, patents, licensing, copyright, civil liberties (they grant civil rights to software owners) and criminal liabilities. Unfortunately, not all countries offer strong property rights protection. Examples of these are countries with piracy rates above 80% present in the developing countries. On the other hand, there are countries that have strong property rights and enforcement such as the USA where the piracy rate is only 20% ([Clifford and Jin \(1997\)](#)).

[Shadlen et al. \(2005\)](#), using a panel of 80 countries from 1994 to 2002, studied to what extent transnational factors, such multilateral obligations under the World Trade Organization's (WTO) Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) and bilateral pressures from the United States, are able to protect software property rights. They found that these factors lead to a substantial increase in the levels of protection in both rich and poor countries.

Also, [Andrés \(2006a\)](#) constructed an index of copyright protection for the European Union that measures to what extent software is protected. For the construction of this index the author used two proxies for the strength of software protection: (i) membership of international copyright treaties – this variable includes the signatories of the Bern convention (1886), WIPO (1996) and TRIPs (1994) – and (ii) enforcement provisions – a measure of the severity of punishment (jail, fines) and how these laws are being applied (based on the works of [Ostergard \(2000\)](#) and [Samuelson \(1999\)](#)). His results, for panel data of 23 countries for the years 1994, 1997 and 2000, show that this index had negative effects, which means that a lack of protection increases piracy.

When macroeconomic data is available on variables such as the type of legal system ([Goel and Nelson, 2009](#)), effectiveness of courts and legal implications, econometric methods such as OLS (ordinary least squares), FE (fixed effects) or RE (random effects) are used. However, these variables fail to capture the behavior of each potential software consumer. To empirically analyze this behavior, surveys provide a richer analysis. Using a sample of students at a leading college of business administration, consisting of 319 observations, 190 females and 129 males, [Al-Rafee](#)

and [Rouibah \(2010\)](#) studied the impact that religious factors, awareness factors and legal factors have in the decision to pirate by using different treatments within a controlled environment. They found that religious factors have an impact on the decision to pirate (as pointed out before), while legal factors were not significant, but more information on legal consequences of violating property rights, which is something that organizations have been using, is effective in lowering piracy.

These results support the argument that our perception evolves over time, the most important factor being the awareness of penalties related to the violation of property rights. In a cross-sectional data the results that relate to awareness factors and legal factors can be implemented using the World Governance Indicators, namely the rule of law and government effectiveness.

More recently [Hashim et al. \(2009\)](#) extending the models of [Ajzen \(1991\)](#) and [Beck and Ajzen \(1991\)](#) of the theory of planned behavior,²⁴ introduced an additional variable that is a message of anti-piracy. The model proposed assumes that the individual has behavioral beliefs, normative beliefs and control beliefs that will affect their perception of reality, the attitude towards the behavior, subjective norms and perceived behavioral control, respectively. Each individual gives different importance to these factors; these affect its intention and behavior. The perceived behavior control can predict the behavior. In this survey, pirates will be nudged by this message and will not undertake deviant behavior. A survey was made of 218 undergraduate students at a large university in the Midwest region of the United States. Out of these 218, 98 questionnaires presented a message of anti-piracy. They identify in which circumstances an individual is susceptible to exogenous nudging from a software company. The results show that anti-piracy messages affect the behavior of a software pirate.

2.5.2. Theory

The lack of results regarding IP protection and enforcement should not surprise us. Theoretically, we could think that higher IP protection levels would lead to higher costs to pirate and thus less software piracy as a whole. Nevertheless, as shown by [Yoon \(2002\)](#), this is not a simple problem, as IP protection levels are set by governments that also have to take into consideration the social optimum. So, the social welfare optimum has a U shape, increasing for low levels of IP protection and decreasing after reaching a maximum. Also for the companies, the optimum level of IP protection depends on the composition of the consumers and its heterogeneity and, therefore, not always a maximum level of protection and enforcement (as in the case of technological protection) is optimum. So, this interaction between governments, companies (and their different levels of bargaining power that through international pressure lead to a reduction of

²³ This Index is measured as: $CPI_{index} = \log\left(\frac{10-CPI}{CPI}\right)$ – higher values means higher corruption, whereas CPI is the index reported by the World Bank.

²⁴ In psychology, the theory of planned behavior is a theory about the link between attitudes and behavior. The concept was proposed by Icek Ajzen to improve on the predictive power of the theory of reasoned action by including perceived behavioral control. For additional information see <http://people.umass.edu/ajzen/tpb.diag.html>.

software piracy) and consumers behavior will set different levels of IP protection in different countries. Taking this into consideration it is not surprising that macroeconomic studies do not capture any effect, as they fail to capture the cross-country heterogeneity of this complex equation.

In terms of individual perceptions (corruption or awareness) the results are consistent with theory. If people perceive the country as being more corrupt they will consider that the probability of getting caught is smaller and so, their cost of pirating will decrease. On the contrary, if people are more aware of the consequences of their illegal behavior, the perceived cost of pirating will increase. This will, in turn, have a correspondent effect on the global level of software piracy in an economy.

3. Conclusions

From the previous survey it can be concluded that the factors that affect piracy software are multidimensional. Overall these factors, classified into eight stylized facts, are coherent with the theoretical literature. However, while some are straightforward and simple: education and GDP *per capita* are related with lower levels of software piracy, whereas an increase in HDI increases software piracy; others, such as the cultural dimensions, are more complex, as these depend on the perception that individuals have in relation to society. Finally, the impact of inequality is negative which is, at first glance, at odds with simple theoretical models. Regarding the technological and the legal dimension although an increase on the protection of software copyrights decreases piracy, only with a better understanding of the whole picture can companies and/or governments put in place efficient technological mechanisms or legal frameworks to prevent it.

However, although these findings are consistent across a variety of empirical studies, we should also be aware of the limitations of empirical strategies used, whether they be surveys, panels or cross-country regressions as well as the data source. In this regard we should note that most cross-country studies rely on data from BSA, which is not an independent actor in this market, but represents companies and is itself a pressure group.

It is our opinion that not only should the researchers try to get access to different data sources, but also that they must take into account several problems with the used methodologies, moving away from single ad-hoc equation regressions and build structural models with simultaneous equations grounded in the theory, as software piracy is not only driven by demand characteristics but, as we discussed in Section 2, can also be a strategic behavior of suppliers.

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