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Yehning Chen  
National Taiwan University

I. Png  
Republic of Singapore

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SOFTWARE PRICING AND COPYRIGHT ENFORCEMENT: PRIVATE PROFIT VIS-A-VIS SOCIAL WELFARE1

Yehning Chen
Department of Finance
National Taiwan University
Republic of China

I. P. L. Png
School of Computing
National University of Singapore
Republic of Singapore

Abstract

The incentive to copy software depends on the publisher’s price and monitoring strategy. This paper analyzes how a publisher’s strategy depends on the penalty for copyright violation. It shows that changes in price and monitoring have qualitatively different effects on potential users. Both affect users’ choice between copying and buying. Only monitoring reduces the expected benefit of those who copy and affects users’ choice between copying and not using. Hence, society should favor dealing with piracy through price rather than monitoring.

Keywords: Intellectual property, pricing, enforcement

1. INTRODUCTION

The Business Software Alliance, an international association of major business software publishers, estimates that software publishers’ worldwide loss to piracy was $11.4 billion in 1998.2 Software publishers, however, must bear partial responsibility for illegal copying. Then can easily reduce copying by cutting their prices.3 Software publishers can also invest in enforcement against potential copiers. For instance, between 1988 and 1994, the Business Software Alliance filed almost 600 law suits worldwide against suspected copyright infringers.4

Accordingly, it is interesting and important to understand the trade-off for publishers between pricing and enforcement. We develop a model where, given the penalty set by the government for copyright violation, a monopoly publisher sets a price and

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3A sample of 340 business students surveyed by Cheng, Sims and Teegen (1997) rated “Software too expensive” as the most important reason for copying software.

monitoring rate. Every potential user of the software makes a choice among buying the legitimate product, copying the item and risking enforcement action, and not using the software.

We show that changes in pricing and the monitoring rate have qualitatively different effects on potential users. Specifically, an increase in monitoring will reduce the net expected benefit of those who copy by increasing the probability that they will be detected, deprived of the software, and subject to a penalty. Hence, it affects people at two margins: persuading some to switch from copying to buying and others to switch from copying to not using. By contrast, a price reduction will raise the net benefit of those who buy, and hence persuade some potential users to switch from copying to buying.

These differences have an important implication for social welfare. We consider software that has already been created, hence welfare increases with the extent of usage (whether of the legitimate product or a copy). Under these conditions, society prefers the publisher to increase sales by reducing price rather than increasing monitoring. The reason is that the price reduction merely persuades some to switch from copying to buying, so increasing overall usage. By contrast, an increase in monitoring will reduce overall usage, and thus reduce welfare.

2. MODEL

We consider the market for a piece of software that has already been produced. The single profit-maximizing publisher sets a price, \( p \), for the legitimate product. It is aware that potential users may copy the software, and it may monitor and bring enforcement action against those who make copies. Let the rate of monitoring be \( \mu \). The cost of monitoring is \( C_M(\mu) \), with positive and increasing marginal cost, \( C_M'(\mu) > 0 \) and \( C_M''(\mu) > 0 \). For simplicity, we assume that the cost of producing the software is zero.

There is a distribution \( \Phi(v) \) of potential users, who differ in their value, \( v \), for the software. They are all risk neutral. Each one chooses among buying the legitimate product, or copying the software and risking enforcement action, or not using the item.\(^5\) (For brevity, we will omit the adjective “illegal” and refer simply to “copies” and “copying.”)

Let us analyze each of these alternatives in detail. If a potential user with value \( v \) buys the legitimate product, she will receive a net benefit of

\[ v - p \]

If she copies the item, she must incur a cost \( k \) and will be detected with probability \( \mu \). In case of detection, she will not enjoy the software but must pay a penalty, \( f \), specified by law. If she is not detected, she pays nothing more. Hence, her net expected benefit from copying is

\[ (1 - \mu)v - \mu f - k. \]

Finally, if she does not use the software, her net benefit is simply 0.

3. USER BEHAVIOR AND PUBLISHER’S STRATEGY

A potential user will buy the legitimate product under the following two conditions. First, buying must provide more net benefit than copying, \( v - p \geq (1 - \mu)v - \mu f - k \), or \( v \geq v_2 \), where

\[ v_2 = \frac{p - k}{\mu} - f. \]

Second, buying must provide more net benefit than not using, \( v - p \geq 0 \), or \( v \geq p \).

\(^5\)We assume that all potential customers are end-users and ignore demand from intermediaries such as libraries. Liebowitz (1982, 1985) and Varian (1999) emphasize that the willingness of such intermediaries to pay for software depends on their (derived) supply of copying.
A potential user will copy the software under the following two conditions. First, copying must provide more net benefit than buying, \((1 - \mu) v \geq \mu f + k > v - p\), or \(v < v_2\). Second, copying must provide more net benefit than not using, \((1 - \mu) v - \mu f - k > 0\), or \(v \geq v_1\), where

\[ v_i = \frac{uf + k}{1 - \mu} \]

We will now derive an important property of the publisher's profit-maximizing strategy.

**Lemma.** A necessary condition for some users to engage in coping is that \(v_1 < v_2\), or

\[ p > \frac{uf + k}{1 - \mu} \]

The publisher will maximize profit by setting the price and monitoring rate so that (i) \(v_1 \leq v_2\), and (ii) \(p \leq k\).

By the Lemma, the profit-maximizing strategy will be such that either \(v_i = v_2\), or \(v_i < v_2\). In the case of \(v_i = v_2\), there is no copying. The case of \(v_i < v_2\) is more interesting as there are two margins of choice among potential users. At the lower margin, \(v_i\), a potential user is indifferent between copying and not using. Her value for the software obviously affects her decision to copy rather than not use: a person with a relatively low value would gain less by making a copy. The other margin is \(v_2\), where a user is indifferent between buying the legitimate product and making a copy. Her value for the software affects her decision to copy rather than buy because, in the event of detection, she cannot enjoy the item: a person with a relatively high value will lose more from this possibility.

Accordingly, in the case of \(v_i < v_2\), there is copying and potential users divide into three groups. Those with sufficiently high values, \(v \geq v_2\), buy the software, while those with intermediate values, \(v \in (v_i, v_2)\), copy it, and those with low values, \(v < v_i\), do not use it.

Hence, the demand for the legitimate product is

\[ \int_{v_2}^{\infty} d\Phi(v) = 1 - \Phi(v_2) \]

and the publisher’s revenue is \(p[1 - \Phi(v_2)]\). By assumption, production of the software involves zero fixed and marginal costs, hence the publisher incurs costs only for monitoring. Therefore, the publisher’s profit is

\[ \Pi = p[1 - \Phi(v_2)] - C_d(\mu) \]

By assuming that the distribution, \(\Phi(v)\), of the potential users’ benefits exhibits a sufficiently increasing hazard rate, we can prove the following result:

**Proposition.** An increase in the penalty for copying will lead the publisher to increase both the price and the monitoring rate.

### 4. WELFARE

From the publisher’s standpoint, the price and monitoring are substitute instruments. The publisher can stimulate sales either by cutting price or increasing monitoring. We now show, however, that price and monitoring have quite different effects on welfare, hence are not substitutes from the social viewpoint. The essential reason for this disparity is that the publisher is concerned only with the benefits to users who buy the legitimate product, whereas society will be concerned with the benefits to buyers as well as the benefits to those who make copies.

From section 2, the expected benefit to each user who makes a copy is
An increase in monitoring will reduce this expected benefit. Further, this reduction will cause users at the lower margin, \( v_1 \), to switch from copying to not using. At this margin, \((1 - \mu) v_1 > k\), hence the switch also implies a reduction in welfare. The reduction in benefits among those who copy and among those who switch to not using, however, does not accrue to the publisher. These changes cause a loss to society with no countervailing gain to the publisher.

Also, from section 2, the expected benefit of each user who buys the legitimate product is \( v - p \).

The increase in monitoring will not affect this expected benefit. Since it reduces the expected benefit from copying, it will cause some users to switch from copying to buying the legitimate item, so reducing the upper margin, \( v_2 \). This switch will increase welfare by increasing the user’s (expected) benefit and leading them to avoid the cost incurred in copying. The switch also benefits the publisher by raising the demand for the legitimate product.

By contrast, a price cut does not affect the expected benefit, \((1 - \mu) v - \mu f - k\), of a user who copies, while it will raise the expected benefit, \( v - p \), a user who buys the legitimate product. Accordingly, the price reduction will induce some users to switch from copying to buying, without reducing the expected benefit of the relatively low-value users who continue to make copies.

We assume that social welfare is the sum of the expected benefits of the users who make copies and those who buy the legitimate product less the cost of monitoring. Since an increase in monitoring reduces the expected benefits of those who make copies while a price cut does not, we conclude that pricing is a more socially responsible way for the publisher to manage copying.

Realistically, however, the government cannot directly control the publisher’s choice of price and monitoring. The government’s only instrument is the penalty for copyright violation, \( f \). The penalty has a direct effect on a potential user’s expected benefit from copying. The penalty also has indirect effects by influencing the publisher’s choice of price and monitoring.

Considering only the direct effects, an increase in the penalty would reduce potential users’ expected benefit from copying, and hence persuade some (at the margin \( v_j \)) to switch from copying to not using, which reduces welfare, while persuading others (at the margin \( v_j \)) to switch from copying to buying, which raises welfare by increasing the expected benefit and reducing costs incurred in copying. The penalty has no direct effect on welfare among people in the interior \((v, v_j)\).

The indirect effects of an increase in the penalty are negative. By the Proposition, an increase in the penalty would lead the publisher to raise its price. This would lead some users to switch from buying to copying, and hence reduce welfare. Also, by the Proposition, the increase in the penalty will cause the publisher to increase monitoring. This would reduce the expected benefit of those who copy and, on balance, further reduce welfare. Since the indirect effects on welfare are negative, the government should shade the penalty below the level indicated by purely considering the direct effect.

5. CONCLUSION

Our main conclusion is that while a publisher may view pricing and monitoring as substitutes, the two variables have quite different welfare implications. By reducing the expected benefit among those who continue to copy, an increase in monitoring imposes greater social losses than a price reduction. Accordingly, society should encourage publishers to use less enforcement and focus on cutting prices as the preferred way to manage software piracy.

We have assumed that the publisher sets the same price to all potential users. As Takeyama (1994) observes, copying is a way by which a publisher can effect price discrimination. Alternatively, the publisher could target a lower price at the individuals who are more likely to make copies, that is, those who receive relatively low benefit (Liebowitz 1982, 1985; Shapiro 1988). To the extent that the publisher can effect price discrimination, the publisher’s private incentive and the social welfare objective will be more closely aligned.
6. REFERENCES


