8-16-1996

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INTRODUCTION

Software piracy is costing today's software-makers billions of dollars annually (BSA, 1994; Greenberger, 1996). Consequently, there has been an increased focus on piracy by industry groups such as the Business Software Alliance. Part of that focus has included an effort to stiffen penalties for piracy and to increase the probability of being caught. This study utilized the reference discipline of Expected Utility Theory (EUT) to study the effects of software cost, financial punishment level, and punishment probability on the computer-user's decision to copy software illegally in an organizational setting. Three hypotheses were developed and tested using an experiment. The results indicate that all three factors are related to the individual's piracy behavior.

EXPECTED UTILITY THEORY

Economic issues such as costs and benefits are commonly claimed to be factors in a person's decision-making process. While different variants of the EUT model exist, the underlying idea is that the individual will choose the course of action that maximizes the expected utility for that individual (Schoemaker, 1982).

Computer-using professionals have three possible courses of action when faced with a situation in which software can be used: purchase any software they may wish to use, do not purchase the relevant software and do without, or commit software piracy (i.e. illegally copy the software). Software is used as a substitute for effort. This work only studies the case where the benefit gained from using the software outweighs the software cost. Therefore, the rational, self-interested employee will always be expected to either pirate or purchase the software.

EUT posits that costs and benefits will play major roles in the individual's decision-making process. In this specific case, the cost of the software is a significant factor. Also, a benefit is gained when the software is utilized (i.e. increased output). The utility to the individual is the benefit gained from the use of the software minus the cost of the software. When the software is pirated, the software cost is not incurred. However, there is a probability of punishment. If punishment is incurred, the level of punishment will become a cost to the individual. EUT posits that the rational individual will pirate the software when the expected utility of pirating the software (expected benefits gained from the software usage minus the expected costs of pirating) outweighs the expected utility of purchasing the software (expected benefits gained from the software minus the expected cost of purchasing).

HYPOTHESES

As the *punishment level* increases, the expected cost of pirating will increase, making the piracy option less likely to be chosen.

H1: There exists an inverse relationship between the punishment level for committing software piracy and the computer-user's piracy behavior.

The second hypothesis is similar to the first. As the *punishment probability* increases, the more likely it is that a punishment will be incurred if the computer-user pirates the software. This increases the cost of piracy. Therefore, the less likely it is that the computer-user will choose to pirate.

H2: There exists an inverse relationship between the punishment probability for committing software piracy and the computer-user's piracy behavior.

A third hypothesis involves the cost of the software. By pirating, the computer-user saves the cost of acquiring the software (the *software cost*). Therefore, as the cost of the software increases, the more money the computer-user will save by pirating and the more likely it is that the computer-user will pirate the software.

H3: There exists a positive relationship between the software cost and the computer-user's piracy behavior.

METHODOLOGY

A modified lab market was utilized in the experiment. Subjects were randomly assigned to sessions from a sample of part-time graduate students at three universities in a U.S. metropolitan area. Almost all of these individuals held full-time jobs that involved the use of computers. In each session, six subjects were asked to role-play as computer-using professionals in organizations that produced "widgets." The sessions were divided up into 20 time periods. In each time period, the subject's organization produced one widget that was to be sold on the open market. The subjects were allowed to set the price for their widgets at any level they desired. However, only the five lowest priced widgets were sold. The organization unable to sell its widget in that time period lost the widget and the cost of producing it. The five organizations that sold their widgets had the income (the sale price) added to their running balance. In effect, a quasi-widget market was produced in which the experimental controller purchased widgets produced by the subjects. To reduce timing strategies, the subjects were not made aware of the actual length of the session.

To produce the widget, the subjects were given the option to purchase software in that time period, to not use any software, or to pirate the software. Purchasing the software involved a cost (the software cost). Pirating the software involved no cost, but did involve the probability of detection and the leveling of a financial fine if the piracy was caught. The subjects were made aware of both the punishment probability and the punishment level if caught. In all cases involving the software, there was a benefit gained from the use of the software: the cost for producing the widget was reduced due to the increased productivity gained from the software usage.

A running balance was kept for each subject. In each time period, the subject was charged a set amount for producing the widget. If the subject sold the widget, that income was added to his or her balance. If the subject purchased the software, the production costs were reduced by a set amount and the subject was charged for the software. The software cost was always less than the benefit gained. If the subject pirated the software, there was no software cost incurred, but the benefit from software usage reduced the cost of producing the widget.

At the end of the time period, a random number generator was used to determine if any subjects were audited by the authorities. If a subject was audited and had pirated the software, a financial fine was incurred and subtracted from the subject's running balance. At the end of the session, the subject with the highest total was financially rewarded, as were those subjects who finished with a profit.

By manipulating the variables (*software cost*, *punishment probability*, and *punishment level*) and monitoring the decision to pirate or not pirate, it was possible to test the hypotheses outlined above. Each variable was tested at two levels, making it necessary to run eight (2x2x2) experimental sessions to ensure that all combinations were tested. The values utilized in the experiment are shown in Table 1. These values were carefully chosen to ensure that perfectly rational behavior would predict that software piracy would occur in four of the scenarios and purchasing would occur in the other four.

The experiment was run in a computer lab using software written by the first author. Each subject sat at his or her own terminal. Using the designed interface, the subjects entered their choices (i.e. purchase software, pirate software, set widget price, etc.). The software recorded the subjects' choices in each session. A central computer was used to display the running balance for each subject, visible to all subjects on a projection screen. The software also randomly selected subjects for audit in each time period (using the prespecified punishment probability for the session) and assessed fines automatically when pirates were caught. Audit and punishment data were displayed on the selected subjects' terminals when appropriate.

Table 1: Variable Settings in the Experiment

Variable	Settings
Cost to produce one widget	$100
Benefit gained from software	$40
Software Cost	$10, $30
Punishment Probability	5%, 50%
Punishment Level	$50, $250

Table 2: Number of Decisions to Pirate in Each Session

Software Cost = $10

Punishment Level

Probability	$50	$250
.05	38 (31.7%)	26 (21.7%)
.50	39 (32.5%)	13 (10.8%)

Software Cost = $30

Punishment Level

Probability	$50	$250
.05	77 (64.2%)	39 (32.5%)
.50	58 (48.3%)	8 (6.7%)

RESULTS

In each session, 120 decisions to pirate or not pirate were made (20 decisions each by 6 subjects). Table 2 details how many decisions to pirate were made in each session. As this decision was dichotomous, it was possible to test the hypotheses using Chi-square analysis. For each hypothesis, significant results were found. In the sessions where the *software cost* was high ($30), there were many more decisions to pirate than in the sessions where *software cost* was low ($10) (Chi-square: 20.56, $p<.0005$). In the sessions where the *punishment probability* was high (50%), there were significantly fewer decisions to pirate than in the sessions where the *punishment probability* was low (5%) (Chi-square: 18.107, $p<.0005$). In the sessions where the *punishment level* was high ($500), there were significantly fewer decisions to pirate than in the sessions with the lower *punishment level* ($50) (Chi-square: 76.036, $p<.0005$).

DISCUSSION

The results indicate that the software industry's attempts to increase the chances of being punished for software piracy are well-founded. By increasing the probability of punishment, it may be possible to decrease the incidence of software piracy. The much publicized Software Publishers Association piracy hotline is one attempt to increase this probability. Similarly, the use of legal action to inflict punishment is shown to be a valid tool in combating piracy. It is important to note that these efforts will only be

successful if computer-users are made aware of these higher levels and actually perceive the probability of punishment and punishment level to be significantly higher than at present.

On an organizational level, the research indicates that a liberal purchasing policy may be a good deterrent of piracy among employees. If an employee has a software package legally and cheaply available to him or her, he or she may be less likely to pirate the software. This strategy has been recommended in the practitioner literature (e.g. Athey, 1989) and may be inexpensive when compared to the possible punishments associated with piracy behavior. The organization may also be able to use internal audits and punishment to minimize piracy behavior among employees.

CONCLUSION

This abstract describes a study of the effects of software cost, punishment probability and punishment level on the individual's decision to pirate software. The results indicate that each of these items is a determining factor in the piracy decision. This supports the software industry's attempts to decrease piracy through increased auditing and detection and may provide useful guidance to organizations attempting to reduce internal piracy.

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