Article
Rate of Software Piracy Vs Value of Software Piracy

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Abstract

A number of studies conclude that there is a greater rate of software piracy by individuals from poorer compared to richer countries. Using archival data, we measure the value of pirated software in addition to the rate of piracy. Under the rational choice theory of crime, we conduct analyses comparing the rate versus value measures of software piracy for a comprehensive sample of 97 countries.

Results confirm the previous finding of higher software piracy rates in poorer compared to richer countries. We extend these findings by demonstrating that the overall value of software pirated per person is greater in richer countries.

The uniqueness of this study is that the value of software piracy has not been studied before in as much depth as the rate of piracy. Software firms can devote their scarce resources to fight digital piracy in countries where the value of the piracy is higher than the rate of piracy.

Keywords: software piracy, piracy value, piracy rate, construct validity.

1. Introduction

Gopal & Sander's (1998) treatise on international software piracy was a watershed article for behavioural software piracy researchers. It was one of the first studies to identify a relationship between national income and software piracy, which is now well accepted. The central premise of the study was that countries with lower per capita income would have higher software piracy rates than countries with higher per capita income. In subsequent years, these results have been replicated by a number of researchers (Andres, 2006; Bagchi et al., 2006b; Depken & Simmons, 2004; Husted, 2000; Marron & Steel, 2000). In this paper, we argue that piracy rates, as operationalised in past studies, capture only one aspect of the full extent to which users engage in piracy. Through an assessment of this value-based measure of pirated software, we are able to account more completely for observed differences in software piracy behaviour. Moreover, in further explicating the domain of software piracy (Craig & Burnett, 2005) this new measure offers additional insights on the relationship between poverty and software piracy.

Although multiple definitions of software piracy exist (BSA & IDC, 2004), typically, the term 'software piracy' refers to some form of unauthorised copying of software (Law & Wong, 2005). Piracy has been a problem for digital content creators, from the mid 1990s where it was viewed as a serious issue needing attention (Gopal & Sanders, 1998) to the present day where it is considered the single largest threat to jobs in the information technology industry (BSA & IDC, 2004). In an April 2003 study funded by the Business Software Alliance (BSA) and the International Data Corporation (IDC), they concluded that reduction of worldwide piracy by 10% over 4 years would add more than 1 million new jobs and $400 billion in economic growth worldwide (BSA & IDC, 2004).

The increase of piracy has, of late, greatly affected the market for software applications (Andres, 2006). According to the International Planning Research Corporation (IPRC), the estimated world piracy rate for business software applications alone was 39% in 2002, leading to losses of $13.07 billion (IPRC, 2003). According to the first annual Business Software Alliance (BSA) & International Data Corporation (IDC) study in 2004, for every two dollars worth of software purchased legitimately, one dollar's worth was obtained illegally. In fact, the situation in some countries such as Russia and China is so grim that the Software Publishers Association (SPA) has designated them as 'one-copy countries', which essentially means that the entire country's demand can be met by one single copy of legitimate software (Banerjee, 2003). According to IDC estimates, while the PC software market will grow from $50 billion to $70 billion over the next 5 years, the value of the pirated software market will grow to about $40 billion.

Paralleling this growth, piracy-related research has been a hotbed of activity in the recent past. According to Holsapple et al. (2008), the amount of research in piracy has grown from 2 published papers per year in 1990 to 28 published papers in the first half of 2006. Whilst this explosion of research is encouraging, even more interesting is the opinion of academicians that research in piracy is still in a nascent stage and a disciplined analysis of piracy as a domain is yet to be conducted (Zwass, 2005).

In this paper, we utilise a framework based on the Rational Choice Theory of Crime to study the phenomenon of software piracy. Specifically, we address the question "do computer users in poorer countries differ significantly from those in richer countries, with respect to their usage of pirated software?" We first replicate previous studies and demonstrate that our data provide results that are consistent with historic studies in the domain of piracy. This supports the validity of our findings and grounds our study in the extant literature. Subsequently, we extend the previous piracy framework to propose a new measure of software piracy and its potential causes. Our findings throw an interesting light on the historical studies dealing with software piracy. Findings from this research demonstrate that alternative indicators are sensitive to different aspects of the domain of software piracy and result in radically divergent findings. In particular, we propose a new measure that reflects the value of software pirated versus its traditional assessment in terms of the rate or frequency of pirating. The rate of software piracy has been studied in the literature in the past but we have yet to find a study using the value of software piracy as an indicator of software piracy. The implication of using this new indicator has far-reaching consequences as it shows poorer countries to be pirating less in terms of value compared to richer countries. Finally, we provide an extended framework discussing the contribution of our findings whilst reconciling our results with the apparently contradicting view of previous research.

The remainder of this paper is organised as follows: In the next section, we provide a brief synthesis of the existing research stream on software piracy. Section 3 introduces the new measure, along with the rationale for the same, whilst Section 4 operationalises the model. Subsequently, we present the results of our findings in a staged series of analyses, which are presented in Section 5. Sections 6 and 7 summarise our findings and present implications and conclusions of this research.

2. Research Background

Software piracy has been a phenomenon of significant interest among researchers and practitioners and, as a result, a substantial amount of published work exists in this domain. According to data gathered by Holsapple et al. (2008), since 1990 the overall number of published software piracy studies exceeds 75. As they note, research on software piracy behaviour has relied on two forms of data collection: archival (8 studies) and surveys (51 studies), whilst the remainder comprises analytical works. Using the empirical studies as a base, we focus our discussion on the measures of software piracy and the antecedents most frequently investigated in this past research (see Holsapple et al., 2008).

2.1 Measurement of software piracy behaviour

Survey research has been employed as one popular approach to develop a deeper understanding of software piracy behaviour (see Peace et al. (2003) for an excellent example). Several indicators using this methodology have been used to operationalise software piracy, ranging from the actual conduct of piracy (Gupta et al., 2004; Moores & Dhaliwal, 2004) to intention to pirate (Tang & Farn, 2005), to attitude and intention to pirate software (Peace et al., 2003). It is interesting to note that all of these operationalisations of the underlying behavioural construct of software piracy find significant results with respect to largely similar indicators (which will be discussed shortly). These results are, however, not surprising as the Theory of Planned Behaviour (Ajzen, 1991) suggests that attitude towards an activity is indeed an important determinant of the intention to carry out that activity. Consequently, intention, although fallible, can serve as a useful indicator of behaviour-based piracy.

Archival research methods, on the other hand, have investigated only one dependent indicator: the software piracy rate provided by the BSA (Gopal & Sanders, 1998; Husted, 2000; Bagchi et al., 2006a; Andres, 2006). This rate is measured as the difference between the market potential for new software (based on an estimate of new hardware sold) and the actual amount of software that was correspondingly sold. Gopal & Sanders (1998) proposed one of the first macroeconomic models of software piracy based on this dependent variable. According to their proposition, countries with low per capita income are expected to have higher software piracy rates. A key point that we will discuss subsequently is that the results of Gopal & Sanders (1998) are based upon piracy rates for only 13 countries. Subsequently a number of researchers have successfully replicated the Gopal & Sanders (1998) results (Husted, 2000; Bagchi et al., 2006a; Andres, 2006; Depken & Simmons, 2004). Table 1 provides a brief overview of the original Gopal & Sanders (1998) paper and these subsequent studies along dimensions we now discuss in more detail.

Table I
Summary of archival research in software piracy

Authors	Factors				
	Demo-graphics	Legal Regulation	Income	Infrastructure	Number of countries
Gopal & Sanders 1998	Yes	Yes	Yes	No	13
Husted 2000	No	No	Yes	No	39
Bagchi et al. 2006	No	Yes	Yes	No	37
Andres 2006	No	Yes	Yes	No	34
Depken & Simmons 2004	No	Yes	Yes	No	65
Shin et al. 2004	No	Yes	Yes	No	49
Marron & Steel 2000	No	Yes	Yes	No	49
Rodriguez 2006	No	Yes	Yes	Yes	23

2.2 Antecedents of Software Piracy Behaviour

Several antecedents have been proposed as predictors of software piracy behaviour amongst individuals. In this section, we will discuss the predictors most frequently investigated in models of software piracy.

2.2.1: *The Income Effect:* This dimension is by far the most widely tested of the antecedents to piracy behaviour both by survey researchers as well as in archival studies. An analytical explanation is provided by Conner & Rummelt (1991), who suggest that the decision to purchase or pirate software is a function of the value obtained from the programme, the cost of pirating and the price of the software. Whilst their model is analytical, the underlying rationale is empirically tested by Peace et al. (2003). Empirical results from this and similar studies converge with the expectations that the price of software (as a function of income) is an important determinant of the propensity to pirate it (Jussawalla, 1992). For instance, Cheng et al. (1997) conclude that one of the primary reasons that students pirate software is the otherwise high cost of buying an original version. Implicit here is the idea that higher priced software is more desirable to pirate than lower priced software. As we discuss later, this finding relates to the premise underlying our new measure of the value of pirated software.

Within the broader domain of income, another interesting variable that has been reported to be predictive is income inequality (Andres, 2006; Husted, 2000). The premise is that with a more equal income distribution there will be a relatively larger economic middle class, which is more prone to acquire illegal copies of software. The argument is that the rich have no need to acquire pirated copies of software, whilst the poor have no access to computers and subsequently no need to pirate software (Husted, 2000). Consequently, an increase in income inequality would be expected to indicate a lower degree of software piracy. Two studies test and provide support for this relationship (Andres, 2006; Husted, 2000).

2.2.2: *The effect of infrastructure:* Survey research has proposed that one of the drivers of software piracy has been the rapid growth in bandwidth availability (Hinduja, 2001; Peace et al., 2003). According to Wall (2001), the Internet is a haven for computer criminals as it provides a domain where digital content is easy to access whilst at the same time providing a certain sense of anonymity to the criminal. Interesting anecdotal evidence is provided by Leyden (2004). With 79% of its population connected to broadband, Iceland is one of the most 'wired' countries in the world. According to SMAIS (Samtök Myndrétthafa á Íslandi, which is the Icelandic equivalent of the Motion Pictures Association of America), raids by police on users of P2P networks for illegal sharing activities reduced Internet traffic by almost 40% (Leyden, 2004). The implication here is that at least 40% of the country's available bandwidth was used for pirating digital content.

Archival researchers, however, have obtained mixed results regarding whether a facilitating infrastructure has significant effects on software piracy. For example, in a longitudinal study on international software piracy, Bagchi et al. (2006a) found significant results for 1996 data, but did not find a significant effect in subsequent years.

2.2.3: *The effect of legal protectionism:* The role played by legal protectionism on software piracy behaviour was first analysed by Gopal & Sanders (1997). Legal solutions could include unannounced audits or bringing lawsuits against unauthorised users of copyrighted contents (Mason, 1986). The premise is that, although legal guardianship of software does not directly influence the cost or effort of piracy, it dissuades piracy due to the threat of sanctions (Gopal & Sanders, 1997). Survey researchers have found that one of the primary reasons proposed for the widespread copying of software has been that pirates are unaware of the law (Christinsen & Eining, 1991; Simpson et al., 1994). Other reasons include limited enforcement of the law, leading to threats that are too minimal to be taken seriously (Hinduja, 2003). Similar findings are reported in other studies where the low probability of being apprehended and penalised is given as one of the primary reasons people continue to engage in piracy (Cheng et al., 1997; Tan, 2002). At the same time, it has been suggested that a higher perceived risk of getting caught (when the legal sanctions are enforced strictly) causes a reduction in pirating behaviour (Peace et al., 2003). These findings appear to be consistent with Deterrence Theory, which states that certainty and severity of punishment decrease deviant activity.

Archival researchers have investigated this construct, again with mixed results. Bagchi et al. (2006a) found significant results of legal protectionism on software piracy in 2003, but did not find similar results in any of the prior years. Similar results were reported by Andres (2006) for 1995. It is interesting to note that the 1996 data for Bagchi et al. (2006a) were similar to the data used by Andres (2006), but the results were opposite in terms of directionality. This difference may be the result of a strong sampling bias in that their samples were limited in scope {Bagchi et al. (2006a) =37 countries; Andres (2006) = 23 countries}.

2.2.4: *The effect of demographics:* Survey research has repeatedly indicated that various demographics serve as good predictors of software piracy behaviour. Three of the demographics that have consistently been suggested by survey researchers are age, gender and computer familiarity (Holsapple et al., 2008). Hinduja (2001) indicates that software pirates are mostly younger males, who are very familiar with computer systems. To the best of our knowledge archival research has not controlled for demographic differences when studying software piracy behaviour.

Consistently across context or culture, younger people are more likely to engage in piracy as compared to older people. In a study conducted amongst respondents in Singapore, Gan & Koh (2006) found significant results, suggesting that age is negatively related to intention to pirate software. Similar results are reported by Kini et al. (2004) in a study amongst respondents in Thailand. Polakowski & Schneider (1998) also found support for their proposition that age is related to software piracy (negatively) using a sample of American students.

The effect of gender is one of the more widely studied demographic factors in the context of software piracy. Within the context of criminology, it has been observed that females have a substantially lower propensity to commit crimes than males (Piquero & Sealock, 2004). Whilst this phenomenon has been studied extensively in diverse contexts, piracy research yields very interesting results. Most researchers conclude that software pirates (especially Internet-based pirates) are generally male (Rahim et al., 1999; Sims et al., 1996; Wood & Glass, 1996; Hinduja, 2001, 2003). Higgins et al. (2006) contends that this difference between the propensity of males and females is largely because of social learning and self-control. As they note, software piracy is a behaviour that is adopted largely due to the influence of peer groups and differential learning from social groups (Higgins et al., 2006). Archival research, in contrast, has not studied the effects of gender.

Whilst the effect of computer familiarity on the incidence of pirating behaviour is not commonly investigated, the few researchers who have examined this factor take the view that software pirates are creative and intelligent (Rahim et al., 1999). They conclude that pirates are likely to be highly familiar with computer systems (Piquero & Sealock, 2004; Rahim et al., 1999). Other researchers believe this is not a surprising finding as pirates must be skilled in computer use because they must know where and how to find this information and how to use it (Craig & Burnett, 2005). Again, archival research has not investigated this effect.

3. The Complete Model And The Development Of A New Measure:

3.1 Completing the model

A synthesis of the literature addressing software piracy behaviour leads to the model shown in Figure 1. The relationships posed serve to integrate past research whilst serving as a nomological network enabling a comprehensive assessment of the validity of our new measure of piracy behaviour.

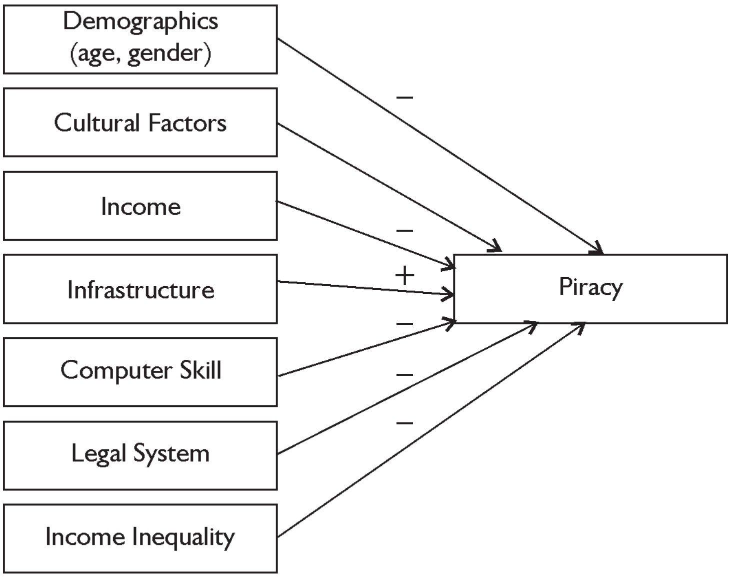

Figure 1. A model of software piracy behaviour

As mentioned in the introduction, one purpose of this paper is to address the substantive research question as to whether computer users in poorer countries differ significantly from those in richer countries with respect to their usage of pirated software and, if so, how is this difference manifested? To accomplish this goal we first assess the construct validity of our proposed measure. We do this by estimating the proposed relationships through a series of empirical stages. In the first stage of our analyses, we replicate past research results by using the previously utilised measure of software piracy (rates). Next, a series of analyses demonstrate how results diverge from prior studies by analysing a new indicator that is sensitive to the value of pirated software. Doing so enables a more complete examination of this substantive research question from differing perspectives. To accomplish these dual goals, the difference in piracy behaviour with respect to the varying effects of income on piracy is examined, controlling for the effects of the predictors shown in Figure 1. This gives rise to our first hypothesis based upon the rate of piracy, as employed in past archival research:

H1: Poorer countries will have a higher overall rate of piracy as compared to richer countries after controlling for the stated antecedents.

This relationship has been widely studied in the literature and been consistently supported (Gopal & Sanders, 1998; Husted, 2000; Andres, 2006; Bagchi et al., 2006a). A successful replication of this historical finding provides a first step towards establishing the validity of our subsequent results.

Most archival data in the area of software piracy have been supplied by the Business Software Alliance (BSA). The BSA is a network of software manufacturers and includes a number of software manufacturers such as Microsoft and Novell (Husted, 2000). This organisation measures the piracy rates in different countries and reports it as a percentage number (with 0% indicating no piracy and 100% indicating full piracy). The piracy rate is calculated as the difference between software programs installed and the amount of licensed software sold legally. This is to say that under ideal circumstances, the market for new software in any country would be a function of the new hardware (computer systems) sold in that country within a particular time frame. The difference between this estimated demand and actual sale of software could be considered the software that is pirated. Whilst this system does have its flaws (one argument has been that the method, in fact, underestimates piracy because a substantial amount of software gets sold for older computers (Traphagan & Griffith, 1998)), most empirical models have largely used the BSA piracy rate estimates (Andres, 2006; Gopal & Sanders, 1998; Husted, 2000; Marron & Steel 2000; Depken & Simmons, 2004; Rodríguez, 2006). Also, whilst the data may have an element of bias in it, we have no reason to believe that the results for any particular set of countries will be differentially biased; i.e., even if a bias is present, it should be a uniform bias across the cross section and, thus, not affect the overall results (Bagchi et al., 2006b).

3.2 The need for a new measure

The measure of piracy defined by the BSA (predominately used in past archival research) assesses the total percent of hardware that runs on pirated software. However, this measure does not account for individual differences between computer users in different countries. As in the survey-based behavioural research on software piracy, it is important to note that it is the users of computer systems that pirate software, not the computer systems themselves. Software piracy, as measured by the overall piracy rate, would be reflective of the actual usage environment, only if each computer in each country would be used by only one (or at least the same number) user. This case is best illustrated by way of an example.

Let us assume that country X has a software piracy rate of 80%, whilst another country Y has a software piracy rate of 45%. Casual observation would suggest that country X has a higher piracy rate than country Y, in effect implying that the citizens of country X pirate far more software than those of country Y. However, suppose we now add on this additional consideration; on average, every computer in country X is shared by 2 persons, whilst every computer in country Y is used by just 1 person (i.e. In country Y, each user has his own computer).

In that case, it would be fair to deduce that each user of each computer is, on an average, responsible for only (80% / 2) = 40% of the piracy, whilst each computer user of each computer in country X is responsible for (45%/1) = 45%.

Also suppose country X's software has a total dollar value of $100 (indicating the total value of pirated software running in that country) and the number of computers is 10. Then the loss due to piracy will be on an average $100/10 = $10 per computer. Also, if each computer is being shared by two users, then each will be responsible for $10/2 = $5 of piracy, on average. On the other hand, if the said computer was being used by just one person, then on an average the single user would have been responsible for all $10 worth of piracy. This difference is fundamental to the valid assessment of the value of overall piracy losses.

It would normally be expected that the number of users per computer would be lower in richer countries than in poorer countries (as more people would have access to their own computer in richer countries). In order to check for this, we obtained data on the number of users per computer from the World Bank. It is interesting to note that the number of users per computer is, in fact, not symmetric across countries (median users =2.97, S.D. = 2.65). For example, the number of users per computer ranges from 0.91 in Switzerland and USA (indicating that each user has, on an average, more than one computer) to 6.4 in Vietnam (indicating that almost 7 users share one computer). In light of this difference we adjust the piracy rates by the number of users per computer. The result is a significant change in the distribution of values representing country-specific differences in piracy rates. For example, the piracy rate for the US is 28% versus .31 for the proposed measure (in the United States, the users per computer is .91). In contrast, for China there are 2.6 users per computer changing the rate measure of 85% to .33 for the value-based measure.

As a result of this effect, we propose and develop a new measure to assess the extent of software piracy, i.e. software piracy per computer user. This is represented by equation 1 below:

$$\text{Software piracy per computer user} = \sum D_\alpha \;/\; Users \qquad [1]$$

Where: D_α = Average dollar value of pirated software per computer, given as

$$D_\alpha = \sum D_\beta / C_i \qquad [2]$$

Where: $\sum D_\beta$ = Total dollar value of pirated software in the country &

C_i = Total number of computers in the country

Or, in simple terms, software piracy per computer user is given as

$$\frac{Totle\ \ value\ of\ \ software\ \ pirated}{Numbers\ of\ computers} \times \frac{I}{Users\ per\ computer} \qquad [3]$$

Our premise is that this measure will be more sensitive in accounting for individual differences in the value of pirated software versus the BSA's overall software piracy rate. In effect, we expect to find a difference in results when comparing the BSA-based aggregate software piracy rate with our more value-sensitive per user piracy measure. Specifically, we expect to find a negative relationship between income and software piracy for the aggregate rate-based measure (as per H1, which is consistent with previous research), but do not expect this same relationship for our proposed value-based measure. The rationale for this differential expectation is provided next.

3.3 Theoretical Background

Prior research has, to a varying extent, embraced a criminological perspective on software privacy (Hinduja, 2001; Higgins et al., 2006; Rodríguez, 2006). We extend this research by considering the rational choice theory of crimes and utilise this theory in making predictions for the types of countries most likely to pirate higher valued software. Landes & Posner's (1989) economic theory of copyright provides a useful starting point for critically studying the impact of differing economic situations on copyright infringement. According to this viewpoint, any predetermined degree of copyright protection can be enforced on any digital content at a certain cost to the copyright owner. Thus, in an optimal system, there would be no copyright infringement, as the original publisher (or content creator) would impose the right level of protection in order to protect the product's content from infringement. However in reality, there is indeed some amount of illegal copying present in every market (see Rodríguez, A. (2006) for a discussion).

The Rational Choice Theory (RCT) of crime suggests that people will make decisions to commit crime in a rational manner, i.e. based upon their expectations for profit maximisation and the minimisation of losses (Felson & Clarke, 1993). Accordingly, individuals choose what they believe to be the best means to achieve their desired end goals. This theory conjectures that individuals are modelled as maximising utility, the "currency" for everything they cherish. According to this formulation, the occurrence of crime will vary according to three broad configurations of factors (Rock, 2004). The first of the situational factors refers to the effort involved (ease or difficulty) in committing the crime. Situational crime prevention (also called target hardening) refers to the act of making the effort involved in carrying out the crime as high as possible, thus deterring crime. Examples of this may include the use of big locks on houses, increasing gun control. Specific to software piracy, increases in technological access, such as Internet bandwidth availability, may act as situational facilitators that increase the incidence of crimes, such as piracy.

The second of the RCT factors refers to the risks involved in offending. Formal surveillance by police in streets is an example of how this second factor attempts to raise the barrier to direct predatory crimes. Specific to software piracy, deterrents could include the extent of adherence to legal regulation and international intellectual protection memberships to which society is subjected. These two deterrent-oriented factors are included in our model under the legal system (see Figure 1)

The final RCT crime dimension refers to the potential rewards of the crime that the perpetuator may enjoy. For example, researchers have pointed out that within the context of burglaries, compact, old school buildings on small plots are three times less likely to be burgled as compared to larger, new buildings, irrespective of location (Hope, 1982). The issue is that compact buildings give the impression that the possible rewards from breaking in are less than what could be obtained from breaking into a larger building. The complete RCT framework is illustrated in Figure 2 and indeed, as will be subsequently shown, several streams of criminological theory converge on similar propositions.

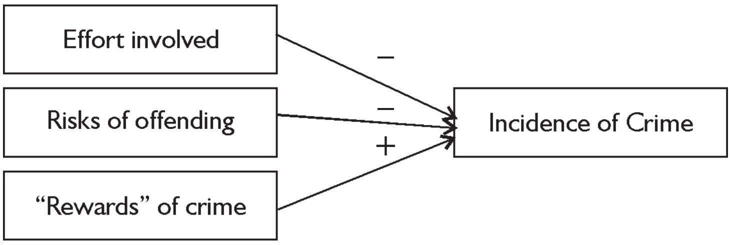

Figure 2. Rational choice theory of crime

According to the RCT, individuals who would gain the most out of obtaining a copy of pirated software (who would have the highest propensity to pirate) would be those who would receive maximum utility in return. A similar argument is provided by Ehrlich's economic theory of crime (Ehrlich,1973), in which it is argued that the decision to commit a crime is a rational choice involving the optimal allocation of resources. Consequently, offenders will be motivated to commit that crime wherein the potential rewards to risk ratio is the highest. Indeed, Rodríguez (2006) argued that Ehrlich's (1973) opportunities and rewards can be replaced by the costs and benefits involved with conducting an illegal activity (in this case, software piracy). Subsequently, Rodríguez (2006) demonstrated that increasing deterrent controls on software piracy decreased the opportunity for committing this crime. Earlier studies that tested this relationship found similar results (Gopal & Sanders,1997).

However, it is useful to note that no study has to date tested what effects the second factor (i.e. increasing the rewards of the crime) might have on copyright infringement in an international context (Ehrlich,1973). With respect to piracy, people using dedicated systems solely for themselves would find greater value (rewards of the crime) for pirated software than people using shared systems. This is because using pirated software on dedicated computers would provide a greater comparative advantage and, subsequently, increased reward to the user of a dedicated system (as the same functional utility is obtained for a lesser cost), whereas users of shared computers would receive a lower level of relative utility (as the benefit would have to be shared with other users of the same computer). In effect, we would expect to see users of dedicated systems to display higher piracy propensity. As we have already noted, people in richer countries have a greater number of dedicated systems than do people in poorer countries. Thus using our new measure and the economic theory of crime (Ehrlich, 1973), we predict the somewhat counterintuitive second hypothesis, which, if supported, would contradict results in the extant literature.

H2: Richer countries will have higher per user piracy than poorer countries after controlling for all other stated antecedents (situational indicators of the RCT).

4. Operationalising The Current Study

As mentioned earlier, most archival research dealing with software piracy has operationalised the effect of income on piracy by using country per capita GDP (or GNP) [(Gopal & Sanders, 1998; Husted, 2000). In this paper, we used the PPP-adjusted GDP, obtained from the International Monetary Fund (IMF) world economic outlook.

Demographics (median age and male to female ratios) and computer familiarity were obtained from the CIA world fact book (available online at www.cia.gov). To our knowledge, archival research has not controlled for these demographics, which have been reported to be significant predictors of piracy in survey-based research. In this paper, we use average computer literacy within the country (percentage of the population who know how to use computers) as a proxy for average computer familiarity.

The strength of the judicial system was measured by the World Bank "Rule of Law Index" (Kaufmann & Mastruzzi, 2003), which is consistent with the methodology employed by Andres (2006). The World Bank rule of law index ranks countries on a scale of 2.5 to 2.5, wherein higher values indicate a more efficient and effective judicial system. This study has been conducted once every 2 years since 1996. We use the values for 2002 which were the latest available. In order to verify the quality of this data, we also obtained the corruption perception index measured by Transparency International (consistent with Bagchi et al. (2006a)) and the regulatory quality index and the government effectiveness indices measured by the World Bank. This latter index was used by Rodríguez (2006) as a proxy for the quality of the regulatory system. Principal components analysis indicated that almost 80% of the variance across these four indices was explained by one underlying dimension (first eigenvalue = 3.207). Thus, for simplicity and parsimony, only the Transparency International index was retained.

Within the context of legal protectionism international trade organisation membership (e.g. TRIPS / WIPO) is quite likely to reflect the extent to which one country does or does not tolerate intellectual property violation (Rodríguez, 2006). Among the major international copyright membership conventions, WIPO (World Intellectual Property Organisation) is one of the oldest and has the widest memberships. WIPO is one of the specialised agencies of the United Nations created in 1967 with the stated purpose of encouraging creative activity and promoting the protection of intellectual property throughout the world. Thus, our measure of external legal protectionism was coded as to whether a country was a member of WIPO (1) or not (0).

The availability of facilitating infrastructure was measured as a function of three variables: availability of telephones, the availability of the number of Internet service providers and the network readiness score of the World Economic Forum. The first two variables are consistent with Bagchi et al. (2006a). However, whilst Bagchi et al. (2006a) obtained these data from the World Bank figures, we obtained our data from the CIA fact book. Doing so allowed us to expand our sample from 37 countries (Bagchi et al., 2006a) to 97 countries.

The degree of economic inequality was measured using the Gini index consistent with previous research (Andres, 2006; Husted, 2000). The Gini index (United Nations Human Development Report 2005) is a measure of inequality of a distribution and is represented as a ratio with values between 0 and 1. The Gini index is an often used indicator of income inequality, in which 0 corresponds to perfect income equality whilst. at the other extreme. 1 corresponds to perfect income inequality. In reality, the majority of nations range between 0.25 (primarily richer countries) and 0.7 (mostly poorer countries).

5. Data Analysis And Results

We divide our data analysis into four steps, the results of which are presented in this section. As mentioned, one of the purposes of this paper is to assess whether computer users in poorer countries differ from computer users in richer countries in terms of the rate versus value of their usage of pirated software. In order to maintain consistency with previous research we use the same data analysis methodology employed previously.

Step 1:

Gopal & Sanders (1998) performed a regression analysis on their archival data for 13 countries and suggested that per capita GDP was a significant factor in predicting piracy rates. In study 1, we first replicate the results of the original Gopal & Sanders (1998) study.

We conducted a regression with the prior measure of piracy (rate) as the dependent variable and per capita GDP as the independent variable. The effect of per capita GDP on piracy rates was consistent with the results obtained by Gopal & Sanders (1998) (b = -5.03, p=0.000, R squared = 0.574), and supports H1. These results are consistent with the original study and replicate their research for a more recent sample of data. These results are also consistent with other subsequent studies (Andres, 2006; Husted, 2000). It should, however, be noted that the samples for these latter studies were different from our sample, as we specifically chose those countries for step 1 to be consistent with the sample used by Gopal & Sanders (1998).

Step 2:

Next, we extended the previously proposed model to the full sample of 97 countries. To the best of our knowledge, no prior study had looked at such a large sample of countries,

1 For the comparison to the Gopal & Sanders, (1998) sample of 13 countries, we ran the analysis without the control variables; as the number of data points is too small to reliability accommodate six independent variables. This is consistent with the empirical model utilised in the study.

whilst studying the relation between GDP and piracy. The one study to approach our sample size was by Marron & Steel (2000), where the authors had data from 77 countries. However, this sample did not contain the control variables depicted in Figure 1. With the addition of their control variables (Hofstede's cultural dimensions), their sample (Marron & Steel, 2000) was reduced to only 49 countries. In our case, analyses included all of the prescribed controls (age, gender ratios, legal controls, infrastructure availability and economic inequality), thus more rigorously testing H1.

A regression for our full sample with piracy rate as the dependent variable and per capita GDP and the control variables as the independent predictors was conducted in step 2. Again, the same effect for income was significant ($b = -15.91$, $p = 0.000$, R squared = 0.81) . Thus, H1 is further supported. Our results compare favourably with previous studies, thus indicating that our expanded sample is both more comprehensive and comparable in composition to prior archival data sets.

Step 3:

We now test H2, with the addition of our new measure of software piracy per computer user (see equation 3 shown previously). Again, we first tested the model on the original Gopal & Sanders (1998) set of 13 countries. In this case, the dependent variable was the dollar value of piracy per computer user whilst the indicator variable was per capita GDP (this model did not include the control variables due to the small sample size). The reverse effect of income was in the hypothesised direction, although not statistically significant ($b = 6.14$, $p > .05$). Thus, H2 is not supported for the original sample of 13 countries. This lack of significance is most likely due to a selection bias towards affluent countries in the original Gopal & Sanders (1998) set. The average income of the 13-country sample of Gopal & Sanders (1998) was U.S. $29542.11, versus U.S. $15101.03 for the extended sample of 97 countries ($t = -5.1809$, $p =0.000$).

Step 4:

In this step we conduct our analyses by incorporating the proposed new measure (per computer user piracy) using the sample of 94 countries (users per computer data were not available for three countries). This analysis was conducted with all the stated control variables. Regression results with per capita GDP, as the indicator variable was statistically significant ($b = 11.16$, $p < 0.002$). Thus, we find significant support for the second hypothesis: more affluent countries have higher per computer user piracy than poorer countries. As predicted, these results contradict the findings reported in past archival studies that have used the rate of software piracy as the focal variable of interest.

2 The results for the controls were largely consistent with previous research (for IT infrastructure, $b = 2.33$, $p < .10$; Judicial System, $b = -1.2$, $p < .10$; Economic Equality, $b = 3.53$, $p < .01$; External Governance, $b = -1.35$, $p > .10$. The results for the latter do not replicate Rodríguez, (2006), but in that study the sample consisted of only European countries. When paring our sample to match the same, the b was -1.95, $p<0.10$, indicating partial replication.

Step 5:

Finally, we tested whether the inflection effect for software piracy holds for our new measure of software piracy per computer user. Gopal & Sanders (2000) have recently presented evidence that software piracy undergoes an inflection in countries with per capita income of around US $6000. The key finding was that at income below $6000, piracy showed a significant negative correlation. This result was again replicated by Shin et al. (2000). Essentially Gopal & Sanders (2000) and others postulate a moderator effect (Baron & Kenny, 1986) of relative affluence on the relationship between GDP and piracy. We assessed this moderator effect to examine whether this inflection would manifest itself at the point suggested in these prior studies.

It is important to note that the last available calculation of this inflection point was based on 1999 data (Shin et al., 2000). Thus, we adjusted the income level for inflation according to the International Labour Organisation (ILO) inflation index (average world inflation between 1999 and 2005 was 3.3% year-on-year). The proposed inflection point thus obtained was $6800. We subsequently divided the 94 countries into two groups, one below the new inflection point and the other above the inflection point, and performed a separate regression within each group. These results are summarised in table 2.

Table 2
Regression results at the inflection point

Class	Obs.	Mean*	Min ($)	Max ($)	Std. Dev. ($)	Piracy % (PPP)	Piracy/users (PPP)
< $6800	28	3661	900	6200	1589	–0.0086 (0.000)	0.4185 (0.264)
> $6800	66	19743	6800	43400	10559	–0.0053 (0.010)	6.8663 (0.016)

* Mean GDP per Capita ($)

Results were consistent with the pattern suggested by Gopal & Sanders (2000) for the piracy rate measure; the strength of the relation did indeed decrease from 0.0086 to 0.0053). However, the more interesting finding was that the inflection point also emerged for the new measure of piracy value. Below the inflection point, the regression coefficient changed with the new measure; from a statistically insignificant value ($b = 0.4185$, $p < .264$) to a value ($b = 6.8663$, $p < 0.016$) above inflection.

This finding indicates that whilst there is no distinct trend in terms of value of pirated software for countries with per capita income less than $6800, for counties with per capita income in excess of $6800, the value of pirated software increases as the income of the countries increases. Thus, overall economic well-being/income level moderates the relationship between per capita GDP and the value of pirated software. This provides an additional test of our premise that the type of software piracy (the rate or degree versus the price or value of the software) varies based upon the affluent status of the country, a point we subsequently discuss in more detail.

6. Summary of findings

Whilst piracy rates may be higher for poorer countries than for richer ones, this does not imply that computer users in poorer countries should be regarded as bigger software pirates compared to richer ones. In fact, the results for our study suggest the relationship reverses; that is, computer users in richer countries on average pirate more high value software than computer users in poorer countries.

We found a significant relationship between per capita GDP and overall piracy rate, as has been hypothesised previously. Consistent with Gopal & Sanders (1998) and other previous research, poorer countries do demonstrate a higher piracy rate when compared to richer ones. At the same time, we find significant support for our second hypothesis, which proposed that absolute piracy per user level (dollar value of pirated software per user) is higher for richer countries than for poorer countries. It is important to note that these differences cannot merely be dismissed as an artefact of differential pricing of software on the part of vendors, as research suggests that this differential pricing is indeed not country specific (Gopal & Sanders, 2000). How, then, do we reconcile these apparently contradictory findings? Is there a message that these results suggest?

Combining our two results, we get a very interesting overall picture: software users in poorer countries pirate a substantially higher percentage of their software than do users in richer countries, whilst the value of software pirated per person is higher in rich countries than in poor countries. Whilst we do not have specific individual-level data to support this proposition, we believe this might be grounded in the nature and degree of the utilitarian-based needs driving computer use. Users in poorer countries may pirate predominantly only the required software needed for their basic functional usage (e.g. word processing). In contrast, users in richer countries may pirate more expensive software that is designed to fulfil higher order needs. Among the latter could be entertainment-oriented software such as expensive games, or high-end versions of operating systems or work-oriented productivity improvement software. Although conjecture on our part, this provides a testable proposition and an interesting avenue for future research.

In light of this finding we also believe that it is useful to ask a critical philosophical question: do multiple small misdemeanours imply a more serious transgression of accepted social values than fewer, but more serious, violations of the law. That is, should a person who commits multiple small crimes necessarily be considered more "socially unacceptable" than a person who commits much larger, albeit fewer crimes? To give an example, would we say that a pickpocket, who steals people's wallets on a regular basis, is a more serious criminal than a white-collar worker who has embezzled a large amount of funds from a bank?

Whilst any straightforward answer to the above question is probably an oversimplification, not answering the question itself may also be a mistake through imposing a value judgment that labels software users in poorer countries as "bigger" pirates of software and consequently as "bigger" violators of intellectual property (a common conclusion in past archival software piracy research). Future research needs to re-examine this phenomenon more closely than has occurred to date. There perhaps has been a tendency to stereotype by concluding that the majority of piracy incidents occur in poorer nations (Gopal & Sanders, 1998; Shin et al., 2000). In one sense this is understandable, as our research confirms that when one considers piracy rates this conclusion is supported. However, this conclusion does not provide a complete picture of the piracy phenomenon, as our research has shown that software piracy is a far more complicated phenomenon than attributions based on piracy rates suggest.

A second implication of our findings is to underscore the importance of understanding more completely what domains our measures of key theoretical constructs empirically assess and to continually evaluate the validity of our operationalisations of important IS constructs. As this research demonstrates, continued assessment of the validity of the measures of our constructs is crucial to expanding the scope of knowledge of phenomena such as software piracy. Our knowledge of this phenomenon is crucially dependent on fully explicating the domain of software piracy as we have demonstrated in this study. As Torgerson (1958) (p. 2) suggests, 'The development of a theoretical science … would seem to be virtually impossible unless its variables can be measured adequately'.

7. Conclusion

In this paper, an alternative approach for measuring the extent and nature of software piracy was introduced by differentiating the rate of software piracy from the value of pirated software. Using the rational choice theory of crime as a theoretical foundation we assessed this alternative measure of piracy. Differential results demonstrated the consequences of considering the rate versus value of pirated software. Our goal was not to imply that one measure is always more appropriate than the other, but rather to show that the two measures tap different aspects of the domain of piracy. We also do not imply that previous research has been misguided in the way piracy has been addressed. Rather, our research strives to more fully explicate the domain and nature of software piracy and reveal meaningfully different aspects of this domain. We believe that applying these different perspectives to software piracy is important before making conclusions on "who pirates more and who pirates less of what."

Drawing conclusions regarding software users and their associated respect for intellectual property is a challenging endeavour that is worthy of future research that examines not only aggregate country-level differences, but also individual-level antecedents, motivations and consequences of piracy. Researchers attempting to more completely study and understand international software piracy should incorporate constructs in their model, which account for the differential value of pirated items. As we have demonstrated, this is an important consideration for software piracy in that the assumption of 'one size fits all' results in potentially misleading and imprecise theory.

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