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Trevor Moores
University of Nevada

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Trevor T. Moores
Department of Management Information Systems
University of Nevada, Las Vegas
Las Vegas, NV 89154-6034
USA
trevor.moores@ccmail.nevada.edu

Abstract

This paper examines the relationship between Hofstede's national culture indices (IDV, PSI, MAS, and UAI), economic wealth (GNI), and software piracy rates (SPR). Although a number of studies have already examined this relationship, the contribution of this paper is two-fold. First, we will examine not only the relationship to SPR, but also the relationship to declines in SPR. The average national SPR has been declining since 1994, although the global rate has leveled off since 1997 and has recently seen a slight increase. Second, we will use a 9-year dataset stretching from 1994 to 2002 to assess wealth and SPR. This allows for a more sensitive analysis of the relative wealth of a country and the underlying SPR. Using a sample of 45 countries, we find a significant negative relationship between GNI, IDV and SPR. We also find that decline in SPR is a function of culture (PDI), not wealth. Areas of further research are discussed.

Keywords: Software Piracy, National Culture, Economic Wealth.

1. Introduction

Software piracy continues to be a major problem for the software industry. The software piracy rate (SPR) is calculated as the number of illegal copies of software as a proportion of the total number of business applications in use. Although the global SPR has declined from 49% in 1994 to 39% in 2002, the rate seems to have stabilized since 1997, hovering between 36% and 40%, with estimated losses to the software industry averaging $11.9 billion a year (BSA, 2003).

While the global SPR has stabilized, the average national SPR has continued to decline, from 76% in 1994 to 55% in 2002. The difference between the global SPR and the average national SPR is that the global SPR treats the world as a single market, and so, the rate is sensitive to the SPR of the larger software markets, such as the US, China, Japan, and Germany. A decline of ten percentage points in the SPR of these four countries in 2002 would reduce the global SPR by 10 percentage points (from 39% to 29%), whereas the elimination of software piracy in countries such as Bahrain, Kenya, Reunion, and Zimbabwe would have no impact.

Countries with high SPRs include Vietnam (95%), China (92%), Indonesia (89%), Russia (89%), and the Ukraine (89%), while the US (23%), Denmark (24%), New Zealand (24%), and Finland (25%) have the lowest SPRs in the world. Countries responsible for the greatest financial losses include China (US$2.41Bn), the US (US$1.96Bn), Japan (US$1.47Bn), and Germany (US$0.93Bn).

Economic wealth and Hofstede's national culture dimensions (e.g., see Hofstede & Hofstede, 2005) are commonly used to explain these differences in national SPRs (Moores, 2003; Shin et al., 2004). Economic wealth contributes because most software vendors use the same pricing strategy across the globe, but what is affordable in the US may be too expensive for ordinary people in countries such as Vietnam, where per capita income is less than 10% of that in the US. Culture contributes because in societies that encourage close ties between members of the in-group over individuality and personal property, sharing is the norm and software piracy rates tend to be higher.

No study has taken into account the fact that national SPRs have been continuing to decline. This decline may be partly explained by an increase in the economic wealth of almost all countries, with Ireland (108.1%), China (104.5%), Vietnam (79.7%), and Poland (72.5%) showing prodigious increases in per capita income from 1994 to 2002. However, associated declines in SPR have not always followed suit, with Ireland (-43.2%) and Poland (-29.9%) showing strong reductions in software piracy, while China (-5.2%) and Vietnam (-5.0%) show very little.

In this study we relate economic wealth and Hofstede's national culture dimensions to SPR to confirm the expected result that wealth and culture play a role in promoting levels in software piracy. We will then calculate rates of change in SPR and determine whether wealth or culture can also be used to explain differences in the rate at which software piracy has declined. In the next sections we will develop a set of hypotheses to be tested and then define the measures used. We show that levels of software piracy are mainly economic, while decline in software piracy is a function of culture.

2. Theoretical Background

At the individual (micro) level, the cost of legal software has often been cited as a reason for engaging in software piracy (Cheng et al., 1997). The more expensive the software, the less likely someone would allow a copy to be made for someone else (Glass & Wood, 1996), while reduction in the price of legal software is associated with a lower intention to engage in software piracy (Moores & Dhillon, 2000). At the national (macro) level, the ability to purchase software becomes a function of per capita national income, with a strong negative relationship typically found between wealth and SPR, such that, as wealth increases SPR decreases (Gopal & Sanders, 2000). Our first hypothesis is:

> **H1:** There is a strong negative relationship between per capita national income and software piracy rates.

Hofstede's national culture dimensions indicate differences in work value perspectives between national cultures (Hofstede & Hofstede, 2005). The dimensions include the individualism-collectivism (IDV) and masculinity-femininity (MAS) poles, and the power distance (PDI), and uncertainty avoidance (UAI) indices.

In brief, IDV refers to the extent to which individuality is prized above group (collectivist) ideals, MAS refers to traditional masculine ideals of achievement, power, and control, PDI refers to the degree of acceptance of equality or inequality within society, while UAI refers to the need for rules and regulations to avoid ambiguity and uncertainty in social settings. While there are criticisms of the measures (McSweeney, 2002), they have been replicated and supported (Merritt, 2000; Sondergaard, 1994).

IDV is often the only cultural factor that is significantly related to SPR (Husted, 2000; Moores, 2003; Shin et al., 2004). In high IDV countries, such as the US, Australia, the UK, and The Netherlands, there is a greater perception of personal property, which may reduce the likelihood a person will give away copies of their software. Thus, we would expect IDV to be the only cultural dimension to be related with SPR, and in line with wealth, we would expect there to be a strong negative relationship with SPR, such that, as IDV increases SPR decreases. Our second hypothesis is:

H2: There is a strong negative relationship between individualism-collectivism and software piracy rates.

When considering declines in SPR, we can speculate that if economic wealth is a strong predictor of the level of software piracy, then countries that experience the greatest increase in economic wealth will also experience the greatest decline in software piracy. Although habit may lead some people to continue pirating software (Limayem et al., 2004), we would expect a strong positive relationship between wealth and declines in SPR, such that, as wealth increases the rate of decline in SPR also increases. Using the same argument, and given the expected strong relationship between wealth and IDV, we also expect a strong positive relationship between IDV and decline in SPR. Our third and fourth hypotheses are:

H3: There is a strong positive relationship between per capita national income and declines in software piracy rates.

H4: There is a strong positive relationship between individualism-collectivism and declines in software piracy rates.

The relationship between PDI, MAS, UAI and decline in SPR is more difficult to determine. No studies have found a significant relationship between these three culture variables and levels of SPR. If we assume that software piracy is a form of corruption, however, there is literature which has found significant relationships between Hofstede's culture variables and national corruption levels (e.g., Husted, 1999; Park, 2003; Ronkainen & Guerrero-Cusumano, 2001). National corruption is often measured using the Corruption Perceptions Index (CPI) developed by Transparency International (see http://www.transparency.org/). A composite score is generated for each country based on surveys of businesspeople and analysts from around the world.

The relationship between culture and corruption is that in cultures with high PDI there is an expectation and acceptance of unequal distributions of power, which also permits for the abuse of power. There is also the expectation that those in power will not tolerate 'whistle-blowing,' and will prevent or punish any such attempts. In this context, corruption and other types of illegal behavior can be rife. In cultures with high MAS, traditional masculine roles are encouraged, and individuals, especially males, are expected to be ambitious, competitive, and strive for material success. It is suggested that this "get ahead" mentality breeds corruption. In cultures with high UAI there is a need to reduce uncertainty, and corruption, often in the form of bribes, is one means of securing a certain result.

It seems reasonable to suggest, therefore, that when corruption is high there is little motivation to resist pirating software, and therefore, there will be lower declines in SPR. Corruption would allow the arcades that sell pirated software to exist, and for "tip-offs" to be given should there be a raid by the police. We would thus expect a strong negative relationship between PDI, MAS, and UAI and decline in SPR, such that, as PDI, MAS, and UAI increase so declines in SPR will decrease. Our final three hypotheses are:

H5: There is a strong negative relationship between power distance and declines in software piracy rates.

H6: There is a strong negative relationship between masculinity-femininity and declines in software piracy rates.

H7: There is a strong negative relationship between uncertainty avoidance and declines in software piracy rates.

3. Method

We can derive a dataset of 45 countries for which national culture, economic wealth, and SPR statistics are available. Measures of national culture are derived from Hofstede (e.g., Hofstede & Hofstede, 2005). Economic wealth is derived from the World Bank online database, and defined in terms of per capita gross national income (GNI), converted to international dollars using purchasing power parity (PPP) rates. Measures of SPR are derived from the 8th annual BSA global software piracy report (BSA, 2003). This report includes SPR statistics from 1994 to 2002. For 2003, BSA changed the methodology, and so the results of the latest survey cannot be directly compared to previous years.

Although most studies relate Hofstede's culture dimensions to one-year statistics on economic wealth and SPR, this single-year approach increases the possibility of capitalizing on chance, where data from a particular year may happen to show a better fit than for other years. In this study we will smooth the wealth and SPR data in order to be more sensitive to the underlying trend in wealth and SPR, rather than to the events of a particular year. We therefore define GNI and SPR as the average over the period 1994 to 2002.

We define two measures of decline in SPR. The simplest, δSPR, will be defined in terms of the relative difference in SPR from 1994 to 2002, expressed as:

$$\delta SPR = \frac{SPR_{2002} - SPR_{1994}}{SPR_{1994}}$$

The second measure, ΔSPR, will take into account fluctuations in SPR from year-to-year, and be defined in terms of the average change in SPR, expressed as:

$$\Delta SPR = \sum_{i=1994}^{2001} \left(\frac{SPR_{i+1} - SPR_i}{SPR_i} \right)$$

For countries with the same rate of decline in SPR year-on-year, δSPR and ΔSPR will have the same value. The empirical analysis will determine which measure is a better fit. To ensure meaningful signs for each of the parameters, δSPR and ΔSPR will be defined in absolute values, where a higher decline is denoted by a higher value of δSPR or ΔSPR. Thus, if a parameter increases the decline in SPR it will have a positive sign, whereas a parameter that reduces the decline will have a negative sign.

We will develop three regression models. The independent variables in each case will be the same, that is, GNI and the four culture dimensions IDV, PDI, MAS, and UAI. In the first model the dependent variable will be SPR. In the second and third models the dependent variable will be decline in SPR, defined in terms of δSPR or ΔSPR. We will use Cook's Distance, D, to determine the existence of any outliers.

4. Results

Summary statistics, including correlations between each of the variables, is given in Table 1. As expected, there is a strong ($p<0.01$) negative correlation between SPR, GNI, and IDV, as well as a strong positive correlation between GNI and IDV. Further significant correlations

Table 1. Summary Statistics (Mean, Standard Deviation, and Correlation with other Variables)

Var.	Mean	StdDev	2	3	4	5	6	7	8
1. SPR	57.36	17.52	-.386 (.009)	-.360 (.015)	-.856 (.000)	-.819 (.000)	.680 (.000)	-.096 (.573)	.365 (.014)
2. δSPR	30.51	11.86	-----	.993 (.000)	.263 (.081)	.295 (.049)	-.478 (.001)	-.193 (.205)	.086 (.573)
3. ΔSPR	35.29	16.53		-----	.237 (.118)	.286 (.057)	-.486 (.001)	-.237 (.117)	.053 (.731)
4. GNI	14.77	9.31			-----	.786 (.000)	-.687 (.000)	.008 (.957)	-.360 (.015)
5. IDV	44.40	26.42				-----	-.708 (.000)	.046 (.766)	-.413 (.013)
6. PDI	55.31	22.90					-----	.101 (.508)	.216 (.155)
7. MAS	49.16	19.16						-----	.035 (.819)
8. UAI	66.04	24.44							-----

Table 2. Regression Results, Whole Sample [n=45]

Var.	BETA	StdErr of BETA	B	StdErr of B	t(39)	p-level
(a) Dep.Var.= SPR (R^2=.7979; F[5,39]=30.7910, p<.0000)						
Intercept			81.0164	9.5203	8.5099	.0000
GNI	-.5311	.1229	-.9989	.2311	-4.3220	.0001
IDV	-.3271	.1312	-.2169	.0870	-2.4936	.0170
PDI	.0887	.1102	.0678	.0843	.8044	.4261
MAS	-.0866	.0737	-.0791	.0674	-1.1748	.2472
UAI	.0182	.0805	.0131	.0577	.2263	.8222
(b) Dep.Var.=δSPR (R^2=.2914; F[5,39]=3.2071, p<.0161)						
Intercept			41.6123	12.0690	3.4479	.0014
GNI	-.0719	.2301	-.0915	.2930	-.3124	.7564
IDV	.1030	.2456	.0462	.1102	.4194	.6772
PDI	-.4846	.2064	-.2511	.1069	-2.3484	.0240
MAS	-.1550	.1380	-.0960	.0854	-1.1238	.2680
UAI	.2123	.1507	.1030	.0731	1.4087	.1668
(c) Dep.Var.=ΔSPR (R^2=.3065; F[5,39]=3.4467, p<.0113)						
Intercept			58.4161	16.6343	3.5118	.0011
GNI	-.1464	.2276	-.2597	.4038	-.6431	.5239
IDV	.1012	.2430	.0633	.1520	.4166	.6793
PDI	-.5306	.2042	-.3830	.1474	-2.5991	.0131
MAS	-.1923	.1365	-.1658	.1177	-1.4087	.1668
UAI	.1619	.1491	.1095	.1001	1.0858	.2842

can also be seen between PDI and most of the other variables. There does not appear to be a problem of multicollinearity, however, with variance inflation factors (VIFs) ranging from 1.05 to 3.32, well below even the most conservative threshold of VIF<5.3 (Hair et al., 1998).

The results of the regression analysis are given in Table 2. When SPR is the dependent variable (see Table 2a), GNI and IDV are significant predictors. This provides support for H1 and H2. All cases are within 4 times the mean Cook's Distance (D=0.0218), suggesting there are no outliers.

When δSPR is the dependent variable (see Table 2b), PDI is the only significant variable. The alternative measure ΔSPR produces a marginally better fit, as shown by the slightly higher R^2 and F-statistic (see Table 2c). The result in both cases is the same, however, with PDI being the only significant variable, providing support for H5. None of the other hypotheses are supported. For both the δSPR and ΔSPR models there is one outlier, namely Japan, with a Cook's Distance more than 8 times the mean (D=0.2582, and 0.2391, respectively).

Because of the size of the software market, Japan is an influential data point and capable of changing the global SPR with changes to its own SPR. Japan is also an extreme example of a worrying trend in software piracy rates from 1994 to 2001. From 1994 to 1997 most countries made significant improvements to their SPR, leveling off between 1997 and 1999, and then increasing from 1999 to 2001.

For instance, Japan made prodigious inroads into software piracy from 1994 to 1997, more than halving the SPR from 66% to 32%. Other countries that also made great improvements over that time period include Italy (-38%) and Denmark (-33%). From 1999, however, Japan's SPR increased to a high of 37% in 2001. Germany (+26%), France (+18%), and India (+15%) also saw notable increases. Most countries, including Japan, then saw a slight decline in SPR in 2002. In the latest survey using the new methodology, Japan's SPR stands at 29% (BSA, 2004). Removing Japan from the dataset improves the R^2 for δSPR and ΔSPR (.3380, and .3576, respectively).

5. Discussion

The results of this study confirm the suggestion that rates of software piracy are a function of economic wealth. The significance of the IDV measure should be interpreted as a corollary to wealth, given the high correlation between the two measures (r=.786, p=.000), and the higher BETA for GNI. GNI on its own explains more than 73% of the variance in SPR and should be considered the prime motivating factor.

This would also suggest that even for countries with relatively high IDV, if wealth is relatively low software piracy will still be a problem. Ireland is an example of such a country, with a relatively high IDV score of 70, but which also, until recently, was one of the poorest countries in Western Europe. From 1994 to 2002, Ireland's SPR averaged 57%, compared to an average in Western Europe of 40%.

The issue of wealth (and hence, the cost of legal software) suggests there is a need to investigate the difference between the "haves" and the "have nots." Shin et al. (2004) suggest that the relationship between culture, economic wealth, and software piracy is different depending on whether a country is classified as rich or poor. For poorer countries (per capita GDP<$6,000), software piracy rates decline more than three times faster with each $1,000 increase in GDP than for richer countries. This result suggests that software piracy will remain a problem even for the richest countries. The results must be viewed with caution, however, because the sample size used by Shin et al. is small (n<25).

Dividing this sample into poorer countries with higher SPR, and richer countries with lower SPR, also produces differences. The regression models are not stable, however, with a series of outliers affecting the overall results of the regression analysis. In spite of these problems, an intriguing area of further research would be to investigate how reasons for engaging in software piracy change as countries become richer. As countries become richer, however, SPR still varies greatly and the role of other factors, such as culture, would seem to become more important.

In particular, when assessing declines in software piracy the issue appears to be a function of culture, not economic wealth. The significant negative relationship between PDI and δSPR and ΔSPR suggest that in cultures where power distance is high, such as Malaysia, Indonesia, and India, declines in software are half the sample average. This result is consistent with studies that relate Hofstede's national culture dimensions to levels of corruption. PDI tends to be the most significant cultural factor (e.g., see Husted, 1999; Park, 2003). This suggests that the natural decline in SPR that would be expected due to increasing GNI for almost all countries is significantly reduced by factors related to national corruption levels.

6. Conclusions

The results of this study confirm the suggestion that overall levels of software piracy are strongly connected to the economic wealth of a country, while the potential for corruption inherent in countries with high PDI slows the natural decline in SPR. This suggests that little can be done to reduce software piracy in economically-disadvantaged countries. Although varying the price according to the wealth of the country may help to remove the excuse behind digital theft, it would be difficult to prevent the (now-legal) trade in cheap software across borders for nothing more than the price of a postage stamp, and effectively rewards countries for failing to protect intellectual property rights.

Similarly, if the rate of decline is a function of PDI, and PDI is an immutable component of national culture, there would appear to be little hope of challenging the worst offending countries. It is unclear what would be needed to bring about a fundamental shift in the PDI of a whole country. On the other hand, there is evidence that culture is not immutable. The close association between wealth and most of the culture variables, including PDI, may suggest that cultural changes are already ongoing. We would expect, for instance, differences as countries become richer. The sample of countries for which Hofstede national culture scores exist is simply too small to perform more sophisticated comparisons. Values are also missing for important countries responsible for significant levels of software piracy, such as China, Russia, and Vietnam.

These and other problems may be overcome by extending this research with a micro-level (individual) analysis. By asking individuals about their perception of software piracy we would be able to confirm whether the culture variables still apply, and whether levels of corruption suggested by PDI is the main reason for continuing to engage in software piracy. At the individual level we may find a number of other factors that lead someone to engage in, or refrain from, pirating software. After all, even in the most corrupt of countries, not everyone will engage in software piracy.

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