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Lobbying to Prevent Commercial Piracy

Francisco Martínez-Sánchez (*Universidad de Murcia*)

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Francisco Martínez-Sánchez†
Universidad de Murcia

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Abstract

In this paper we develop a common agency model to analyze the problem of pirates entering the market, in which the incumbent and the consumers form pressure groups to lobby the government on policies to prevent piracy while the pirates try to avoid being stopped. We show that a monopoly is not an equilibrium when both the incumbent and consumers lobby the government, and that the cost of monitoring commercial piracy is very important in determining (truthful) equilibria, as is the case where there is no lobby competition. However, it is now more difficult getting the pirate to enter the market.

Keywords: Common Agency, Lobbying, Commercial Piracy, Incumbent, Consumers, Government

JEL classification: K42; L86

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†Dpto. de Métodos Cuantitativos para la Economía y la Empresa, Universidad de Murcia, 30100 Murcia, Spain. E-mail: fms@um.es

1 Introduction

Most studies about piracy show the industry losses from piracy by region, highlighting the large losses in North America and the European Union because the markets there are so large, even though these regions have relatively low piracy rates. In particular, the 2005 Global Software Piracy Study reveals that losses in 2004 (expressed in millions of dollars) totalled 1,546 in Latin America, 2,313 in Eastern Europe, 7,549 in North America and 12,151 in the EU. Thus, the incumbent may use two tools for preventing piracy: (i) it can develop an antipiracy system such as digital rights management (DRM) and (ii) it can also set low prices. DRM can be prejudicial to consumers of original information goods, because it hinders the use of those goods. For instance, DRM for music can limit the uses of music files downloaded from online retailers, the number of computers to which the user can transfer his or her files and the number of times a playlist can be burned on a CD-R (Duchêne and Waelbroeck (2006)). However, the latest technological developments and the Internet have enabled consumers to overcome these restrictions so that consumers are able to learn by copying, to the point where it is possible that some consumers may prefer a copy to an original information good because they can use the copy more easily in more devices and even improve its quality (Martínez-Sánchez (2008)). On the other hand, setting low prices is a very useful method of preventing piracy as Papadopoulos (2003) shows empirically and Bae and Choi (2006) and Martínez-Sánchez (2010) show theoretically. But these tools are costly, so in order to maintain a monopoly profit the incumbent lobbies the government for it to carry out harsh policies against piracy. However, consumers prefer that the government only partially protects the incumbent because piracy helps to limit the prices that the incumbent sets (Martínez-Sánchez (2010)). Therefore, consumers lobby the government for it carry out a mild policy against piracy.[1]

The importance of lobbying the government to prevent the entry of a pirate in the market has been analyzed by Banerjee (2006), in which political pressure is only carried out by the developer of the original good and not by consumers. He comes to the conclusion that special interest lobbying may result in monitoring as the optimal policy, although not monitoring is the unique socially optimal policy where the pirate always enters the market.

In this paper, we develop a common agency model, as in Grossman and Helpman (1994) and Dixit et al. (1997), to analyze the problem of pirates entering the market when the incumbent and consumers form pressure groups to lobby the government regarding policies to prevent them and the pirate tries to avoid being stopped.[2] Given that in common agency models there is a multiplicity of equilibrium (Dixit et al. (1997)), to overcome it we consider the truthful equilibrium refinement introduced by Bernheim and Whinston (1986), which selects equilibria that implement efficient actions and are coalition-proof Nash Equilibria. We focus on a game with complete information for two reasons. Firstly, although a fully

[1] In our model, we can think that the incumbent's lobby represents the lobby of software firms and the lobby of record companies, and that the consumers' lobby represents the lobby of consumers' association. As cases in point, we can quote two news items taken from the Spanish newspaper *El País*: "EMI, NBC, Microsoft y Vivendi form a 'lobby' for fighting piracy" (2005) and, "SGAE and consumers mobilize for tax" (2007).

[2] Common agency models have already been applied to analyze how the government makes economic policies. For instance, Grossman and Helpman (1994) analyses how the government forms trade policy.

satisfactory theory of menu auctions would certainly allow for incomplete information, we would soon see that significant complexities arise even when there is no private information (Bernheim and Whinston (1986)). Second, ruling out informational considerations permits us to isolate the effect on the outcome of the game of the competition between the principals from the effect of the existence of some private information (Laussel and Le Breton (2001)).

Over the past few years, most digital products have frequently been illegally copied and sold, to the point where it is possible to find a new product pirated before it is officially launched on the market. As cases in point, we can mention two news items taken from the Spanish newspaper *EL PAIS*: "New García Márquez Novel Pirated In Colombia Before Its Presentation"(2004b) and, "Pirated Version Of Xbox's Star Game For Christmas Appears On Internet"(2004a). Moreover, while I write this introduction, a pirated version of the film "X-Men Origins: Wolverine" has appeared on the Internet one month before its official presentation. For this reason, it can be reasonable to assume that pirates have some market power because they can get and sell copies of an information good before it is on the market without the authorization of the incumbent. In this respect, we allow the pirate the advantage of deciding before the incumbent whether to enter or not. To that end we have extended the model developed by Martínez-Sánchez (2010), which analyzes the roles of the government and the incumbent in preventing commercial piracy.[3] He shows that the government will not help the incumbent to become a monopolist, even if the incumbent installs an antipiracy system, because a monopoly provides the lowest social welfare. However, it will let the pirate enter as a follower or as a leader, or encourage the incumbent to set a low enough price to successfully deter the pirate from entering the market, which depends on the technology for monitoring the pirate.

Our analysis shows that a monopoly is not an equilibrium when both the incumbent and consumers lobby the government on the policy of preventing commercial piracy. Secondly, the cost of monitoring the pirate is very important in determining (truthful) equilibria, as is the case without lobby competition. Thirdly, for the case, where the pirate entering the market as a follower is a truthful equilibrium, it is necessary for the government to make a major effort to compare what happens when there is and is not any lobbying. Finally, we find that lobby competition implies that the demand for original products is at least the same as that obtained without lobbies. This is because it is easier to curb commercial piracy with lobby competition.

The rest of the paper is organized as follows: Section 2 describes the model formally. The equilibrium is obtained in Section 3. Finally, Section 4 concludes.

[3] Commercial piracy is defined as those cases in which some firms make and sell copies of a good without the authorization of the incumbent (Banerjee (2003), Poddar (2003), Martínez-Sánchez (2010), Kiema (2008) and López-Cuñat and Martínez-Sánchez (2009)).

2 The model

We consider that there is a continuum of consumers indexed by $\theta \in [0, \overline{\theta}]$. θ is assumed to follow a uniform distribution, and represents the consumers' tastes for the quality of a product. Each consumer is assumed to buy only one unit of the good or none at all. We consider that consumers form a pressure group to lobby the government on the policy of preventing commercial piracy, and we assume that the payment of consumers' lobby to the government is equivalently allocated among them, independently of its purchase decisions. So that consumers' payments do not affect its purchase decisions. Thus, the utility of consumer θ, following Mussa and Rosen (1978), is,[4]

$$U(\theta) = \begin{cases} \theta q_i - p_i & \text{if he buys the original product} \\ \theta q_p - p_p & \text{if he buys the pirated product} \\ 0 & \text{if he does not buy} \end{cases} \tag{1}$$

where p_i, q_i, p_p and q_p are the price and quality of the original and pirated products, respectively. We assume $q_i > q_p > 0$. Let $x_i = p_i/q_i$ and $x_p = p_p/q_p$ be the incumbent's and pirate's hedonic prices, respectively. Since qualities are common knowledge, decisions on prices are equivalent to decisions on hedonic prices. Let $r = q_i/q_p > 1$ be the ratio of qualities.

Firms' demand functions are obtained as follows. Let θ_o be a consumer who is indifferent to buying the original and pirated products. From (1), $\theta_o = (rx_i - x_p)/(r-1)$. Let θ_i be a consumer indifferent to buying from the incumbent and not buying at all, that is, $\theta_i = x_i$. Let θ_p be a consumer indifferent to buying from the pirate and not buying at all, that is, $\theta_p = x_p$. The demands faced by the incumbent and the pirate are

$$D_i(x_i, x_p) = \begin{cases} \overline{\theta} - \theta_i & \text{if } x_i \leq x_p \\ \overline{\theta} - \min\{\theta_o, \overline{\theta}\} & \text{if } x_i \geq x_p \end{cases} \tag{2}$$

$$D_p(x_i, x_p) = \begin{cases} 0 & \text{if } x_i \leq x_p \\ \min\{\theta_o, \overline{\theta}\} - \theta_p & \text{if } x_i \geq x_p \end{cases} \tag{3}$$

According to the terminology on common agency models (Grossman and Helpman (1994) and Dixit et al. (1997)) we consider the consumer lobby as an individual principal that maximizes the net utility of consumers $U_c(\alpha, G, T_c(\alpha, G)) = CS(\alpha, G) - T_c(\alpha, G)$, where $CS(.)$ and $T_c(.)$ represent the consumer surplus and the payment function of the consumer lobby. The expression of consumer surplus is:

$$CS = \int_{\theta_p}^{\theta_o} (\theta q_p - p_p)\, d\theta + \int_{\theta_o}^{\overline{\theta}} (\theta q_i - p_i)\, d\theta \tag{4}$$

We assume that a firm remains in the market if and only if it is making a positive profit. Like consumers, we let the incumbent lobby the government on the policy of preventing commercial piracy. If

[4] We assume that consumers do not face the risk of prosecution for the use of copies because they did not make copies of original products and sell them, which is true for the penal codes of most countries (e.g., see articles 270 to 272 of the Spanish penal code).

the pirate's illegal operations are detected, which occurs with probability α, he must pay the penalty G and he loses his income. Thus the expected profits of the incumbent and the pirate are:

$$U_i(.) = q_i x_i D_i(x_i, x_p) - T_i(\alpha, G), \quad U_p(.) = (1-\alpha) q_p x_p D_p(x_i, x_p) - \alpha G, \tag{5}$$

where $T_i(\alpha, G)$ represents the payment function of the incumbent to the government. We consider that the cost incurred by the incumbent in developing an original product is a sunk cost and the production costs of both the incumbent and the pirate are zero as in Banerjee (2003), Martínez-Sánchez (2010) and López-Cuñat and Martínez-Sánchez (2009).

The government is responsible for monitoring and penalizing the pirate. Let α and G be the monitoring rate of a pirate and the penalty that the government imposes on the pirate if he is detected, respectively. We assume $G \in \left[0, \overline{G}\right]$, where $\overline{G}$ is the maximum legal penalty. Let $C(\alpha)$ be the cost of monitoring piracy. We assume $C(0) = 0, C'(0) = 0, C'(\alpha) > 0$. Let $\alpha G + \alpha \delta I_p(x_i, x_p) - C(\alpha)$ be the net expected revenue of the government, where $I_p(x_i, x_p) = q_p x_p D_p(x_i, x_p)$ represents the pirate's revenue and $\delta \in [0,1]$ represents the government's ability to reuse the revenue seized from the pirate. The government chooses the antipiracy policy (α, G) that maximizes its net utility function $G(\alpha, G, \mathbf{C}) = T_i(\alpha, G) + T_c(\alpha, G) + aW(\alpha, G)$, where $W(\alpha, G)$ is the social welfare and a indicates the weight the government attaches to social welfare, which is the sum of the profits of the incumbent and the pirate, the consumer surplus and the net expected revenue of the government.

We include the pirate's profit in social welfare because he is an agent that generates revenue and helps to avoid the incumbent setting high prices. However, we may decide not to include the pirate on ethical and moral grounds. In that case, the results obtained hold if the marginal monitoring cost of piracy is high enough.[5]

Given that in common agency models there is a multiplicity of equilibrium to overcome it we consider the truthful equilibrium refinement introduced by Bernheim and Whinston (1986). We define a truthful equilibrium as an equilibrium in which all payment functions are truthful relative to the equilibrium utility levels. A truthful payment function is a payment function that rewards the agent exactly the amount of change in the principal's utility when he changes action, provided that the payment before and after the change is strictly positive. Thus, the principal obtains the same utility for all actions that induce positive payments (see Grossman and Helpman (1994) and Dixit et al. (1997)). Formally, a payment function $T_h(\alpha, G, u_h)$ for principal $h \in \{c, i\}$ is truthful relative to the constant utility u_h if $T_h(\alpha, G, u_h) = \max(0, U_h(\alpha, G) - u_h)$.

The complete information game is the following:

Stage 1. Each lobby chooses a payment schedule simultaneously and without cooperating.

Stage 2. The government announces the policy (α, G) to maximize social welfare.

Stage 3. The pirate decides whether to price first or not. If he decides to price first he becomes the leader on prices (l-subgame), but if he waits he becomes a follower on prices and decides whether to enter the market or not after the incumbent has set the price of the original product (f-subgame).

[5] See Martínez-Sánchez (2010) for more details.

Stage 4. Finally, consumers decide to buy the original product, the pirated product or neither after they have observed firms' prices.

In the next section, we look for the truthful equilibrium of the game.

3 Truthful Equilibrium

3.1 Market Equilibrium

3.1.1 F-subgame

Here, we solve the subgame where the pirate decides to wait, so he becomes a follower on prices. The pirate's best-response function is:

$$x_p^{BR}(x_i) = \begin{cases} x_i/2 & \text{if } 0 \leq x_i \leq \frac{2\overline{\theta}(r-1)}{2r-1} \\ rx_i - (r-1)\,\overline{\theta} & \text{if } \frac{2\overline{\theta}(r-1)}{2r-1} \leq x_i \leq \frac{\overline{\theta}(2r-1)}{2r} \\ \overline{\theta}/2 & \text{if } \frac{\overline{\theta}(2r-1)}{2r} \leq x_i \leq \overline{\theta} \end{cases} \tag{6}$$

By substituting (6) in the pirate's profit, we obtain the pirate's maximum profit $\pi_p^c(x_i) = (1-\alpha)\,q_i\gamma(x_i) - \alpha G$, where

$$\gamma(x_i) = \begin{cases} \frac{x_i^2}{4(r-1)} & \text{if } 0 \leq x_i \leq \frac{2\overline{\theta}(r-1)}{2r-1} \\ \left(rx_i - (r-1)\,\overline{\theta}\right)\left(\overline{\theta} - x_i\right) & \text{if } \frac{2\overline{\theta}(r-1)}{2r-1} \leq x_i \leq \frac{\overline{\theta}(2r-1)}{2r} \\ \frac{\overline{\theta}^2}{4r} & \text{if } \frac{\overline{\theta}(2r-1)}{2r} \leq x_i \leq \overline{\theta} \end{cases} \tag{7}$$

The pirate decides to enter the market when $U_p(x_i) > 0$, i.e. when $\gamma(x_i) > g$, where $g = \alpha G/q_i(1-\alpha)$ is increasing in α and G and indicates the government's efforts to prevent piracy. Hence, for simplicity, we represent the antipiracy policy though the variable g instead of (α, G). Note that $\gamma(x_i) > g$ is equivalent to $x_i > x_i^{ne}$, where x_i^{ne} is the non-entry hedonic price, which is[6]

$$x_i^{ne} = \begin{cases} \sqrt{4(r-1)\,g} & \text{if } 0 \leq g \leq \frac{\overline{\theta}^2(r-1)}{(2r-1)^2} \\ \frac{\overline{\theta}(2r-1) - \sqrt{\overline{\theta}^2 - 4rg}}{2r} & \text{if } \frac{\overline{\theta}^2(r-1)}{(2r-1)^2} \leq g \leq \frac{\overline{\theta}^2}{4r} \\ +\infty & \text{if } \frac{\overline{\theta}^2}{4r} < g \end{cases} \tag{8}$$

Therefore, the pirate's optimal decision is to enter and price $x_p^{BR}(x_i)$ if $x_i > x_i^{ne}$; and to not enter if $x_i \leq x_i^{ne}$. Depending on the pirate's optimal decision the incumbent anticipates profits

$$U_i(x_i) = \begin{cases} q_i x_i\left(\overline{\theta} - x_i\right) - T_i(g) & \text{if } 0 \leq x_i \leq x_i^{ne} \\ q_i x_i D_i\left(x_i, x_p^{BR}(x_i)\right) - T_i(g) & \text{if } x_i^{ne} < x_i \leq \overline{\theta} \end{cases} \tag{9}$$

[6] We assume x_i^{ne} is equal to $+\infty$ when $\overline{\theta}/4r < g$ for convenience of analysis only. This means that the pirate is deterred from entering at any price when the government's effort is very high.

From maximizing the incumbent's profit (9), we obtain:

$$\begin{array}{lllll} x_i^f = \frac{\overline{\theta}(r-1)}{2r-1}, & I_i^f = \frac{\overline{\theta}^2 q_i (r-1)}{2(2r-1)}, & x_p^f = \frac{\overline{\theta}(r-1)}{2(2r-1)}, & I_p^f = \frac{\overline{\theta}^2 q_i (r-1)}{4(2r-1)^2}, & \theta_o^f = \frac{\overline{\theta}}{2}, \\ x_i^m = \frac{\overline{\theta}}{2}, & \pi_i^m = \frac{\overline{\theta}^2 q_i}{4}, & & & \end{array} \quad (10)$$

where I_i^f and I_p^f are the incumbent's and pirate's revenues when the pirate is the follower. We find that when the government makes little effort to combat commercial piracy (g very low), the pirate enters as a follower and price x_p^f, and when the government makes a major effort (g very high), the pirate's entry is blocked, so that the incumbent becomes a monopolist that prices at a monopoly price of x_i^m. However, for intermediate levels of government effort, the incumbent finds it optimal to set a low enough price (x_i^{ne}) to prevent commercial piracy. These results are summarized in the following proposition.

Proposition 1 *In any SPE, the optimal strategies of the incumbent and the pirate are:*

(a) The pirate will price according to (6) and will enter the market only if $g < g_l$, where

$$g_l = \frac{\overline{\theta}^2 \left(r - \sqrt{2r-1}\right)}{8(r-1)(2r-1)}. \quad (11)$$

(b) The incumbent will price $x_i^* = x_i^f$ and the pirate will price $x_p^* = x_p^f$ if $g < g_l$.

(c) The incumbent will price $x_i^* = x_i^{ne}$ if $g_l \leq g < g_m$, and $x_i^* = x_i^m$ if $g_m \leq g$, where

$$g_m = \begin{cases} \frac{\overline{\theta}^2 (2-r)}{4} & \text{if } 1 < r \leq 3/2 \\ \frac{\overline{\theta}^2}{16(r-1)} & \text{if } 3/2 \leq r. \end{cases} \quad (12)$$

Proof: see Appendix A in Martínez-Sánchez (2010).

Note that when $g_m \leq g$, commercial piracy is only eliminated because of the high expenditure employed by the government in preventing it, so the incumbent can set a monopoly price. However, when $g_l \leq g < g_m$, government intervention must be accompanied by the incumbent setting a low enough price, so the incumbent shares with the government the cost of eliminating commercial piracy.

3.1.2 L-subgame

The l-subgame is reached when the pirate prices first and thus becomes the leader on prices. The incumbent's best-response function is:

$$x_i^{BR}(x_p) = \begin{cases} \left(\overline{\theta}(r-1) + x_p\right)/2r & \text{if } 0 \leq x_p \leq \frac{\overline{\theta}(r-1)}{2r-1} \\ x_p & \text{if } \frac{\overline{\theta}(r-1)}{2r-1} \leq x_p \leq \overline{\theta}/2 \\ \overline{\theta}/2 & \text{if } \overline{\theta}/2 \leq x_p \leq \overline{\theta} \end{cases} \quad (13)$$

The pirate incorporates the incumbent's reaction function into his profit function and chooses the price that maximizes his profit, yielding the following hedonic prices, indifferent consumers and revenues:

$$x_i^l = \frac{\overline{\theta}(r-1)(4r-1)}{4r(2r-1)}, \quad I_i^l = \frac{\overline{\theta}^2 q_i (r-1)(4r-1)^2}{16r(2r-1)^2}, \quad x_p^l = \frac{\overline{\theta}(r-1)}{2(2r-1)}, \quad I_p^l = \frac{\overline{\theta}^2 q_i (r-1)}{8r(2r-1)}, \quad \theta_o^l = \frac{\overline{\theta}(4r-3)}{4(2r-1)}, \tag{14}$$

where I_i^l and I_p^l is the incumbent's and the pirate's revenue when the pirate is the leader. Since the incumbent's profit is not negative he always enters the market. Note that the pirate's profit as leader $(U_p = (1-\alpha)\, I_p^l - \alpha G)$ is positive if and only if $g < I_p^l / q_i = g_0$.

3.1.3 Pirate: leader or follower

In this subsection we analyze the pirate's optimal decision about when to enter the market. From results obtained in each subgame, the results obtained are that if the pirate waits he anticipates profit of $U_p^F = (1-\alpha) I_p^f - \alpha G > 0$ when $g < g_l$, and $\pi_p^F = 0$ when $g_l \leq g$. But if the pirate prices first he can expect a profit of $U_p^L = (1-\alpha) I_p^l - \alpha G$, which is positive if and only if $g < g_0$. Since $g_l < g_0$, to obtain the pirate's optimal decision we have to compare U_p^F with U_p^L in the three regions given by $g < g_l$, $g_l \leq g < g_0$, and $g_0 \leq g$.

For $g < g_l$, we have $U_p^F = (1-\alpha) I_p^f - \alpha G$, and $U_p^L = (1-\alpha) I_p^l - \alpha G$. Since $I_p^f > I_p^l$, the pirate decides to wait to price the copy until after the incumbent prices the original product.

For $g_l \leq g < g_0$, we have $U_p^F = 0$ and $U_p^L > 0$. Since $U_p^L > U_p^F$, the pirate prices the copy before the incumbent prices the original product.

For $g = g_0$, we have $U_p^F = 0$ and $U_p^L = 0$. To ensure the existence of equilibrium it is necessary for the pirate to become a follower that will not enter later.

For $g_0 < g$, we have $U_p^F = 0$ and $U_p^L < 0$. So the pirate decides to wait and becomes a follower that will not enter the market.

As we can see, the pirate's optimal decision, like the incumbent's optimal decision, depends on the level of expenditure by the government on avoiding commercial piracy. When $g < g_l$, the pirate waits since his profit is higher as a follower. However, when $g_l \leq g < g_0$, he prices first because he anticipates a profit of zero as a follower, since the incumbent deters him from entering the market through prices, and a positive profit as a leader, since when he prices first he restricts himself to force the incumbent not to deter him. The following proposition shows the pirate's optimal decision according to the government's expenditure:

Proposition 2 *In any SPE,*

(a) The pirate will wait and price the pirated product as a follower $x_p^* = x_p^f$, when $g < g_l$. So the incumbent becomes a leader and prices $x_i^* = x_i^f$.

(b) The pirate will become the leader and price $x_p^* = x_p^l$, when $g_l \leq g < g_0$. So the incumbent becomes a follower and prices $x_i^* = x_i^l$.

(c) The pirate becomes a follower that will later not enter, when $g_0 \leq g$. So the incumbent becomes a monopolist that prices $x_i^* = x_i^{ne}$ when $g_0 \leq g < g_m$, and $x_i^* = x_i^m$ when $g_m \leq g$.

3.2 Government's optimal policy

In this subsection, we look for the government's optimal policy. In line the technical methodology developed by Laussel and Le Breton (2001) and Laussel (2006), we know that a truthful equilibrium consists of an anti-piracy policy g that maximizes a weighted sum of the gross utility levels of the lobbies and the government. Therefore, the government's policy on avoiding commercial piracy $g^o \equiv (\alpha^o, G^o)$ represents a truthful equilibrium if:

$$g^o \in \arg\max_{g\geq 0} \Omega(g) = aW(g) + \pi_i(g) + CS(g) \tag{15}$$

From the results previously obtained, we have that:

$$\Omega(g) = \begin{cases} aW(g) + \pi_i^f + CS^f & \text{if } 0 \leq g < g_l, \\ aW(g) + \pi_i^l + CS^l & \text{if } g_l \leq g < g_0, \\ aW(g) + \pi_i^{ne}(g) + CS^{ne}(g) & \text{if } g_0 \leq g < g_m, \\ aW(g) + \pi_i^m + CS^m & \text{if } g_m \leq g \end{cases} \tag{16}$$

where

$$W(g) = \begin{cases} CS^f + \pi_i^f + I_p^f - \alpha(1-\delta) I_p^f - C(\alpha) & \text{if } 0 \leq g < g_l, \\ CS^l + \pi_i^l + I_p^l - \alpha(1-\delta) I_p^l - C(\alpha) & \text{if } g_l \leq g < g_0, \\ CS^{ne}(g) + \pi_i^{ne}(g) - C(\alpha) & \text{if } g_0 \leq g < g_m, \\ CS^m + \pi_i^m - C(\alpha) & \text{if } g_m \leq g \end{cases} \tag{17}$$

$$CS^f = \frac{\overline{\theta}^2 q_i \left(4r^2+r-1\right)}{8(2r-1)^2}; \quad CS^l = \frac{q_i\overline{\theta}^2\left(16r^3+12r^2-15r+3\right)}{32r(2r-1)^2}; \quad CS^{ne} = \frac{q_i\left(\overline{\theta}-x_i^{ne}\right)^2}{2}; \quad CS^m = \frac{\overline{\theta}^2 q_i}{8}. \tag{18}$$

Given that a higher monitoring rate (α) entails a higher cost, a higher penalty (G) does not entail a higher cost and $\alpha \equiv \frac{q_i g_l}{q_i g_l + G}$ is decreasing in G, the government will choose the maximum penalty, which is $\overline{G}$. Note that $\Omega(g)$ is decreasing in α since (i) the values CS^k,$\pi_i^k, I_p^k, k \in \{f, l, m\}$ are independent of α; (ii) the sum $CS^{ne} + \pi_i^{ne} = q_i \left(\overline{\theta}^2 - \left(x_i^{ne}\right)^2\right)/2$ is decreasing in α because $g \equiv \alpha G/q_i(1-\alpha)$ is increasing in α, x_i^{ne} is increasing in g and $CS^{ne} + \pi_i^{ne}$ is decreasing in x_i^{ne}; and (iii) the monitoring cost of piracy is increasing in α, $C'(\alpha) > 0$. So in order to maximize $\Omega(g)$ the government will choose the minimum monitoring rate that leads to different outcomes, which is $\alpha \in \{\alpha_f, \alpha_l, \alpha_{ne}, \alpha_m\}$, where $\alpha_f = 0, \alpha_l = \frac{q_i g_l}{q_i g_l + \overline{G}}, \alpha_{ne} = \frac{q_i g_0}{q_i g_0 + \overline{G}}$ and $\alpha_m = \frac{q_i g_m}{q_i g_m + \overline{G}}$. As a result, since g is increasing in α, social welfare is decreasing in g, so the value of g in the social maximum is reached in $\{0, g_l, g_0, g_m\}$. The maximum value of $\Omega(g)$ is obtained from comparing the following values:

$$\begin{aligned} \Omega^f &= a\widehat{W}^f + \pi_i^f + CS^f \\ \Omega^l &= a\widehat{W}^l + \pi_i^l + CS^l - aC_l \\ \Omega^{ne} &= (a+1)\widehat{W}^{ne} - aC(\alpha_{ne}) \\ \Omega^m &= (a+1)\widehat{W}^m - aC(\alpha_m) \end{aligned}$$

where $\widehat{W}^k = CS^k + \pi_i^k + I_p^k$ represents the gross social welfare in outcome $k \in \{f, l, ne, m\}$. We know that π_{i0}^{ne} and CS_0^{ne} are the incumbent's profit and the consumer surplus at $g = g_0$, which are:

$$\pi_{i0}^{ne} = \sqrt{\frac{\overline{\theta}^4 q_i^2 (r-1)^2}{2r(2r-1)}} - \frac{\overline{\theta}^2 q_i (r-1)^2}{2r(2r-1)}; \quad CS_0^{ne} + \pi_{i0}^{ne} = \frac{\overline{\theta}^2 q_i \left(3r^2-1\right)}{4r(2r-1)}. \tag{19}$$

Let $\Delta\widehat{W}_y^x = \widehat{W}^x - \widehat{W}^y$ be the gain in gross social welfare in outcome x as compared to outcome y. Let $C_l = C(\alpha_l) + (1-\delta)\alpha_l I_p^l$ be the social cost that the government supports when the pirate is a leader, where the first term is the cost of monitoring commercial piracy and the second is the expected money loss of the revenue seized from the pirate. For the sake of simplicity we call $C_{ne} = C(\alpha_{ne})$. The value of the gross social welfare in each outcome and the relationship between them is as follows:

$$\widehat{W}^f = \frac{\overline{\theta}^2 q_i \left(12r^2-9r+1\right)}{8(2r-1)^2}; \quad \widehat{W}^l = \frac{\overline{\theta}^2 q_i \left(48r^3-28r^2-9r+5\right)}{32r(2r-1)^2}; \quad \widehat{W}_0^{ne} = \frac{\overline{\theta}^2 q_i \left(3r^2-1\right)}{4r(2r-1)}; \quad \widehat{W}^m = \frac{3\overline{\theta}^2 q_i}{8} \tag{20}$$

$$\widehat{W}^m < \widehat{W}^f < \widehat{W}^l < \widehat{W}_0^{ne} \tag{21}$$

Let $\beta_f^{ne} = \left(CS^{ne} + \pi_i^{ne} - CS^f - \pi_i^f\right)/a > 0$, $\beta_f^l = \left(CS^l + \pi_i^l - CS^f - \pi_i^f\right)/a > 0$ and $\beta_l^{ne} = \left(CS^{ne} + \pi_i^{ne} - CS^l - \pi_i^l\right)/a > 0$. As can be seen in Proposition 3 and in Figure 1, we obtain similar results to the case without lobby competition (Martínez-Sánchez (2010)). Thus, the cost of getting an outcome (in particular, the cost of monitoring piracy) is very important in determining truthful equilibria, such as the case without lobby competition. Note that when a goes to infinity, β goes to zero, and regions approach those regions in the model without lobbies. The intuition is that when the government attaches a higher weight to social welfare, the ability of lobbies to influence it is lowered.

Proposition 3 *The unique truthful equilibrium is:*

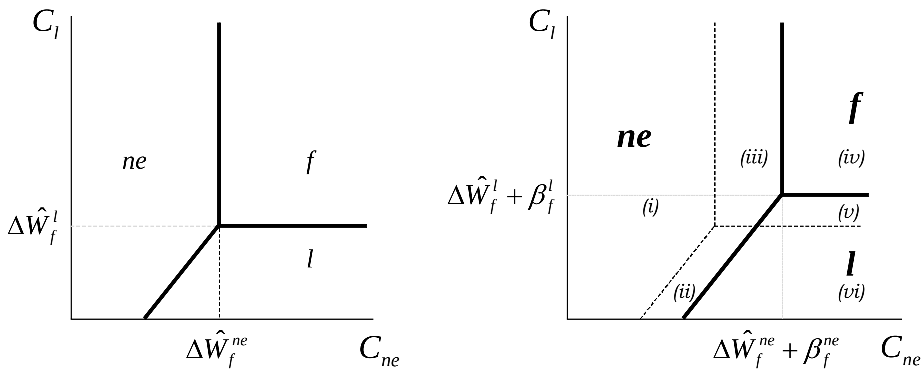
(a) $g^o = 0$ *if* $C_k > \Delta\widehat{W}_f^k + \beta_f^k$ *for all* $k \in \{l, ne\}$*;*

(b) $g^o = g_l$ *if* $C_{ne} - C_l > \Delta\widehat{W}_l^{ne} + \beta_l^{ne}$ *and* $C_l < \Delta\widehat{W}_f^l + \beta_f^l$*; and*

(c) $g^o = g_{ne}$ *if* $C_{ne} - C_l < \Delta\widehat{W}_l^{ne} + \beta_l^{ne}$ *and* $C_{ne} < \Delta\widehat{W}_f^{ne} + \beta_f^{ne}$*.*

From (21), given that $C'(\alpha) > 0$, we can deduce that a monopoly (with no restriction in prices) provides the lowest social welfare due to the excessive power of the incumbent in the market. Thus, the government never chooses α_m provided that the incumbent's revenue is high enough for supporting the cost of developing the original product. Otherwise, the government will let the incumbent become a monopolist because he does not want to distort the incumbent's incentives to develop new products.

As can be seen from Figure 1 and Proposition 3, the outcome that maximizes social welfare depends on the relationship between gross social welfare and the cost of getting each outcome. In particular, encouraging the incumbent to deter the pirate from entering maximizes social welfare if the cost of getting this outcome is low enough; letting the pirate be the leader maximizes social welfare if the cost of getting this outcome is low enough and that cost in ne-outcome is high enough; otherwise, letting the pirate enter as a follower maximizes social welfare.



(a) Without Lobby competition

(b) With Lobby competition

Figure 1: Truthful Equilibrium

By comparing Figures 1(a) and 1(b) we can see that: (i) the region that determines the outcome ne as a truthful equilibrium is bigger with lobby competition, which implies that when the equilibrium without lobby competition is the outcome ne, this is also a truthful equilibrium when there are lobbies; and (ii) with lobby competition, for the outcome f to become a truthful equilibrium it is necessary for the government's efforts in achieving outcomes l and ne to be higher in comparison to the cost without lobby competition. Thus, it is more difficult for the pirate to enter as a follower when we incorporate lobby competition.

As we can see in Figure 1(b) is divided into six regions, so that outcome f is a truthful equilibrium in region (iv), outcome l is a truthful equilibrium in regions (v) and (vi) and outcome ne is a truthful equilibrium in regions (i), (ii) and (iii). Note that the outcome that is a truthful equilibrium maximizes social welfare in regions (i), (iv) and (vi). In other words, there are truthful equilibria that do not maximize social welfare (regions (ii), (iii) and (v)) contrary to the case without lobby competition (Martínez-Sánchez (2010)).

From Martínez-Sánchez (2010), we know that the relationship between the demands in every outcome is (22). Thus, as we can see in Figure 1 (b), in regions (i), (iv) and (vi), the demands for the original and the pirated products do not change regard to the case without lobby competition, but in regions (ii), (iii) and (v), original product's demand is higher and pirated product's demand is lower. Thus, lobby competition implies that the demand for original products is at least the same as that obtained without lobbies. This is because it is easier to curb commercial piracy with lobby competition.[7]

$$D_p^l < D_p^f < D_i^m = D_i^f < D_i^l < D_i^{ne} \tag{22}$$

[7] See Gil (2006), Gil (2007) and Martínez-Sánchez (2007) for an interesting discussion about this point.

4 Conclusions

We have developed a common agency model to analyze the problem of preventing commercial piracy when the incumbent and consumers lobby the government on the policy of preventing it and the pirate tries to avoid being stopped.

Our analysis shows that a monopoly is not an equilibrium when both the incumbent and consumers lobby the government on the policy of preventing commercial piracy. Secondly, the cost of monitoring the pirate is very important in determining (truthful) equilibria, such as the case without lobby competition (Martínez-Sánchez (2010)). Thirdly, for the case where the pirate entering the market as a follower is a truthful equilibrium, it is necessary for the government to make a major effort to compare what happens when there is and is not any lobbying. Finally, we find that lobby competition implies the demand for original products is at least the same as that obtained without lobbies.

In this model, the government only considers the social welfare generated in one market, so it does not take into account the impact of its decision in other markets. Therefore, it would be interesting to extend our model to analyze the effect on the behaviour of incumbents in other markets.

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Francisco Martínez-Sánchez (*Universidad de Murcia*)

Departamento de Fundamentos del Análisis Económico
Facultad de Economía y Empresa
E-30100 Campus de Espinardo
Murcia (SPAIN)
Tel.: (34) 868 883 784
E-mail: nsb@um.es
Website: www.um.es/analisiseco