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Selective Enforcement of Copyright as an Optimal Monopolistic Behavior*

Danny Ben-Shahar and Assaf Jacob

Abstract

We present a perfect Nash equilibrium in which the creator of a work, motivated by economic considerations, selectively enforces her own copyright. In fact, the creator may not only permit, but may strategically promote infringement of the copyright, thereby participating indirectly in predatory pricing, and so raising barriers to entry. Our model is highly applicable to the software industry, where relatively high entry costs and the relatively low cost of copyright infringement make this phenomenon likely. We further show the conditions under which exogenous intervention, through intensive enforcement of copyrights, increases social welfare. Finally, we explore some potential strategies for such legal intervention.

KEYWORDS: Antitrust, Copyright, Predatory Pricing, Monopoly, Microsoft, Nash Equilibrium, Price Discrimination

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**The Radziner School of Law, The Interdisciplinary Center Herzliya; P.O. Box 167, Herzliya 46150, Israel; telephone: +972-9-952-7280, fax: +972-9-956-8605, email: ajacov@idc.ac.il #We thank Omri Ben-Shahar, Alon Harel, Ariel Porat, Yoram Shachar, Gerald Willmann, the editor (Aaron Edlin), and two anonymous referees as well as the participants of the Antitrust Economics and Law Session at the American Law and Economics Association Annual Meeting, Georgetown 2001, the Fourth Kiel Workshop on Microeconomics of the New Economy, Germany 2001, the Economics of Copyright Piracy session at the American Economic Association Annual Meeting, Atlanta 2002, and law school seminars at the Hebrew University and the Interdisciplinary Center Herzliya for constructive comments. The authors are responsible for any remaining errors.

1. Introduction

The traditional economic analysis of intellectual property rights, and of copyright in particular, relies on the *ex ante* and *ex post* perspectives discussed, for example, by Landes and Posner (1989).¹

From an efficiency aspect, it is argued that social welfare will rise if, *ex post*, a creative work may be copied without limitations. According to this argument, use of the product benefits many, while the cost of making additional copies is insignificant. What is more, new products often build upon their predecessors. For this reason, free distribution is likely not only to encourage direct use of the work, but also to serve as a basis for new works and ideas, thus maximizing future social welfare.

On the other hand, from an *ex ante* point of view, creators who are not assured the protection of future copyrights may lack the incentive to create new works. This is particularly so when the cost of creating an original work is considerably higher than that of making each additional copy.^{2,3}

One straightforward implication of the *ex ante* view, often emphasized by researchers, is the importance of making available legal remedies for copyright violations. Allowing the creator to fully recover profits lost due to infringement protects the creator's premium and maintains the incentive to create. The State's role, according to this view, is to provide a clear registry of right. Copyright holders, for their part, have a strong incentive to take action privately against any detected infringement. This paper challenges this standard view.

Specifically, we show that there exist circumstances in which creators maximize their profit under the threat of competition by selectively enforcing copyrights. While shrinking short-term profits, this strategy generates a long-term benefit in the form of reduced competition. The underlying strategy is to deter potential competitors from entering the market by lowering prices, even at the cost of immediate profit loss. Because antitrust laws are sensitive to predatory pricing and unlawful monopolization,⁴ lowering prices directly is not an option. But the incumbent may achieve the same result by strategically failing to enforce copyrights.

In markets where copyright violation is widespread, this policy may enable incumbents to "legally" maintain their monopolistic position. An example

¹ Also see Nordhaus (1969), Besen *et al.* (1992), Hadfield (1992), and Nethanel (1996).

² This is, for instance, true in the software industry, which is the primary example for our model, where the cost of creating software is generally huge, while the cost of copying it is negligible.

³ For other motivations that substantiate copyright laws, see, among others, Goldstein (1996), Abrams (1983), Brown (1985), Yen (1990), Fisher (1988), Kaplan (1967), Ladd (1983), and Patterson and Lindberg (1991).

⁴ See Section 2 of the Sherman Act, 15 U.S.C.A. § 2.

for this alleged phenomenon comes from the software industry.⁵ Figure A1 in the appendix shows an advertisement for Hewlett-Packard CD-Writers published in local Israeli newspapers. As it turns out, the campaign was shared by Microsoft Corp.⁶ The advertisement shows a large photo of an original box that contains Microsoft Office2000 and, next to it, a pirated copy of the software with the statement: “Warning! Copying software, games, or music protected by copyright is strictly forbidden and constitutes a serious criminal offense. Violators are subject to a maximum of 3 years imprisonment and a fine of NIS 1,000,000 (equivalent to approximately \$220,000).” Beneath the photos, the ad continues in highlighted letters: “Nonetheless, if you do have something to copy, let us offer you the best CD-Writers in the world—Hewlett-Packard.” Undoubtedly, the involvement of Microsoft Corp. in producing this advertisement casts suspicion that Microsoft Corp. is, in effect, engaged in promoting the violation of its own copyrights in some segments of the market.⁷

The Netscape case provides another example of alleged selective copyright enforcement.⁸ For some time, Netscape distributed its software free of charge (while dominating more than 80% of the browser market). Then, at some point, Netscape divided the market into commercial and non-commercial segments, and while maintaining its free-distribution policy for non-commercial customers, it began charging commercial users 40 to 100 dollars for its software. Although there is no clear evidence of a direct selective enforcement strategy in Netscape’s behavior, Netscape policy could be interpreted as designed to crowd rivals out of the browser market. That is, by giving up some profits that could have been produced under competition in the non-commercial market, Netscape maintained its monopolistic control of the commercial market.⁹

The basic intuition runs as follows: consider a market that consists of a single firm with a unique product. Potential competitors threaten to develop a substitute product and enter the market. We claim that equilibrium is sustained when the monopoly intentionally splits the market into, say, two sub-markets with

⁵ In general, the promotion of copyright violation within the software industry might be carried out in various ways, both actively (by not using the enforcement mechanisms available to the firm) and passively (by not using protective measures and anti-copying devices).

⁶ See further discussion on this matter in Kaspi (2000)

⁷ This suspicion is corroborated by the fact that BSA, which is the main civil enforcement authority of Microsoft Corp. in Israel, tends to overlook non-commercial users in its advertisements in the local media and mainly focuses on commercial users. Also, Kaspi (2000) points out that Microsoft’s compliance with presenting the software “Office2000” in an advertisement for Hewlett-Packard CD-writers is arguably designed to implicitly encourage readers to copy its software.

⁸ For further discussion of the Netscape case, see, for example, Karpinski (1995).

⁹ In spite of Netscape’s evidential failure, its strategy, *ex ante*, may have indeed been rational. To Netscape’s misfortune, however, its rival was Microsoft Corp., which was later indicted for an antitrust violation for distributing its browser gratuitously in all sub-markets.

unambiguous boundaries.¹⁰ In one sub-market, the monopoly enforces its copyright and thereby preserves its monopolistic power. In the other, copyright is not enforced and the price, in effect, drops to zero.

For a new firm to enter the market, it must generate a profit at least sufficient to justify the initial fixed entry cost.¹¹ By splitting the market so that in one segment the product is, in effect, marketed at a price of zero, the monopoly considerably reduces the prospective competitor's potential profit. If accurately executed, this strategy eliminates any incentive for prospective competitors to enter the market: one sub-market will produce no profits, while limiting sales to the other sub-market—and competing there with the existing monopoly—may not compensate the competitors for the high fixed entry cost.¹²

This selective copyright enforcement strategy may considerably reduce social welfare. The described equilibrium relies on the fact that potential profits are insufficient to compensate rivals for the fixed cost of entering the market. If those profits, combined with the consumer surplus net of the monopoly's reduction in profits, exceed the fixed entry cost, then an exogenous intervention by enforcing copyrights may become socially beneficial. We identify conditions under which such intervention may increase social welfare. Finally, we discuss possible procedures within the legal system that might enhance competition by eliminating strategic selective enforcement of copyrights and increasing efficiency. These can be adopted by both private and public entities.

We should note that in addition to the analysis of Landes and Posner (1989), several studies in the copyright law literature examine the incentives for the creator and their effect on social welfare. Liebowitz (1985), for example, identifies market conditions in which some level of copyright infringement leads to increased social welfare. Besen and Kirby (1989) argue that in some cases, where it is less costly to distribute a copy by sharing than by producing an additional original unit, copyright holders might rationally seek a certain level of

¹⁰ For example, in the context of the software industry, it is likely that the two sub-markets are the commercial and private segments (which are possibly differentiated by the elasticity of the demand functions). One may also think, for example, of two geographical sub-markets in the international context.

¹¹ We ignore here the possibilities of imitation and licensing between competitors. As examined, for example, by Katz and Shapiro (1987), imitation and licensing may alter the leader's strategy with respect to innovation. Ignoring these possibilities, however, allows us to focus on the main idea raised in our analysis, namely, the potential indirect manipulation of prices by means of selective enforcement of copyright.

¹² Another strategy that the monopoly may adopt is to interchangeably allow copyright violation in the market in one period and enforce copyright in the next period. This policy, however, may not only be technically difficult to implement (that is, selling a product in a market where it has previously become a norm to copy), but it may not support a perfect Nash equilibrium under a finite time horizon. For more on this strategy, see, for instance, Kreps (1990:468). See also the discussion following Proposition 1.

infringement. The underlying intuition is that while sharing via copying reduces the number of original sales, it also enhances consumers' willingness to pay because they can share and trade the goods with others. Bakos *et al.* (1999) identify the "aggregation effect" associated with profitable copyright violation. They show that in some cases a group valuation of a product might have a probability distribution with lower variance than that of an individual member of the group, which allows the producer to extract more from the consumer surplus.¹³

In the following section we briefly discuss legal considerations of predatory pricing and outline our approach in this context. In Section 3 we construct the model. In Section 4 we derive a perfect Nash equilibrium in which a leading firm adopts a selective enforcement strategy to maximize profits under the threat of a possible rival entering the market. We further demonstrate, in Section 5, the possible increase in social welfare that may follow an exogenous intervention in the monopoly's selective copyright-enforcement strategy. In Section 6 we discuss possible legal implementation of an exogenous intervention. We summarize in Section 7.

2. Predatory Pricing

Antitrust regulations might prevent a monopoly from simply setting a predatory price. Exposure to a criminal suit, however, depends on the authorities' enforcement policy and the interpretation of predatory pricing by the courts. This interpretation is particularly important in cases dealing with intellectual property, where costs are incurred mainly at the research and development phase, while subsequent marginal costs are especially low. In such cases, it may be argued that no price is predatory because one cannot sell below a zero cost.¹⁴

Moreover, in the traditional view of predatory pricing, the predator is likely to face difficulties maintaining its predation policy over extended periods. This is because it is compelled not only to sell at a lower price, but also to produce more units to match the greater demand that follows the price cut.¹⁵

Nevertheless, as argued by Posner (2000, page 3): "Intellectual property is characterized by heavy fixed costs relative to marginal costs...dramatically so in the case of software, where it is only a slight overstatement to speak of marginal cost as zero." Furthermore, deterring entry by means of predatory pricing is not always an irrational strategy. In the new technology it is "plausible that the profit

¹³ For further economic analysis of copyright law see, for example, Benjamin and Kormendi (1974), Ordover and Willig (1978), Novos and Waldman (1984), Johnson (1985), Besen (1986), Nascimento and VanHonacker (1988), Conner and Rumelt (1991), Takeyama (1994), Lunney (1996), Gopal and Sanders (1997), Liu (2001) and Hui and Png (2003).

¹⁴ For further discussion of such cases, see, for example, Watson (1998).

¹⁵ See, for example, McGee (1958) and Edlin (2002).

from extending the monopoly another year or two will exceed the cost of the exclusionary practices required to achieve the extension” [Posner (2000, page 7)].

The Supreme Court of the United States argues that a threshold to a predatory pricing claim is the cost.¹⁶ However, as construed by many legal scholars,¹⁷ the Supreme Court limits predation claims to those cases where prices are below average total cost (that is, not necessarily below marginal cost). The Court does not embrace a particular cost test such as the Areeda-Turner average variable cost rule. Moreover, since the Brooke decision and due to dynamic developments in the economic environment, courts and lawmakers have sought to re-evaluate and expand the traditional view of predatory pricing. Their basic argument is that, frequently, a price higher than short-run marginal cost is predatory because it can be aimed at both excluding an equally efficient rival and allowing the predator to engage in prolonged periods of monopolistic pricing.¹⁸

Furthermore, Edlin (2002) argues that, in effect, there is no compelling reason to restrict predation cases to below-cost pricing because above-cost pricing can also limit competition and thus harm consumers.¹⁹

Legislators and courts worldwide have further expanded the predatory pricing framework. For example, under the legal systems of Canada, England, and the EEC, arguing for a predatory pricing strategy is possible if prices are below average total cost.²⁰ As noted by Elhauge (2003), cases also tend to suggest that European doctrine may be interpreted such that any price cut made by the monopoly in response to a rival’s entry is illegal, whether the new price is above or below cost. The emphasis is on the monopolist’s intention to drive the rival out of the market. According to Elhauge (2003), under EC law, predation may be established when the resulting price fails to maximize the monopolist short-run profits.²¹

We argue that, in comparison with traditional predatory pricing schemes, the predation strategy discussed here may prevail because the additional demand

¹⁶ See *Brooke Group Ltd. v. Brown & Williamson Tobacco Corp.*, 509 U.S. 209, 222 (1993).

¹⁷ See, for example, Hovenkamp (1994), McCall (1997), and Bolton *et al.* (2000).

¹⁸ For further discussion, see also Bolton *et al.* (2001), Watson (1998), Spector (2001), and Edlin (2002).

¹⁹ In particular, Edlin (2002) explores a strategy in which the monopoly, in response to the rival’s entry, sets a price above its own cost but below the entry’s cost. This practice is predatory because it may be maintained for extended periods and thus forces the rival out of the market.

²⁰ For these practices, see, for example, Section 50(1)(c) of the Competition Act R.S.C. 1985, C-34 in Canada, Section 18(2) of the Competition Act 1998 in England, and *AKZO Chemie BV. v. Commission of European Communities*, 1991 ECJ CELEX LEXIS 5086 and *Cie maritime Belge Transports Sa and others V. European Commission and others* [2000] All E.R. (EC) 385 in the EEC. Also, see Lang (1997).

²¹ Elhauge (2003) further discusses the importance of EC law for the U.S. in the era of global markets.

that follows predation is filled by the public, which simply produces more pirated copies.²² Moreover, the monopoly in our case recoups the losses generated in one sub-market by maintaining its monopolistic price in the other sub-market, thus enjoying immediate profits in place of uncertain future ones.

Nonetheless, the authorities might find it difficult to prove that the monopoly is violating antitrust laws in the case presented here, since the burden on competitors is not imposed directly by the firm but merely indirectly—the users are, in effect, responsible for this phenomenon by transgressing the law. The monopoly's omission is in choosing not to exercise its rights to a civil action²³ or to start a criminal action.²⁴ Also, because predatory pricing is difficult to prove, using masquerading techniques in practice immunizes the predator.

Because it might be difficult to distinguish between exclusionary practices and ordinary commercial practices in which a firm chooses to omit enforcement, we propose in Section 6 preliminary guidelines for examining whether the monopoly is, in fact, allegedly engaged in a wrongful act.

3. The Model

Consider two potentially producing firms in the market: a leader and a follower. Though one firm's product is unique, it may be a perfect substitute for that of the other firm. For simplicity, let us assume that the firms' production functions are identical and their marginal costs of production are zero.²⁵ Let us denote the leader by L and the follower by F .

Consumers can costlessly reproduce the product if copyright is not enforced by the firm. Therefore, the producing firm must decide on the quantity it intends to produce and its intended level of copyright enforcement. We assume, without loss of generality, that the firm's decision on the level of enforcement, e , is binary. That is, $e \in \{0,1\}$, where $e=0$ ($e=1$) represents no enforcement (perfect enforcement). Suppose that both firms exhibit a constant marginal enforcement cost denoted by mc .²⁶

²² This also forces the rival, which wishes to recoup its initial investment, to invest in enforcing both the monopoly's and its own copyrights.

²³ See Section 501 (b) of the 1976 Copyright Act.

²⁴ See Section 506 (a) of the 1976 Copyright Act.

²⁵ While, for simplicity, we model the marginal production cost to equal zero, the intuition presented here also maintains under a positive marginal production cost.

²⁶ Modeling two distinct production functions with increasing marginal costs implies that the firms should optimally balance production and enforcement. Our assumption about the cost of production and enforcement allows us to overlook this issue and focus on the main insight of the model. Also, one may argue that the marginal cost of enforcement might even drop with quantity since the latter is associated with a lower price for the product, which in turn decreases the incentive for copyright infringement.

In addition, suppose that there are two sub-markets with distinct demands for the substitute products and that boundaries between the sub-markets are maintained. Particularly, let us assume that market's i , $i=\{1,2\}$, demand function for the product is

$$(1) \quad p_i = \begin{cases} a - b_i q_i & \text{if } e = 1, \\ 0 & \text{if } e = 0, \end{cases}$$

where p_i and q_i are the price of the product and the demanded quantity in sub-market i , and a and b_i are positive constants, where we assume that $b_2 > b_1$.²⁷

The number of consumers in a sub-market i is n_i , and each consumer requires no more than one unit of the product. In order to assure non-negative prices for all q , we assume that $b_i \leq a/n_i$.

We posit that if the leader alone is to prevail in the market, it will either charge a monopolistic price in sub-market i and enforce its copyright, or not enforce its copyright and thereby permit prices to drop to zero.²⁸ If the leader and the follower are to coexist in the market, then we assume that they compete in a Stackelberg-type competition and enforce copyrights in either both or one of the sub-markets.²⁹

Particularly, we posit two possible pricing schedules for each of the monopoly and duopoly market states: a monopoly price with copyright enforcement in each of the sub-markets (denoted by MM); a monopoly price with copyright enforcement in sub-market 1 and no copyright enforcement (leading to a zero price) in sub-market 2 (M); a Stackelberg competition price with copyright enforcement in each sub-market (SS); and a Stackelberg competition price with copyright enforcement in sub-market 1 and no copyright enforcement (leading to a zero price) in sub-market 2 (S).

One should note that given the described monopoly and duopoly set-up, any pricing and enforcement strategy other than M , MM , S , and SS is necessarily dominated. This stems from the fact that, independent of whether the market experiences full or zero enforcement, the best a monopoly (Stackelberg competitor) can do in equilibrium is to set the monopoly (Stackelberg) price.

²⁷ The assumption that $b_2 > b_1$ is not essential. The results may, qualitatively, also obtain if $b_2 \leq b_1$.

²⁸ Notice that if copyright is not enforced, it is irrelevant whether the charged price is positive or zero, since all consumers are assumed to costlessly copy the product, which in effect sets the price to zero.

²⁹ We should note that our results do not particularly rely on the Stackelberg set-up assumption. One can, similarly, construct a setting with, for example, either a Cournot-type oligopoly (where the profits of the competitors are identical) or perfect competition, which will also generate no entry on the part of the follower(s). Hence, the intuition presented in the model does not depend on the specific set-up.

Now, following Equation (1) and given the four potential market price schedules, it is a straightforward matter to derive the profit generated by the firms under each scenario. This part of the analysis follows ordinary derivation of monopoly and Stackelberg quantities and prices, which are shown in the appendix.

The potential profits are then

$$(2) \quad \pi^{MM} = \frac{(b_1 + b_2)(a - mc)^2}{4b_1b_2},$$

$$(3) \quad \pi^M = \frac{(a - mc)^2}{4b_1},$$

$$(4) \quad \pi_L^{SS} = \frac{(b_1 + b_2)(a - mc)^2}{8b_1b_2},$$

$$(5) \quad \pi_F^{SS} = \frac{(b_1 + b_2)(a - mc)^2}{16b_1b_2},$$

$$(6) \quad \pi_L^S = \frac{(a - mc)^2}{8b_1},$$

and

$$(7) \quad \pi_F^S = \frac{(a - mc)^2}{16b_1},$$

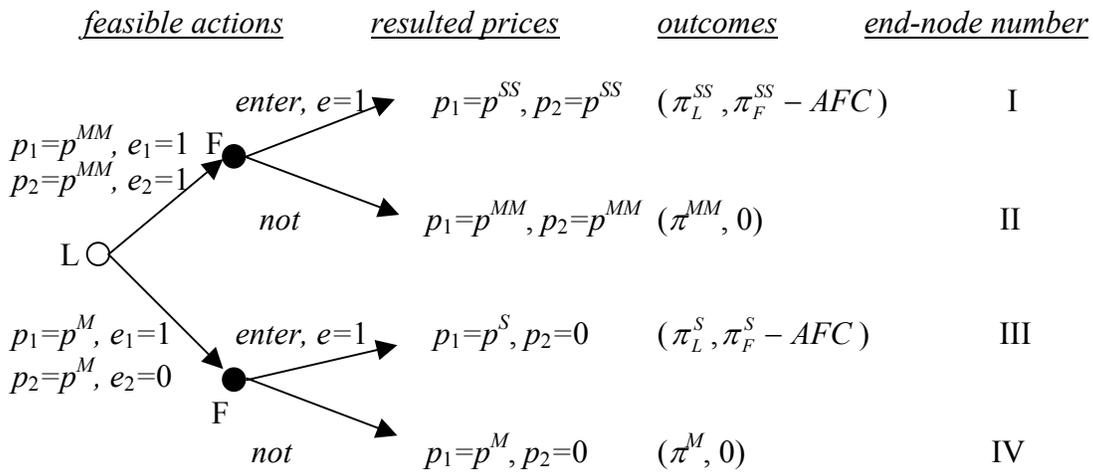
where π^{MM} and π^M are the monopoly's profit when copyright is enforced in both sub-markets and in sub-market 1 only, respectively; π_L^{SS} and π_F^{SS} are the leader's and follower's profits, respectively, when a Stackelberg competition with copyright enforcement persists in both sub-markets; and, finally, π_L^S and π_F^S are the leader's and follower's profits, respectively, when a Stackelberg competition with copyright enforcement prevails in sub-market 1, while no copyright enforcement prevails in sub-market 2.

Next we demonstrate a perfect Nash equilibrium under which a monopoly optimally adopts a strategy of selective copyright enforcement.

4. Selective Copyright Enforcement

Denote the monopolistic (Stackelberg) price in each sub-market if one firm only prevails (two firms prevail) and copyrights are fully enforced by P^{MM} (P^{SS}). Likewise, denote the monopolistic (Stackelberg) price if one firm only prevails (two firms prevail) and copyrights are enforced in sub-market 1 only by P^M (P^S). Now, given the profit functions in Equations (2)-(7) derived under the described four market conditions, consider the following extensive form game played by the leader and the follower as depicted in Figure 1.

Figure 1: *The interaction between the leader and the follower as an extensive form game*



In the first stage of the game, the leader selects the prices to prevail in each sub-market. As a sole producer at that stage, the leader can select either $p_1 = p^{MM}$ with $e_1 = 1$ and $p_2 = p^{MM}$ with $e_2 = 1$ (where p_i and $e_i, i=\{1,2\}$, are the price and enforcement level, respectively, in sub-market i) or, alternatively, $p_1 = p^M$ with $e_1 = 1$ and $p_2 = p^M$ with $e_2 = 0$.

In the second stage of the game, the follower chooses whether to *enter* or *not enter* the market. Entry is accompanied by a fixed cost of magnitude AFC .³⁰ The equilibrium prices in each sub-market after the follower's decision in stage two, contingent upon the leader's action in stage one, appear next to the end nodes in Figure 1.³¹ Most important, notice that in the strategies leading to node IV, the

³⁰ In fact, AFC is the average fixed entry cost per period. Hence, when entering the market the follower considers the profits per period vis-à-vis the corresponding average fixed cost.

³¹ The rationale for $p_2=0$ under end node III is discussed following Proposition 1.

leader sets identical monopolistic prices in both sub-markets but enforces copyright only in sub-market 1. Following Equation (1), the non-enforcement in sub-market 2 leads to a zero price in that market.

Finally, the term to the left (right) of the comma in the parenthesis in Figure 1 represents the profits of the leader (follower), depending on the prevailing prices in each sub-market, which follow the previously chosen actions.

Under the above set-up, we claim that

Proposition 1: *If $\pi_F^S < AFC < \pi_F^{SS}$, then the unique perfect Nash equilibrium (PNE) of the described extensive form game leads to an outcome where the incumbent sets prices $p_1 = p^M$ with enforcement $e_1 = 1$ and $p_2 = p^M$ with enforcement $e_2 = 0$, and the follower opts not to enter.*

Corollary 1: *The condition, which yields the unique PNE in Proposition 1, is equivalent to $0 < \frac{b_2}{b_1} \left[\frac{16b_1 AFC}{(a - mc)^2} - 1 \right] < 1$.*

Proof: The strategies that support the outcome described in Proposition 1 are

Leader: Set $p_1 = p^{MM}$ with $e_1 = 1$ and $p_2 = p^{MM}$ with $e_2 = 1$ if the follower does not enter thereafter; otherwise, set $p_1 = p^M$ with $e_1 = 1$ and $p_2 = p^M$ with $e_2 = 0$.³²

Follower: Enter and set $e_1 = 1$ and $e_2 = 1$ if leader sets $p_1 = p^{MM}$ with $e_1 = 1$ and $p_2 = p^{MM}$ with $e_2 = 1$; otherwise, do not enter.

Focusing on the sub-game, which follows the incumbent's proposed prices $p_1 = p^{MM}$ with $e_1 = 1$ and $p_2 = p^{MM}$ with $e_2 = 1$, note that the follower's optimal response is to *enter* and set $e = 1$ (an action accompanied by an average fixed cost of entry, AFC , and a marginal cost of enforcement, mc), if this action generates greater profits than *not enter*. That is, *enter* and set $e = 1$ is a strategy supporting a sub-game Nash equilibrium if

$$(8) \quad \pi_F^{SS} - AFC > 0.$$

³² Note from Equation (1) that, provided that $e_2 = 0$, then setting $p_2 \neq 0$ is redundant since prices will, in effect, drop to zero due to copyright infringements. Equivalently, given that $e_i = 1$, the monopoly is always better off setting the monopolistic price.

Likewise, if the leader chooses $p_1 = p^M$ with $e_1 = 1$ and $p_2 = p^M$ with $e_2 = 0$, then the sub-game Nash equilibrium is supported by a follower's *not enter* strategy if

$$(9) \quad \pi_F^S - AFC < 0.$$

From inequalities (8) and (9) we get

$$(10) \quad \pi_F^S < AFC < \pi_F^{SS}.$$

Now, given the follower's optimal response strategy, the leader anticipates that pricing $p_1 = p^{MM}$ with $e_1 = 1$ and $p_2 = p^{MM}$ with $e_2 = 1$ will generate a profit of magnitude π_L^{SS} , while pricing $p_1 = p^M$ with $e_1 = 1$ and $p_2 = p^M$ with $e_2 = 0$ will eventually produce π^M . Consequently, the leader's choice of $p_1 = p^M$ with $e_1 = 1$ and $p_2 = p^M$ with $e_2 = 0$ supports a sub-game Nash equilibrium if

$$(11) \quad \pi^M > \pi_L^{SS}.$$

Following Equations (3) and (4), the condition in (11) may be presented as

$$(11a) \quad \pi^M = \frac{(a - mc)^2}{4b_1} > \frac{(b_1 + b_2)(a - mc)^2}{8b_1b_2} = \pi_L^{SS}.$$

However, given that $b_2 > b_1$, it follows after a reduction that Condition (11a) sustains for all a , $b_2 > b_1$, and mc .

Finally, note that the Nash equilibrium in each sub-game is unique. This provides the uniqueness of the spoken PNE (end of proof of Proposition 1).

Given the expressions for the profit functions in (5) and (7), the condition in (8) may be written as

$$(8a) \quad \pi_F^{SS} - AFC = \frac{(b_1 + b_2)(a - mc)^2}{16b_1b_2} - AFC > 0,$$

and the condition in (9) may be expressed as

$$(9a) \quad \pi_F^S - AFC = \frac{(a - mc)^2}{16b_1} - AFC < 0.$$

However, conditions (8a) and (9a) imply that AFC is such that $\pi_F^S = \frac{(a - mc)^2}{16b_1} < AFC < \frac{(b_1 + b_2)(a - mc)^2}{16b_1b_2} = \pi^{SS}$, which after a reduction leads

to the condition appearing in Corollary 1. \square

Note that the game described in Figure 1 is a two-stage interaction, where the leader makes the first move—simultaneously committing to certain price and enforcement levels—and the follower responds by either entering or not entering the market. One may argue that, realistically, there could be a third stage in the game, where if the follower chooses to enter the market, the leader should be able to change her initial no-enforcement policy in sub-market 2 and optimally shift to an enforcement regime. Indeed, conditional on the follower entering the market, the leader would be better off by now enforcing a Stackelberg equilibrium price in sub-market 2 than by attaining zero profits from that sub-market, if she continues the no-enforcement policy. This would, of course, lead to a different equilibrium than that stated in Proposition 1. In fact, the outcome of this equilibrium would be identical to that obtained under end-node I in Figure 1.

While the three-stage-game argument is valid under some circumstances, there are also real-world situations in which the leader may commit to the no-enforcement policy so that it is either completely irreversible or requires excessive effort to reverse. These situations are in line with the two-stage framework of the model. The leader is better off with the irreversible commitment because she then obtains the outcome of end node IV as opposed to that of end node I.

The software industry is an example of a market in which the leader can credibly commit to a policy of no copyright enforcement: if no enforcement involves, for example, the failure to act on copyright protection measures generally inherent in the software, then the policy cannot be reversed with respect to products already sold. Moreover, enforcing copyright in a market where infringement has already become a norm might consume both time and cash.³³ Hence, for practical matters, the no-enforcement decision may be considered irreversible. In other words, in situations in which the leader adopts measures that persuade the follower that she is, in fact, committed to no enforcement, then the presented model is valid and the derived outcome sustains perfect Nash equilibrium.³⁴

³³ The prevailing norms among peer-to-peer users and the use of software like Napster and Kazaa show how difficult it is to change these norms.

³⁴ Additional arguments that substantiate the credibility of a monopoly's threat of predatory pricing can be found, for example, in Salop and Romaine (1999) and Goldsmith and Posner (1999).

Intuitively, there are two crucial elements leading to the attained PNE. The first is that $\pi_F^S < AFC < \pi_F^{SS}$, which implies that the follower merely opts to enter the market when profits may be extracted from both competitive sub-markets. The other condition is $\pi_L^{SS} < \pi^M$, which implies that the leader is better off generating a monopolistic profit from one sub-market than competing in both sub-markets.^{35,36}

Also, consistent with Edlin (2002), one might argue that contrary to the strategy adopted under Proposition 1, the monopoly would, in fact, be better off enforcing its copyright until the moment that entry actually occurs, and utilizing its selective enforcement policy only subsequent to the appearance of a rival firm. This argument is undoubtedly valid in circumstances where the variable costs in the industry are not insignificant, such that the rival firm faces not only a fixed cost hurdle in entering the market, but also an ongoing variable cost obstacle once operating in the market [see, for example, the case of the airline industry suggested by Edlin (2002)]. In contrast, we propose a situation (typical to the software industry) in which the potential rival's variable cost is relatively trivial while the bulk of its cost is concentrated in research and development of the initial product (prior to entering the market). In this case, the monopoly predicts that once the rival enters the market it will be particularly difficult to drive it back out (due to its low variable costs). In other words, the monopoly's alternative, of crowding the rival out once it is in the market, is impractical. This, combined with

³⁵ As one can see from the proof, $\pi_L^{SS} < \pi^M$ does not explicitly appear in Proposition 1 since it holds for all $a, b_2 > b_1$, and mc , given the setting of the model.

³⁶ Note that $\pi_F^S < AFC < \pi_F^{SS}$ and $\pi_L^{SS} < \pi^M$ imply that it is necessary for attaining the PNE that the AFC experienced by the follower sustains $\pi_F^S < AFC < \pi^M$. In other words, AFC must fall between the monopoly's profit in sub-market 1 and that of the follower if it enters that market. One might argue, however, that, realistically, if AFC is greater than π_F^S it is likely to also be greater than π^M , which implies that the monopoly should not have entered the market in the first place. The response to this claim is twofold: first notice that although the model demonstrates a duopoly situation, one can more generally think of the alternative full competition framework, where the competitor's profit is substantially lower than that of a monopoly. That is, our duopoly framework may also be extended to a competitive market where the difference between followers' and monopoly's profits is more significant. Furthermore, under some circumstances it is likely that the AFC experienced by the leader is lower than that incurred by the follower. This may be true for several reasons: frequently, in order to compete, the follower must launch a better product. Moreover, the monopoly's dominance in the market is already established and the competitor is thus often required to devote substantial resources to establishing its market share. In the software industry, the major reason corresponds to the network effect: in order to compete with the monopoly the superiority of the product presented by the follower should be such that it not only "compensates" the customers in terms of technical qualities, but also dominates network effect advantages such as compatibility, switching costs etc.

the monopoly's commitment to selective enforcement, drives the monopoly to conduct its predatory strategy prior to the entrance of the rival. This effectively substantiates the incumbent's choice between those strategies leading to end-nodes *I* and *IV* in Figure 1.

Finally, consistent with Mclean and Riordan (1989) and Waldman (1991), it may be argued that our model would collapse once an oligopoly is introduced, because of free riding by the incumbent firms. Note, however, that investing in entry deterrence by an oligopolistic firm in the general case [such as discussed in Mclean and Riordan (1989) and Waldman (1991)] translates to a lack of investment in copyright enforcement in our framework. That is, while under-investment generally promotes the entry of rivals in the ordinary case, it is under-investment in enforcement that *raises* the barrier to entry in our model. This, in turn, implies that, in the presence of an oligopoly, free riding would only further encourage this under-investment in enforcement that makes entry more difficult.

Under the equilibrium proposed in Propositions 1, the monopoly allegedly conducts an illegal pricing policy. However, the policy is sophisticatedly hidden. Although prices are seemingly identical everywhere, the selective copyright enforcement indirectly and intentionally functions as a mechanism that, in effect, achieves the same objective—raising barriers to entry by means of a predatory pricing policy.

Next, we show that the pricing and enforcement strategy conducted by the monopoly might lead to economic inefficiencies.

5. Efficient Exogenous Intervention

We argue that

Proposition 2: *If the condition for the described PNE is satisfied and, further, if $AFC < \frac{3b_2(a - mc)^2 - b_1(a^2 + 30amc - 15mc^2)}{32b_1b_2}$, then an exogenous intervention in enforcing copyrights is optimal.*

Corollary 2: *If the condition for the described PNE is satisfied and, further, if $\frac{b_2}{b_1} > \frac{3a^2 + 26amc - 13mc^2}{(a - mc)^2}$, then an exogenous intervention in enforcing copyrights is optimal.*

Proof: Recall that under the described PNE, the leader sets $p_1 = p^M$ with $e_1=1$ and $p_2 = p^M$ with $e_2=0$ and the follower does not enter the market. The follower enters the market only if, at the minimum, $p_1=p^{SS}$ and $p_2=p^{SS}$ are to prevail in the

respective sub-markets together with copyright enforcement. We therefore compare the social welfare attained under the PNE state, M (that is, without exogenous intervention) with that obtained under SS (that is, with exogenous copyright enforcement).

Denote the monopolistic (Stackelberg) supplied quantity in sub-market i , $i=\{1,2\}$, if one firm only prevails (two firms prevail) in the market by q_i^M (q_i^{SS}). Now, Figures 2 and 3 depict the social loss in the market under M and SS , respectively, excluding fixed costs.

Figure 2: Social loss under M (without exogenous copyright enforcement)

Figure 2a: Sub-market 1

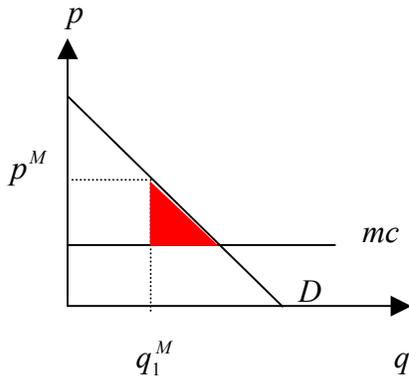


Figure 2b: Sub-market 2

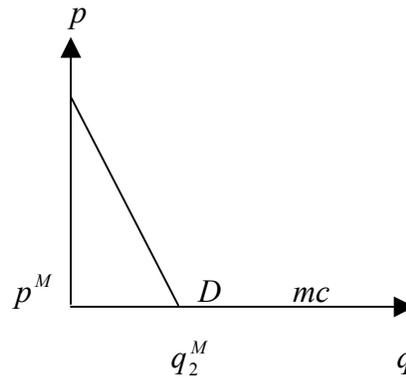


Figure 3: Social loss under SS (with exogenous copyright enforcement)

Figure 3a: Sub-market 1

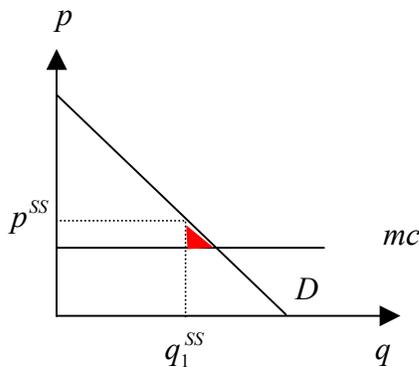
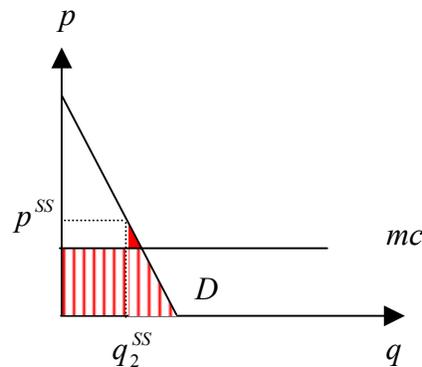


Figure 3b: Sub-market 2



The shaded areas indicate the dead-weight loss. The striped areas depict the loss of consumer surplus due to intervention. Summing up the shaded areas in Figures 2a and 2b, we find that the total social loss (dead-weight loss) under M , denoted by SL_M , is

$$(12) \quad SL_M = \frac{(a - mc)^2}{8b_1}.$$

Similarly, computing the sum of the shaded and striped areas in Figures 3a and 3b, we find that the total social loss (dead-weight plus loss of consumer surplus) under SS , denoted by SL_{SS} , is

$$(13) \quad SL_{SS} = \frac{b_2(a - mc)^2 + b_1(a + 3mc)^2 + 24b_1mc(a - mc)}{32b_1b_2}.$$

If the value obtained from subtracting the right-hand side of Equation (12) from the right-hand side of Equation (13) is greater than the fixed costs associated with the follower's entry, then exogenous intervention is socially beneficial. That is, exogenous intervention in enforcing copyrights is optimal if

$$(14) \quad AFC < SL_M - SL_{SS}.$$

Substituting the right-hand side of Equations (12) and (13) with the expressions in (14) yields

$$(15) \quad AFC < \frac{3b_2(a - mc)^2 - b_1(a^2 + 30amc - 15mc^2)}{32b_1b_2}.$$

However, given Proposition 1, we know that the condition in (10) is sufficient for the PNE. Thus, combining the conditions in (10) and (15) produces the requested result (end of proof of Proposition 2).

Provided that the conditions for PNE in (10) are achieved, the condition for intervention presented in Inequality (15) is redundant if and only if the right-hand side of Inequality (15) is greater than π_F^{SS} in Equation (5). That is, if

$$(16) \quad \frac{3b_2(a - mc)^2 - b_1(a^2 + 30amc - 15mc^2)}{32b_1b_2} > \frac{(b_1 + b_2)(a - mc)^2}{16b_1b_2},$$

then attaining the PNE conditions is sufficient for an intervention to become efficient. However, Inequality (16) reduces to

$$(17) \quad \frac{b_2}{b_1} > \frac{3a^2 + 26amc - 13mc^2}{(a - mc)^2},$$

which is the condition provided in the Corollary (end of proof of Corollary 2). \square

Proposition 2 argues that there may be market conditions that require regulators' intervention to improve efficiency. Such intervention is required when the follower's profit combined with the accompanying consumer surplus are greater than the combination of the entry fixed costs and the reduction in the monopoly's profit. If this is indeed the case, then exogenous enforcement of copyright becomes socially beneficial.³⁷

We should emphasize that the identified condition for exogenous intervention in copyright enforcement, presented in Proposition 2, is specific to the assumed Stackelberg competition. Put differently, if the alternative to the above PNE were a competitive equilibrium, the specific condition for intervention would change. Moreover, there could also be cases in which exogenous intervention may not benefit social welfare.³⁸ The basic insight is that under certain market conditions, regulators should evaluate the effect of intervention in enforcing copyright law in order to maximize social welfare.

Conceptually, this result is analogous to the well-accepted motivation of antitrust authorities for restricting the abuse of monopolistic power: namely, the potential reduction in social welfare. Here the monopolistic abuse is conducted via selective copyright enforcement as opposed to more conventional ways, such as direct predatory pricing.

We further conduct a comparative statics analysis for the intervention conditions, which yields the following:

Corollary 3: *Given that the condition for the PNE is satisfied, then the greater b_2 is, the more likely is the optimality of the exogenous intervention in enforcing copyright.*

Corollary 4: *Given that the condition for the PNE is satisfied, then the smaller b_1 is, the more likely is the optimality of the exogenous intervention in enforcing copyright.*

³⁷ In fact, for a complete analysis of the efficiency aspect, we also require that from the monopoly's *ex ante* perspective, the profit generated under copyright enforcement in both submarkets, π_L^{SS} , is greater than the fixed cost associated with entering the market. Otherwise, given the expected intervention policy, the monopoly would fail to enter the market in the first place and society would lose the potential welfare. Note, however, that the latter requirement holds, in general, for many antitrust cases where intervention is advocated and is not restricted to the particular paradigm presented in our model.

³⁸ For example, if a Cournot equilibrium replaces the presented Stackelberg equilibrium, then an exogenous intervention would not benefit social welfare under our *assumed setting*.

Proof: The proof of both Corollaries 3 and 4 is immediate following the condition in Corollary 2. □

Observing Figures 2 and 3 immediately clarifies the intuition. Given that the PNE, as presented in Figure 2, is attained, then one may notice from Figures 2b and 3b that a greater b_2 corresponds to a steeper demand curve (that is, a more inelastic demand function) in sub-market 2. This, in turn, decreases the shaded and the striped area of social loss under SS (Figure 3b). It thus follows that a greater level of b_2 , *ceteris paribus*, is associated with a diminishing social loss when intervention occurs.

Further, notice that any increase in the level of b_1 sharpens the slope of the demand function in sub-market 1. This, in turn, decreases the dead-weight loss in both Figures 2a and 3a. Nevertheless, the drop in the dead-weight loss due to a rise in b_1 is greater under M (see Figure 2a) than it is under SS (see Figure 3a). It therefore follows that if the condition for the PNE is satisfied, then an increase in the level of b_1 , *ceteris paribus*, reduces the likelihood that exogenous intervention will improve efficiency.

Finally, we claim that

Corollary 5: *Given that the condition for the PNE is satisfied, then the smaller the marginal enforcement cost mc is, the more likely is the optimality of the exogenous intervention in enforcing copyright.*

Proof: Differentiating the right-hand side of the condition for an optimal exogenous intervention presented in Inequality (17) yields

$$(18) \quad \frac{\partial[(3a^2 + 26amc - 13mc^2)/(a - mc)^2]}{\partial mc} > 0,$$

which implies that the likelihood that an exogenous intervention in enforcing copyright improves efficiency rises as the level of mc falls. □

The intuition here is obvious: the smaller the marginal cost of copyright enforcement, the more probable it is that the additional copyright enforcement imposed on the market by regulators will indeed benefit social welfare.

6. Exogenous Intervention: Legal Implementation

In the previous section, we identify the conditions under which selective enforcement of copyright yields inefficiency that may require exogenous intervention. Before we turn to the legal mechanisms that might improve efficiency, a crucial preliminary problem must be addressed: namely, how antitrust authorities can determine whether any given case of non-enforcement is an innocent response to high enforcement costs, or is, in fact, a strategy wrongfully adopted to deter the entry of rivals.

Our analysis suggests the following questions as guidelines: 1) Is there sufficient competition in the market? 2) Does the copyright holder hold market power? 3) Are different levels of copyright enforcement being observed in different segments of the market? 4) Is copyright enforcement particularly costly?³⁹ 5) Do other firms in equivalent situations enforce their copyrights?

Of course, these are only preliminary guidelines to which more parameters could be added. Other elements to be considered include a *prima facie* predatory pricing scheme and the firm's possible use of "business justification" and the "efficiencies defense" as suggested and applied by Bolton *et al.* (2000) (see pages 2274-2278).

If the answers to the questions above suggest that the firm operates in a non-competitive market in which it applies, apparently without justification, different levels of enforcement in different sub-markets; and if, in particular, the firm fails to employ any non-costly protective measures against infringement in some or all segments of the market, then the suspicion that the firm is violating antitrust laws appears justified. In this case, we may consider two types of legal intervention: private and public.

Under a private enforcement regime, a competitor is given tools with which to contest the leading firm's wrongful acts. The State does not directly intervene in the market, but it allows a competitor to act upon its interest.⁴⁰ Thus, for example, once the veil covering the monopoly's wrongful activity is pierced and the firm's strategic enforcement is revealed as predatory pricing, a competitor may file an antitrust suit for violation of both Section 2 of the Sherman Act⁴¹ and Section 4 of the Clayton Act.⁴² Furthermore, Section 16 of the Clayton Act⁴³ allows private injunctive relief.

³⁹ Although some means of enforcement (courts, for example) are costly, there are many less costly measures against infringements such as anti-copying devices embedded in software. Failure to use inexpensive protective measures, given all other circumstances, can thus be held against the copyright owner.

⁴⁰ One can argue that competitors might not sue or, as we later claim, ask the government to sue, but only threaten the monopoly that they will do so. This would allow the competitors to reach a Coasian deal with the leader under the threat of competition. While this argument is indeed valid, it only applies to certain market conditions. The effectiveness of such a threat depends on several factors such as how credible it is; the number of competitors willing to enter the market or willing to make a credible threat; the chances for detection, etc. The higher the transaction costs and the need for coordination, the less likely that such a threat can succeed. Moreover, if the motivation for an anti-trust policy is to maximize consumer surplus, then one should consider acting even prior to the competitor's complaint or formal filing of a suit. In criminal law the state often acts – even against the will of the involved parties.

⁴¹ 15 U.S.C.A. § 2.

⁴² 15 U.S.C.A. § 15.

⁴³ 15 U.S.C.A. § 26.

Antitrust laws are not alone in providing competitors with remedies. Other areas of law can be used as well.⁴⁴ One example is the doctrine of copyright misuse.⁴⁵ The rationale underlying the copyright misuse doctrine is the following: while authors have by law certain monopolistic rights, which often equip them with market power, society seeks to limit the extension of owners' copyrights beyond the boundaries drawn by the law.⁴⁶

Since the doctrine was first implemented in 1990, the courts have been divided in their views. Some regard the doctrine as a branch of antitrust law, emphasizing the fact that without antitrust principles the courts have no clear guidelines by which to determine whether a firm is indeed misusing its rights.⁴⁷ Others, however, emphasize a more general public welfare approach for assessing misuses, stressing the independent character of the copyright misuse doctrine.⁴⁸ Under either interpretation, however, the strategic enforcement adopted by the monopoly in our model is recognizable as copyright misuse.

Two obstacles must be resolved in applying the copyright misuse doctrine to strategic enforcement. The first is that the doctrine is, by and large, used as a shield and not as a sword. Defendants raise a copyright infringement suit in order to prevent the enforcement of copyrights upon them.

The other obstacle lies in the class of circumstances in which the doctrine is generally implemented.⁴⁹ In our case, counter to the ordinary application, it is the *competitor* who seeks a *more intensive enforcement* of copyright by the monopoly. Nevertheless, if the legal system aims to restrain the monopoly power generated by privileges provided to the firm by society, these differences are insignificant and the copyright misuse doctrine may be applied. For example, if the leading firm sues for a breach of its copyright in the future, the court may refuse to provide it with any remedies. The "sanction" for recurring strategic

⁴⁴ The applied doctrines used for enforcement are either part of the positive law or to be developed over time by future courts' decisions.

⁴⁵ While less developed, the copyright misuse doctrine has the same roots as the patent misuse doctrine.

⁴⁶ Thus, for example, this doctrine was implemented in a case where a firm, in order to extend its rights, had used anticompetitive clauses in its standard software licensing agreement and was, therefore, found by the court to have practiced copyright misuse. See *Lasercomb Am., Inc. v. Reynolds*, 911 F. 2d 970 (4th Cir.1990) (hereafter referred to as the Lasercomb decision).

⁴⁷ See, for example Judge Posner in *Saturday Evening Post Co. v. Rumbleseat Press, Inc.*, 816 F. 2d 1191 (7th Cir. 1987),

⁴⁸ See, for example, the Lasercomb decision.

⁴⁹ Paradigmatically, the misuse doctrines (in patent and copyright law) were designed to prevent the extension of the monopoly power granted by the legislator through unlawful means. The underlying motivation is that the realm of copyright and patent law is not wrongfully extended, for example, by a tying arrangement, draconian anticompetitive licensing, etc. Instead, in our case, monopoly power is extended by "narrowing" the realm of copyrights via selective enforcement.

behavior may be the practical withdrawal of rights granted by the State.⁵⁰ The risk of losing its rights in all sub-markets should provide the monopoly with sufficient motivation to enforce them. Moreover, the law may be amended along these lines to allow competitors new and more flexible remedies under the doctrine of copyright misuse or other doctrines.⁵¹

In general, the competitor would have an incentive to sue, under either antitrust or copyright law, if its expected compensation (as ruled by the courts) exceeded the cost of bringing the suit. Furthermore, the monopoly might refrain from its strategy if courts imposed expected costs greater than the benefit derived from the monopoly's policy. In the spirit of Figure 1 in Section 3, the court should impose on the monopoly expected costs greater than $\pi^M - \pi_L^{SS}$, which, in turn, will shift the equilibrium from end node IV to end node I (see Figure 1). This may be achieved, for example, if the sanction for the monopoly's strategic behavior is a complete withdrawal of the rights given by the State or even punitive damages.⁵²

The other mechanism the legal system might provide is public enforcement. This framework includes two major means: first, the State, like the private entities, may enforce antitrust law upon the leading firm. The State can file a criminal suit for antitrust violations through either the FTC or the DOJ. Note that from a public welfare perspective, the likelihood that the overall public interest is maintained is greater here than under a private suit initiated by a competitor. This is because the State might consider the requirements of the individual firm as well as those of the consumers.⁵³

Finally, the State may use criminal law by pursuing the breaching public. Indeed, the U.S. Copyright Act includes a criminal procedure that allows the government to impose a fine or even incarceration when a party commits willful infringement.⁵⁴ By adopting the role of the copyright owner, the government can

⁵⁰ A rationale for complete withdrawal of copyright is that by failing to attempt to enforce its copyright in one sub-market, the monopoly proves an intention to transfer its rights to the public domain; therefore, it should completely lose its copyright in both sub-markets.

⁵¹ Note that, consistent with our framework, a broader interpretation of the fair use doctrine (i.e. allowing "more" fair use) may benefit copyright holders but, concurrently, might reduce overall efficiency.

⁵² Note that the threat to remove all copyrights granted by the State is "weakly credible" because under either alternative (with or without copyright withdrawal), the competitor remains out of the market while the monopoly suffers a substantial loss if the threat is exercised. Hence, the competitor might gain a market share if, in fact, the monopoly internalizes the threat *ex ante*.

⁵³ This claim ignores the potential greater transaction cost involved when the initiative for enforcement is public rather than private. Yet we argue that this possible greater cost may lose significance in relation to the broader reach of the State vis-à-vis the individual competing firm.

⁵⁴ See section 506 and 506(a) of the Copyright Act and section 2319 of title 18, United States Code.

enforce copyright through criminal procedure. This will produce a deterring effect because it will raise the costs of copying. Raising these costs will, in turn, open the door for competitors to enter the market and will enhance overall efficiency. In the spirit of Corollary 5 in the previous section, this public policy is more likely to preserve optimality as the marginal enforcement cost becomes smaller.

Note that by adopting the role of copyright enforcer, the State, while enhancing competition, might also increase the profit of the monopoly. In light of Figure 3b, the monopoly, in effect, rolls the enforcement costs under the *mc* curve onto the taxpayer. While this produces a wealth distribution effect, efficiency is still enhanced. Indeed, it may be argued that the monopoly should be charged by law for the State's enforcement costs.

7. Summary

According to conventional law and economic analysis, two major economic forces determine the optimal level of copyright enforcement. One, which supports complete enforcement, is designed to motivate creators, *ex ante*, by assuring a maximum return for their efforts. The other, which supports no enforcement, is aimed *ex post* at both maximizing the number of consumers for the work, and facilitating the creation process by allowing a creator to draw upon works created by others.

Completing the *ex post* argument, we claim in this study that a creator may use the violation of her copyright as a mechanism to effectively induce a price break in a subset of the market, which, given sufficiently high entry costs, deters competitors from entering the market. The creator may, in fact, maximize long-term profits by strategically promoting an optimal level of copyright infringement.

Appendix

Figure A1: An advertisement for Hewlett-Packard CD-Writers published in local Israeli newspapers. As it turns out, the campaign was shared with Microsoft Corp.

אזהרה: העתקת תוכנות, משחקים או מוסיקה, המוגנים בזכויות יוצרים אסורה בתכלית האיסור ומהווה עבירה חמורה על החוק שעונש עליה הינו עד 3 שנות מאסר ו-1,000,000 ש"ח קנס.

Warning! Copying software, games, or music protected by copyrights, is strictly forbidden and constitutes a serious criminal offense. Violators are subject to a maximum of 3 years imprisonment and a NIS 1,000,000 fine (equivalent to approximately \$220,000)

However, if you do have something to copy, let us offer you the best CD-Writers in the world.

אבל אם בכל זאת יש לכם משהו לצרוב, תרשו לנו להציע לכם את הצורבים הטובים בעולם

 invent	HP CD-Writer Plus M820e צורב נייד המתחבר בקלות באמצעות כרטיס PCMCIA לכל מחשב נייד. כולל גם ממשק SCSI-2 המאפשר היבור למחשב שולחני. שקול פחות מרובי ק"ג וגודל כף יד. מהירות קריאה: 20x כתיבה: 4x שכתוב: 4x		HP CD-Writer Plus 9210i צורב פנימי בעל ממשק SCSI מהיר ביותר שתוכנן למשתמשים המבקשים ביצועים גבוהים. מהירות קריאה: 32x כתיבה: 8x שכתוב: 4x	
	דגמי צורבים נוספים ותוכנות בלעדיות של HP: כל דגמי הצורבים של HP מצוידים במגוון עשיר וייחודי של תוכנות מובילות להשגת המקסימום מהצורב החדש שברשותך. למידע נוסף 09-9524848 www.hp.co.il		HP CD-Writer Plus 9210e צורב חיצוני בעל ממשק SCSI פתרון יעיל ביותר למשתמשים הזקוקים לצורב נייד ומהיר ביותר. מהירות קריאה: 32x כתיבה: 8x שכתוב: 4x	

Deriving Equations (2)-(7):

If a firm solely prevails in the market and charges the monopolistic price with copyright enforcement in each sub-market, then its supplied quantity in each sub-market, q_i^{MM} , is

$$(A1) \quad q_i^{MM} = \frac{a - mc}{2b_i}.$$

Substituting the quantity produced from Equation (A1) into the price function in Equation (1) yields the monopolistic price in each sub-market, p^{MM} ,

$$(A2) \quad p^{MM} = \frac{a + mc}{2}.$$

It follows from Equations (A1) and (A2) that the profit generated by the monopoly when copyright is enforced is π^{MM} , as appears in Equation (2).

If, instead, we assume that the monopoly pricing and copyright enforcement persist only in sub-market 1, while a zero price prevails in sub-market 2, then the supplied quantity and price in sub-market 1 are identical to those presented in Equations (A1) and (A2), respectively, and thus the total profit of the monopoly π^M is equal to that which appears in Equation (3).

If, on the other hand, the leader and the follower coexist in the market and share the demand in each sub-market under a Stackelberg competition with copyright enforcement, then the total supplied quantity in each sub-market, q_i^{SS} , is

$$(A3) \quad q_i^{SS} = \frac{3(a - mc)}{4b_i},$$

and so the price in each sub-market, p^{SS} , is

$$(A4) \quad p^{SS} = \frac{a + 3mc}{4}.$$

From Equations (A3) and (A4), it follows that the total profit generated by the leader, π_L^{SS} , and by the follower, π_F^{SS} , under the Stackelberg competition prevailing in the two sub-markets is as it appears in Equations (4) and (5), respectively.

Likewise, if we assume that a Stackelberg-type competition prevails in sub-market 1, while a zero price persists in sub-market 2, then the total supplied quantity and price in sub-market 1 (denoted by q_1^S and p^S , respectively) are

identical to those presented in Equations (A3) and (A4), respectively. Then the total profit of each firm, π_L^S and π_F^S , are as they appear in Equations (6) and (7), respectively.

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