Piracy in the Musical Industry: An Economic Approach with Marketing Implications

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Abstract
The music industry has witnessed in the last decade a proliferation of the means to circumvent copyright in protected materials: peer-to-peer networks or for-profit organized piracy are two of the many challenges the industry has to face. This paper aims at explaining the effects of piracy from an economic perspective, and how the firm strategies on pricing and promotion may affect these. We find that piracy increases consumer's welfare at a cost of lower firm revenues, although these are likely to emerge not as a consequence of illegal copying but because of the lower prices that firms apply to the legal units sold. Moreover, and as phonographic recordings are experience goods, promotion helps creating both a legal and illegal demand. The main effect of piracy is to decrease optimum promotional efforts which in turn will imply a cut in prices reinforcing the benefits for consumers. However, in the face of negative dynamic effects, the net effects of promotion may be ambiguous.

Keywords
Piracy, copyright infringement, phonographic industry, optimum pricing strategy, optimum promotion, welfare evaluation.

1. Introduction

The expansion of internet and both the accessibility and low cost of available copying technologies and storage media has had a significant economic impact in the cultural industry. More specifically the music industry has witnessed in the last decade a proliferation of the means to circumvent copyright in protected materials: peer-to-peer networks or for-profit organized piracy are two of the many challenges the industry will have to face in the near future.

The Spanish case may help in clarifying our point. A significant share of the market for popular music in Spain is illegal. According to some private organizations (as collected by the final report of the Sub-commission on the study of measures against piracy in copyrighted material,

of the Spanish Congress in November 2003) this share accounts for a 35% of the total market, which makes around 30 million copies distributed in the parallel markets.

However the economic effect of this market is rather controversial. While the industry claims that each pirated copy crowds out a legal sale, several authors have pointed out that not every illegal copy would have been bought. Two recent works that stress this point are those by Hui and Png (2003), and Rob and Waldfogel (2004). Moreover if illegal copying has dynamic effects, as the former authors claim, then it may increase the demand for the original copies.

The main objective of this paper is to highlight the economic effects that the emergence and expansion of piracy has in the music industry. We are interested in establishing the link between marketing variables, price and promotion, and economic outcomes. By following this strategy we aim at stressing the role that the music industry plays in determining the share of the illegal market.

We find that pricing plays a role in determining the share of the illegal market, as firms may choose to reduce it by cutting prices, although it comes at the cost of lower revenue. Our work considers two groups of consumers that differ in their demand. Then the incentive compatible price for any group will be the price at which a consumer in that group prefers to buy rather than to copy. The price strategy of the firm may be either to price for both groups, setting a low price, or to price for one, setting a high price. Therefore a profit maximizing strategy will emerge such that there is illegal market, high price, or not, low price. In both cases the cost for the firm is in terms of lost revenue as the existence of illegal markets forces it to set lower prices than otherwise it would have set. However illegal markets benefit consumers as they eliminate welfare losses. Moreover illegal markets make skimming no longer an available strategy for firms if those who place a lower than the price valuation on the product get it cheaper in the illegal market.

Second, promotion directly influences the knowledge individual consumers hold about the product. In popular music this means that the demand will be directly related to the promotion efforts by the industry. As an experience good, *ex-ante* consumer's valuation of a music recording may differ from that *ex-post*. This means that individuals knowledge of a product affect their willingness to pay. And it is through promotion that firms explicitly scatter information about their product.

However, better knowledge on a product also amounts to explaining the emergence of parallel markets: when a copy is both feasible and a proxy for the original product, there is a potential benefit from entering an illegal market.[1] From this point of view promotion enhances both the legal and the illegal market: there are returns to promotion although when it is high enough further increases will generate an expansion in the distribution the parallel market with no significant results in the accounts of the firm undertaking such efforts.

In our setup promotion both increases the willingness to pay for the original copy of consumers and the valuation of the illegal work. Hence the efforts in promotion will, on average, widen both the legal and the illegal markets. Piracy leads to lower promotion efforts by firms, which may have chosen larger levels of promotion should illegal markets not exist. The net effect is ambiguous as promotion increases the willingness to pay, therefore reducing consumers' welfare. However it also spreads information about a product that otherwise would not have been available. This may cause an *ex-post* dynamic inefficiency.

The paper is organized as follows. Next we introduce the basic model by resorting to the optimal pricing strategy of the firm. Section 3 assesses the economic impact of piracy given the setup previously developed. Section 4 introduces the role of promotion and its impact. Finally we close with some conclusions.

2. Pricing Strategy

We start by defining the setup. Assume a firm producing an information good, i.e. phonographic recorded material. Assume that consumers have two alternatives: either purchase the product from the legal market or to copy it (buy it from the illegal market). Define v_i as the monetary valuation for the original product of the *i*-th individual, while u_i is his monetary valuation for the copied material. When purchasing, consumers pay a price *p*, while by copying, consumers incur in a transaction cost t_i.

Finally, consider there are *n* consumers for the information product. Let the consumers be grouped into two different segments: n_L low demand consumers (which we will label as *L*), and n_H high demand consumers (which we will label as *H*), such that $n = n_H + n_L$. Then we assume that $v_H > v_L$. However we do not impose any *a priori* constraints on the valuation of the copied materials and on the transaction costs individuals face.

The problem the firm faces is choosing *p*, such that the profits are maximized. Let us consider the alternative outcomes of this setup. If a consumer is to buy the product, then the firm should price it such that:

1. For any consumer, his willingness to pay for the original product (i.e. the monetary benefits of the CD) must exceed the price. This is the participation constraint (PC).

2. For any consumer the net benefits of buying must exceed those of copying. This is the incentive compatibility constraint (IC).

These are

$$\begin{cases} v_L \geq p \ (\text{PC}) \\ v_L - u_L \geq p - t_L \ (\text{IC}) \end{cases} \tag{1}$$

for low demand consumers, and

$$\begin{cases} v_H \geq p \ (\text{PC}) \\ v_H - u_H \geq p - t_H \ (\text{IC}) \end{cases} \tag{2}$$

for high demand consumers.

It can be easily shown that only (IC) constraints in equations (1) and (2) can be binding. However for a given price *p*, it is not evident which one will prevail as it depends on the specific parameters of the model. And this turns out to be the problem of which group of consumers has more incentives to copy the product.

2.1 Optimum Strategy when Low Demand Consumers' Restriction is Binding

Consider that the incentive compatibility restriction of *L*-consumers, i.e. expression (1), is binding. This means that high demanders place also a higher value on the original product, and make low demand consumers prone to copy it if the price is high enough. This amounts to say that

$$v_H - u_H + t_H \geq v_L - u_L + t_L \tag{3}$$

In this case a firm faces two alternative price strategies. To set a price that will induce low demanders to buy in the *official market*. In this case the firm will set the price to its minimum possible level:

$$v_L + t_L - u_L = \underline{p} \tag{4}$$

Expression (4) emerges from the IC constraint of the low demand consumers. Alternatively, should the firm exclude low demanders from the official market, it will price its product given the IC constraint of the high demand group. In this case

$$\overline{p} = v_H - u_H + t_H \tag{5}$$

Obviously $\underline{p} < \overline{p}$.

Let us consider a profit maximizing firm. Then, the optimum choice will depend on the profits from both alternative pricing strategies. Let the profit function be

$$\pi = R - c\left(q\right) \tag{6}$$

where *R* is the revenue of the firm and *c*(*q*) is a standard cost function which depends on output *q*. Revenue is linear in the size of the population buying the product, while the assumptions on the cost function may vary the outcomes. Depending on the pricing strategy profits will be either

$$\underline{\pi} = \underline{p} n_H - c\left(n_H\right) \tag{7}$$

if pricing is set such that both groups enter the market, or

$$\overline{\pi} = \overline{p} n - c\left(n\right), \tag{8}$$

if only high demand consumers buy the good.

Assume a general cost function

$$c(q) = c_F + c_V(q)$$

where c_F are fixed costs, and $c_V(\cdot)$ variable costs.

The condition for the firm to price such that both groups buy in the official market is $\underline{\pi} \geq \overline{\pi}$. Otherwise the firm will prefer to supply only to the high demand group. Whether it is on the interest of the firm to do so depends on three facts: (a) The cost structure of the firm; (b) The relative size of both groups; and (c) The relative valuation that both groups place on the information product. Let us analyze these.

If the firm is to set the price $\underline{p}$, from (7) and (8) it must hold

$$n_L \underline{p} \geq \underbrace{n_H \Delta c + n_L \underline{c}}_{\text{A}} - \underbrace{n_H \Delta p}_{\text{B}} \qquad (9)$$

where $\Delta c = \underline{c} - \overline{c}$, and $\Delta p = \underline{p} - \overline{p}$, being $\underline{c}$ and $\overline{c}$ the average cost of producing n and n_H respectively. Expression (9) simply states that revenue raised from including low demand consumers in the official market must exceed the increase (or decrease) in costs, labeled as A, and revenue losses due to high demand consumers paying a lower price, labeled as B. Define α as the share of high demanders in the total population, i.e. $\alpha = n_H / n$. Then we can modify expression (9) and get

$$\left(\underline{p} - \underline{c}\right) \geq \alpha\left(\overline{p} - \overline{c}\right). \qquad (10)$$

Equation (10) presents the information in a different way. In order for the low pricing strategy to be optimal, the benefit of the marginal unit sold in the latter case must exceed that of the marginal unit sold in the high pricing strategy weighted by the population structure. Let us consider this in depth by analyzing the alternatives a firm faces given its cost structure.

2.1.1 Increasing Average Costs

When the firm faces increasing average costs then $\underline{c} > \overline{c}$. In this case the right hand side of expression (9) is always positive, and the firm will benefit form expanding the market if the size of low demanders and/or their valuation of the good is high enough. Or, as per expression (10), whenever the benefit of the marginal unit in the low price case exceeds the weighted benefit of the marginal unit in the high price case. Note that the profit of the marginal unit depends both on the valuation of the good and on the marginal cost. From these we can get some results.

First, other things equal, the larger the increase in costs the more likely the firm will opt for the high price strategy. Obviously, the lower the valuation of the marginal consumer, the more likely the firm will opt for the high price strategy. Note that the marginal consumer valuation is given by expression (4). Then, the firm will opt for the low price strategy:

1. The higher the *L*-consumers' valuation of the original product.
2. The higher the *L*-consumers' transaction costs.
3. The lower the *L*-consumers' valuation of the copied product.

Finally the relative size of the population of consumers affects the strategy of the firm. The firm will opt for the low price strategy the higher the share of low demand consumers.

Two comments apply. First, regarding to average costs. It seems plausible to assume that in the case of information goods average costs are not increasing, or at least they are not too steep. These goods are easily manufactured and duplicated so marginal costs may be low. Moreover some of them, especially the release of records by consolidated stars in big companies, imply a big initial investment in promotion. In this case a product may face economies of scale. However not-too-steep increasing costs or constant returns may be an acceptable assumption for an important share of the records marketed, especially by independent companies. In this case expanding the market shall not mean a significant increase in costs.

Second, while valuation is subjective to the consumers, transaction costs may be both a subjective and an objective variable. Following Holm (2003), transaction costs may include variables such as computer skills, ethical tolerance, income and expected penalty. Obviously copyright protection technologies or the legal system may affect transaction costs. Hence phonographic firms may increase transaction costs by lobbying for a less piracy-tolerant legal system, or developing and introducing new copy protection technologies, or just by modifying the perception that the public has on this issue.

2.1.2 Constant Average Costs

The case of constant returns is just a simplification of the general one. In it $\underline{c} = \overline{c}$. In this case the strategy of the firm depends solely on the structure of the consumers' population or their valuation of the information good. Now it is easier for the firm to stick to low price strategy as increasing production and sales do not increase unit costs.

2.1.3 Decreasing Average Costs

Finally we consider the possibility of economies of scale. As previously noted, economies of scale in the phonographic industry may arise as a consequence of promotion investments. In this case the larger the volume of production and sales, the lower the cost. This may change qualitatively the previous results depending on the magnitude of the cut in costs.

Note that, if we assume increasing returns to scale, there is an ambiguity in the sign of the right hand side of expression (9). As $\underline{c} < \overline{c}$, then the decrease in revenue caused by the cut in price may be offset by the cut in costs of an expanding production. Hence we get that whenever the decrease in average cost is larger (in absolute terms) than the decrease in price, i.e. $\Delta c > \Delta p$, then the optimal strategy for the firm is always to price low. On the contrary, if the previous condition does not hold then high pricing may still be a feasible outcome, although in the case it will be easier to meet the conditions that lead to low price setting.

One special case of economies of scale is that of zero marginal cost. Some distribution systems, for instance legal internet sites for downloading music, face a null marginal cost. If all costs are fixed conditions (9) and (10) yield an obvious result: the firm will choose the strategy that maximizes its revenue. This means that the firm will price set the low price if revenue gains (those of the low demand consumers buying in the legal market) exceeds revenue losses (those of the lower price applied to high demand consumers).

2.2 Optimum Strategy when High Demand Consumers' Restriction is Binding

Until now we assumed that the net valuation of high demand consumers was higher than that of low demand consumers. In this case the profit maximizing pricing strategy does not distort the market outcomes: low demand individuals copy in the illegal market if the price exceeds their net reservation value. In other words, firm sales are not affected by piracy although price cuts (depending on the specific strategy undertaken by the firm and the characteristics of the consumers) may lead to a decrease in profits. This amounts to say that in our previous setup illegal copies are distributed when the price exceeds the net willingness to pay of some consumers. In this case the firm cannot claim lost sales, as parallel market copies would not have been distributed otherwise.

The previous situation may significantly change if the sign of inequality (3) is reversed. This reverses the entry conditions in the market as, once the illegal market exists, low demand consumers enter at a higher price than high demand consumers. Why should this be so? If we consider that the parameters defining *L*-consumers remain unchanged, and compared with the previous setup then there are two main reasons. Other things equal:

1. *H*-consumers place a relative larger valuation on the illegal copy.
2. *H*-consumers face lower transaction costs.

While there is no rationale for supporting (ii), (i) may be a potential outcome. In it high demanders do not differentiate between the original and the copy: they get the same utility from both.

Again the firm has two alternative strategies which we will call $\bar{p}'$ and $\underline{p}'$. Note that, given the previous assumptions, $\bar{p}' = \underline{p}$: now *L*-consumers enter the official market at a higher price. The firm can set a price that disincentives high demanders form buying in the official market. This high price equals the low price in the previous setup:

$$v_L - u_L + t_L = \bar{p}'(= \underline{p}) \tag{11}$$

Alternatively, the minimum price that makes both groups enter the market will be

$$v_H - u_H + t_H = \underline{p}' \,. \tag{12}$$

And the pricing strategy of the profit maximizing firm will be

$$n_H \underline{p}' \geq n_L \Delta c + n_H \underline{c} - n_L \Delta p \,, \tag{13}$$

which is similar to expression (9). Shall the firm set the price to $\underline{p}'$, revenue raised from high demand consumers should compensate lost revenue due to the price cut ($n_L \Delta p$) and the variation in cost. Condition (10) is still valid, so what we previously said applies in this case. With decreasing and constant returns, firms will follow the same behavior as in the previous case.

Note that this case differs from the previous one in that piracy emerges from potential high demanders that are relegated from the market. To understand the differences between both cases imagine what outcome we should expect from both situations shall illegal markets not exist. Consider that the firm chooses to set a high price. In this setup, when high demanders' constraint is binding, if we eliminate illegal markets high demanders will purchase the legal product. Here illegal markets crowd out legal sales. This is the argument at which the industry sticks when claiming that piracy reduces sales. However in the previous setup, when low demanders constraint is binding, illegal markets only crowd out legal sales if

$$\overline{p} \leq v_L , \tag{14}$$

which will be unlikely to hold.

Moreover it should be noted that, in addition to the crowd-out effect, in this scenario we find a significant reduction in profits as it implies a sharp cut prices. We will return to this in the next section.

3. Pricing and the Economic Impact of Piracy

In order to asses the economic impact of piracy we resort to welfare analysis and consider the benefits and costs that each group bears in the scenarios we have so far considered. We distinguish between the two alternative situations given the willingness to pay of both groups of consumers: one in which *H*-consumers show a higher willingness to pay, and one in which *L*-consumers show a higher willingness to pay. Both will be compared between them and the benchmark case: a situation in which there are no illegal markets and copying is not an alternative.

3.1 The Benchmark Case

Consider that it is not possible to copy an original. Then a high pricing strategy redistributes the benefits of exchange towards the firm. As high demand consumers have no alternative source of getting the product the firm could set a price $\overline{p} = v_H$, which leaves consumer surplus equal to zero. On the contrary the firm gets a rent

$$R_H^{NC} = n_H \left(\overline{p} - \overline{c} \right) = n_H \left(v_H - \overline{c} \right). \tag{15}$$

Meanwhile, as low demand consumers are prevented from entering the market this generates a loss of welfare equal to

$$n_L \left(\underline{p} - \underline{c} \right) \tag{16}$$

Obviously, and as long as $\underline{p} > \underline{c}$, there are potential exchanges which are not undertaken reducing aggregate welfare.

If the firm opts for the low pricing strategy, then the problem turns out to be one of rent redistribution between consumers and firms. Ideally, in our two groups setting, no consumer

obtains the product in the illegal market. In this case the firm sets a price $\underline{p} = v_L$, leaving *H*-consumers' surplus equal to

$$CS_H^{NC} = n_H\left(v_H - \underline{p}\right) = n_H\left(v_H - v_L\right) \tag{17}$$

while *L*-demand consumers get no surplus. On the other hand the firm gets a rent equal to

$$R_{HL}^{NC} = n\left(\underline{p} - \underline{c}\right) = n\left(v_L - \underline{c}\right) \tag{18}$$

Note that in this case there is a net gain as the deadweight loss (16) is appropriated by the firm in the form of rents, expression (18), while *H*-demand consumers enjoy a surplus.

Let us turn now to two scenarios we previously analyzed. Depending on their willingness to pay we can sort the groups of consumers. If *H*-consumers show a higher willingness to pay then *L*-consumers will copy when the price is high (scenario A). Conversely if *L*-consumers show a higher willingness to pay then *H*-consumers will copy when the price is high (scenario B).

3.2 Scenario A: Piracy when Low Demand Consumers Copy

3.2.1 High Pricing Strategy

When copying is possible, the participation constraint of *H*-consumers guarantees that these will extract a surplus from exchange. Certainly, as the firm has to take into account that a high price incentives the illegal market, then the maximum price will be $\overline{p} = v_H - u_H + t_H$. Hence the firm gives up part of its rent as consumers' surplus which is given by

$$CS_H^{\overline{p}} = n_H\left(v_H - \overline{p}\right) = n_H\left(u_H - t_H\right). \tag{19}$$

As copying is available, low demand consumers are diverted to the illegal market due to the high pricing strategy. This implies a net surplus of

$$CS_L^{\overline{p}} = n_L\left(v_L - t_L\right) \tag{20}$$

In this context there is a net welfare gain compared with the setting in which there is no possibility of copying. The welfare loss is substituted by the amount of the new *L*-consumer's surplus given by expression (21).

The rent in this case is given by

$$R_H^{\overline{p}} = n_H\left(v_H - u_H + t_H - \overline{c}\right) \tag{21}$$

There is a clear-cut conclusion from this. Copies exchanged in the parallel market would not otherwise have been sold in the official one, as the price is far too high for *L*-consumers to buy the product. Hence the industry claim that illegal downloads crowd out official sales is not sustained in this context.

However it should also be noted that, due to the existence of the illegal market, firms suffer a loss of revenue due to the incentive compatibility constraint of high demanders. As this group can also illegally obtain the product, producers cannot completely extract consumers' surplus, which causes a revenue reduction. The extent of this loss will depend on both the consumer's valuation of the copied material and the transaction costs they face: the lower the former and the higher the latter the less affected the revenues of the firm.

This conclusion may be extended to a more general setup in which more than two groups of consumers exist. Then, instead of a binary strategy, the firm faces a more complex one. But the fact is that once it chooses the profit-maximizing price, the illegal market generates a net surplus. Assume that this is $p = v_i - u_i + t_i$, being *i* the marginal consumer. While those above the marginal consumer, i.e. consumers buying the product, get $CS_j = v_j - v_i + u_i - t_i$, the marginal consumer and those below, i.e. consumers that copy the product get $CS_k = u_k - t_k$. In brief, the existence of the illegal market while reducing firms' revenue, due to a cut in prices, increases consumers' surplus and eliminates the allocative inefficiency.

3.2.2 Low Pricing Strategy

When the firm opts for the low pricing strategy no consumer obtains the product in the illegal market. It increases the surplus of *H*-consumers due to lower prices. When copying is available, the lower price that firms apply implies an increase by the same amount of consumers' surplus.

The incentive compatible price is $\underline{p} = v_L - u_L + t_L$, which is lower than before. Now *H*-consumers' surplus increases while low demand consumers get a positive surplus in the legal market, equal to the surplus they would get otherwise in the illegal one.

$$\begin{aligned} CS_H^{\underline{p}} &= n_H \left(v_H - v_L + u_L - t_L \right) \\ CS_H^{\underline{p}} &= n_L \left(u_L - t_L \right) \end{aligned} \qquad (22)$$

On the other hand the value of the rent is

$$R_{HL}^{\bar{p}} = n\left(v_L - u_L + t_L - \underline{c} \right) \qquad (23)$$

Overall compared with high pricing strategy, the result is unambiguously positive. It is positive for consumers as there is a net increase in the surplus of high demanders, while low demanders' surplus remains unchanged. Part of this increase is a transfer of rent from the firm. However the firm has to enjoy profit gains: it has to be so if the firm chooses a low price, which implies that at least the firm is not worse off. Additionally, when the production is under economies of scale there are efficiency gains in production. Therefore setting a low price makes everyone better off, or at least indifferent.

However, when compared with the benchmark consumers are unambiguously better of, while firms are unambiguously worse off: profits decrease with price reductions due to piracy.

3.3 Scenario B: Piracy when High Demand Consumers Copy

The case for high consumers copying is quite similar to the previous one with some minor changes in the results. Next we briefly present them.

3.3.1 High Pricing Strategy

Now the incentive compatible high price will be $\overline{p}' = \underline{p} = v_L - u_L + t_L$. Consumers' surplus is given by

$$CS_L^{\overline{p}'} = n_L\left(v_L - \overline{p}'\right) = n_L\left(u_L - t_L\right). \tag{24}$$

High demand consumers obtain the good in the parallel market and get a surplus of

$$CS_H^{\overline{p}'} = n_H\left(v_H - t'_H\right) \tag{25}$$

Again, there is a net welfare gain compared with the setting in which there is no possibility of copying. The rent in this case is given by

$$R_L^{\overline{p}'} = n_L\left(v_L - u_L + t_L - \overline{c}'\right) \tag{26}$$

In this setup high pricing has an ambiguous meaning as it is the low price in the previous one. However the comparison of high pricing in both scenarios raises two comments. First, although the expressions are the same, aggregate consumers' surplus is larger than in the case for high pricing with *L*-consumers' copying. This is so as now *H*-consumers place a larger value on the copy ($u'_H > u_H$) or face lower transaction costs ($t'_H < t_H$). Second, firms may be better off if $n_L > n_H$ and unit costs diminish (or more unlikely if $n_H > n_L$ and unit costs are increasing).

3.3.2 Low Pricing Strategy

In this scenario the firm sets the price to $\underline{p}' = v_H - u'_H + t'_H$. Obviously consumers' surplus will increase due to the lower price.

$$\begin{aligned} CS_{LH}^{\underline{p}'} &= n_L\left(v_L - v_H + u'_H - t'_H\right) \\ CS_{LH}^{\underline{p}'} &= n_H\left(u'_H - t'_H\right) \end{aligned} \tag{27}$$

On the other hand the value of the rent is

$$R_{LH}^{\underline{p}'} = n\left(v_H - u'_H + t'_H - \underline{c}\right) \tag{28}$$

Again low pricing benefits consumers at the expense of firms, as profits are lower than in the two scenarios of the previous scenario. If high demand consumers show a lower willingness to pay then it could be the case that low pricing could make the firm better off if $n_H > n_L$ and unit costs diminish (or more unlikely if $n_L > n_H$ and unit costs are increasing).

3.4 Pricing Strategies, Profits And Efficiency

We may briefly summarize the previous results.

From the firms' standpoint the existence of illegal markets

1. Reduces profits always. Depending on the strategy the reduction of profits may be more or less significant.
2. Affects the volume of sales when high demanders copy.

The fact is that firms need reduce its prices in order to keep selling to their target public. When low demanders copy, once the firm decides its price strategy sales may be unaffected by the existence of illegal markets. Should illegal markets not exist, individuals that copy the product would not buy it. In other words, in this setup piracy is a consequence of pricing. Conversely piracy crowds out sales when it is high demanders the group that copy the product.

Contrary to intuition, although a firm may be better off without parallel markets, once they exist it is not clear which scenario maximizes its benefits. It will depend on the relative size of both consumers' groups and on the behavior of average costs. For instance a firm may prefer that high demand consumers copy rather than low demand ones if the share of large *H*-consumers is small and economies of scale are significant. Although in this case, the firm would be better off in the all consumers buy situation (low pricing strategy) of scenario A.

In brief, if the firm faces economies of scale then profits from scenario A (*H*-consumers have a higher willingness to pay) dominate profits from scenario A. On the contrary, when firms face increasing unit costs scenario B can be a better outcome for certain population structures.

From the consumer's standpoint the existence of illegal markets unambiguously increases their welfare. To some extent piracy increases price or quality competition in the market and as a consequence illegal markets always imply a redistribution of rent from the firm to the consumers. Of course the lower the price, the more benefits accrue to consumers.

Finally efficiency gains arise in parallel markets as they increase the access of consumers to the good. From an allocative efficiency standpoint the existence of illegal markets eliminate deadweight losses.

4. Promotion and Piracy

Until now we have assumed that the value that consumers place in a product was exogenous. However phonographic products have a characteristic: they are experience products and consumers' valuation may vary with the knowledge they have on the product. By means of promotion firms can affect the value consumers place on a good. Let us analyze it.

4.1 Description of the Setting

Consider the following setting: firms face a decision setup in which they have to choose the optimum amount of promotion they invest in a given product. Let us consider that there are *m* firms promoting their product.[2] In this process firm *i* expenses in promotion are e_i. The efficiency of a firm in the promotion of its product is given by its relative effort in promotion:

$$x_i = f(e_1, e_2 \ldots e_i \ldots e_m) \tag{29}$$

Following the literature on contests, we assume a standard setup in which probability of success, here to be understood as the relative efficiency of the promotion of a firm, is given by the following expression

$$x_i = \frac{e_i}{\sum_{j=1}^{m} e_j} \tag{30}$$

To simplify the setup let us consider that high demand consumers have a larger net willingness to pay (hence we are in the best case from the firm standpoint). Consumers valuation of the original product and the copy of firm *i* are now a function of the relative promotion efforts, i.e. $v(x_i)$ and $u(x_i)$. Then, the (PC) and (IC) of the representative consumer of each group is given by

$$\begin{cases} v(x_i) \geq p_i \text{ (PC)} \\ v(x_i) - u(x_i) \geq p_i - t \text{ (IC)} \end{cases} \tag{31}$$

Expression (31) shows that by means of promoting a product a firm may affect the willingness to pay of consumers and hence the outcomes that we analyzed in the previous setup.

Notice that once all firms choose promotion outlays it will affect the willingness to pay of consumers, i.e. the demand. However for every potential demand there is an optimal amount *n* that the profit maximizing firm will sell in the market. So we can consider the setup as a sequential one in which a firm chooses in a two-stage game:

1) First it decides over *n*, i.e. whether to sell to high demand or to both groups.
2) Second, given the decision at the previous step the firm chooses an optimal level of promotion outlays *e*.

4.2 Solution of the Model

In order to solve the model we resort to backward induction. Once either *n* or n_H is known, the firm chooses the optimal amount *e*. In this case the profit maximizing strategy for the firm is to choose the amount of resources devoted to promotion, given the behavior of the rest of the firms. This is

$$\underset{e_i}{Max} \ \pi_i = p(x_i)n - c(n) - e_i \tag{32}$$

By expression (31), and given the assumptions we depart from, we know that

$$p(x_i) = v(x_i) - u(x_i) + t \tag{33}$$

Hence expression (32) turns out to

$$\underset{e_i}{Max}\ \pi_i = \left(v(x_i) - u(x_i) + t\right)n - c(n) - e_i \tag{34}$$

The first order condition for (34) is given by

$$f'(e_i)\left\{v'(x_i) - u'(x_i)\right\}n = 1 \tag{35}$$

with *g*' the first derivative of *g* with respect to its main argument. We assume that the second order condition holds. Hence expression (36) shows that, in equilibrium, the marginal benefits of promotion equal marginal costs. The term *f*' measures the marginal effect of an increase in promotion outlays over its efficiency rate. As we assumed a functional form for *f*(*x*), expression (30), we can get its derivative

$$f'(e_i) = \frac{E_j}{E_i^2} \tag{36}$$

with

$$E_i = \sum_{i=1}^{m} e_i$$
$$E_j = E_i - e_i$$

On the other hand *v'*(*x*)-*u'*(*x*) measures the marginal variation of the consumer's net willingness to pay as a consequence of an increase in the efficiency rate *x*. Note that it is the difference between the effect of promotion efficiency on the marginal valuation of the original product and the marginal valuation of the copy.

In order to get some qualitative results we may impose some further constraints on *v*(*x*) and *u*(*x*). First, note that any effort in promotion can be only justified if for a certain initial range *v'*(*x*)>*u'*(*x*). This means that any increase in promotion, within the given range, will increase the net willingness to pay of consumers. Shall *u'*(*x*)>v'(*x*) it would be optimal for the firm to reduce its effort until *e*=0.

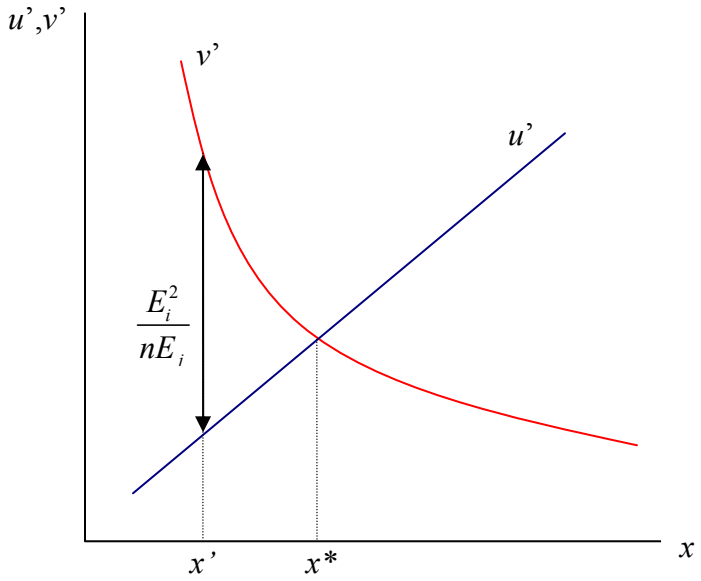
Moreover we assume a concave functional form for *v*(*x*), and a convex (or even linear) function for *u*(*x*). This implies that *v*''(*x*)<0, while *u*'(*x*)≥0. The concavity of *v*(*x*) implies that promotion efforts are subject to diminishing returns. The convexity (or linearity) of *u*(*x*) implies that promotion efforts spread the knowledge of a product within the objective population raising the valuation of the copied material at an increasing (constant) rate.

Finally we assume that within the range [0,1] the value *v*(*x*)-*u*(*x*) can reach a maximum and then decline. However this maximum will not be a profit maximizing strategy as at that point the slope of the objective function (35) will be negative: the firm can increase profits by decreasing promotion efforts. Note that, substituting (36) in (35) and reorganizing, at the equilibrium *v*(*x*) and *u*(*x*) are not equalized but the former is greater than the latter by the amount

$$v'(x_i) - u'(x_i) = \frac{E_i^2}{nE_j}$$

Let us illustrate the equilibrium concept. While $v'(x)$ measures the marginal benefits of the efficiency of promotion efforts on the net willingness to pay, $u'(x)$ reflects the marginal costs of promotion on the net willingness to pay. The former is decreasing as an increase in the efficiency of promotion increases the willingness to pay although at a decreasing amount, while the later may be increasing or constant. Figure 1 shows this. The efficiency ratio that maximizes the willingness to pay is x^*. However, the profit maximizing firm will choose lower promotion efforts, i.e. x': at this point $v'>u'$.

Figure 1:
Optimum Relative Effort of Promotion



Note that this value x' depends on the efforts of the firm as well as on the number of firms and relative size of the efforts of these. It can be shown that, other things equal, the smaller the firm, i.e. the larger E_j for a given E_i, the larger x'. Conversely, the larger the firm the smaller x'. An increase in the concentration of the market is likely to yield a lower E_j, hence increasing the gap between x' and x^*.

Although counter-intuitive at a first glance, these results are not unexpected. They do not imply that a smaller firm devotes larger resources to promotion. It simply states that the gap between its actual strategy and its price maximizing one will be smaller. But even in this case it will invest less resources than a large firm as x^* is specific for each given firm or product. The next section will help clarifying this point.

4.3 Comparative Statics

We now will turn to analyze the effects of other specific variables on the promotional efforts of the firm.

4.3.1 Effect of the Size of the Market on E

Let us start by analyzing the effect of the size of the market *n*. By total differentiation of expression (35) we get the following expression for the derivative of *e* with respect to *n*:

$$\frac{de}{dn} = \frac{E_i^2}{n} \frac{u'(x) - v'(x)}{2E_i \left[u'(x) - v'(x)\right] + E_j \left[v''(x) - u''(x)\right]} > 0 \qquad (37)$$

Unambiguously an increase in the size of the population increases the optimum effort of the firm in promotion. It can be easily shown that in figure 1 a larger *n* closes the gap between *x*' and *x**. Hence we find that, to some extent, promotion is justified on the basis of economies of scale, but counter-intuitively the larger the market the higher the price that the firm will be able to apply. The larger the objective population, the more efforts the firm will devote to promotion and hence the closer will be the actual strategy and the price maximizing strategy. The size of a market is then an important variable in determining the price that the firm will seek: the larger it is, the more promotional efforts the firm will make in order to extract the maximum surplus from consumers.

This has some interesting implications. The model predicts that promotional efforts will be larger the broader the public the firm targets which on the other hand allows the firm to extract a larger surplus from consumers, i.e. to charge higher prices as willingness to pay increases with promotional efforts. On the contrary recordings aimed at a narrower audience will have lower promotional efforts and, other things equal, the price the firm can set will be lower. This poses a theoretical paradox: if promotional expenditures increase the likelihood of economies of scale, recordings aimed at a broader audience should have a cost advantage. However it can be easily shown that prices of the products of the majors, which bear most part of promotional efforts, are well above those by independent firms. Hence the cost decrease from economies of scale must accrue to firms in the form of larger profits.

This comment also applies to the difference of local/global products. Global products are those aimed at an international audience, while local are those aimed at a national one. As expected in our model, the former will bear a higher price than the latter regardless of the benefits that the scale of production imposes.

4.3.1 Effect of the Relative Size of the Firm on E

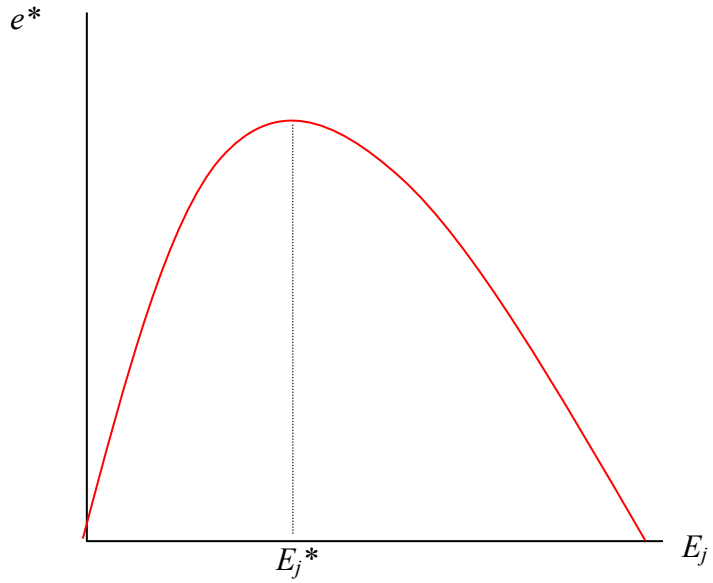
Now we turn to the relative size of the promotion efforts of the firm. Note that when we speak of relative size we mean in terms of the market. We intend to analyze the effect of E_j, i.e. the resources spent on promotion by the rest of the firms, on *e* which is given by

$$\frac{de}{dE_j} = \frac{1}{E_j} \frac{E_i(e_i - E_j)\left[u'(x) - v'(x)\right] + eE_j\left[v''(x) - u''(x)\right]}{2E_i \left[u'(x) - v'(x)\right] + E_j \left[v''(x) - u''(x)\right]} \qquad (38)$$

Note that the sign of expression (39) is not unambiguously determined. In fact it may change depending on the effort of the firm with respect to the outlays of the rest of the firms. It can be shown that there is a threshold level for E_j^* such that for every value $E_j < E_j^*$, an increase in promotional efforts by others are matched by an increased in promotional efforts by the firm.

Conversely for every $E_j > E_j^*$, an increase in promotional efforts by others decrease the efforts made by the firm. Figure 2 shows this result.

Figure 2:
Optimum Efforts as a Function of E_j.



When promotional efforts of competitors are low, an increase in E_j incentives efforts by the firm. However when promotional efforts of competitors are large enough, a further increase in those will disincentive promotional expenditures by the firm.

Relative promotional efforts of the firm are related to the number of competing firms and the asymmetry between firms. Other things equal, the larger the number of firms, the larger will be other firms promotional efforts. In a similar way, the more the asymmetry, i.e. the smaller a firm with respect to the rest of competitors, the larger E_j.

4.4 Promotion and Piracy

The previous comments show that promotion increases deadweight losses as it leads to high pricing, implying a redistribution of welfare from consumers to firms. The size of the welfare loss is related to the target public and the efforts made by other firms. However, how does affect piracy to the promotion strategy of the firm and therefore to the efficiency loss? Note that in the absence of piracy the firm faces the following value function

$$\underset{e_i}{Max} \;\; \pi_i = v(x_i)n - c(n) - e_i \qquad (39)$$

Now the first order condition is

$$f'(e_i)\; v'(x_i)\; n = 1 \qquad (40)$$

Compared to expression (35) now $f'(x)\, v'(x)$ has to be larger. And given that both derivatives are decreasing in e, promotion efforts increase without illegal markets. This is a quite reasonable outcome. As promotion increases the size of the illegal market firms choose lower levels of promotion.

This reinforces the outcome we got in the previous section: piracy decreases the profits maximizing price by a firm. As promotion is linked with the price the firms may charge, less promotion means less rent extraction by the firm and an increase in the *ex-post* welfare of those consumers that purchase the product. Hence piracy reduces welfare losses: it implies a transfer of profits into consumer surplus.

Two comments apply. First, the industry claims that piracy jeopardizes the future of new talents may be misleading. By concentrating efforts in well-known superstars the industry may be inducing piracy and hence affecting the long-term profitability of the sector.

Finally if promotion efforts are fixed costs, the lower level of promotion implies that the scope of the economies of scale will be more limited. This has two consequences. The product is produced more efficiently, therefore there is an allocative gain. However, and due to the limited promotional efforts, some consumers may not purchase it and will have an *ex-post* welfare loss. This last assertion may partially support the industry claim.

5 Conclusions

This paper has focused in the economic effects of piracy and its implication in terms of two marketing variables: price and product. Although the issue remains controversial, there are some clear cut conclusions we can draw from the model we develop.

First, piracy does not perfectly crowd out sales: revenue losses are due to a mix of price decrease and lost sales. This means that piracy, may increase welfare as prices converge to marginal costs.

Second the optimal level of promotion decreases in the presence of piracy. This means that firms may choose lower levels of promotion than otherwise preferred. However this has an indirect effect on prices as they are pushed down. This adds to the previous effect implying that firms set a lower price in the presence of piracy, hence increasing efficiency.

However this comes at a cost. There may be dynamic negative effects of piracy if firms decrease their level of promotion which may lead to some ex-post welfare losses as consumers are not aware of products that, should they have known about them, would be eager to purchase.

Notes

[1] Obviously a copy will never be an exact reproduction of the original. Apart from the quality of the media used for the copy, there are additional aspects that makes both differ: either a jewel case or a digipak format, the booklet, and the lyrics to mention a few, make the copy just a rough substitutive of the original. It depends on the value that the consumer places on these additional characteristics of the product what make a copy a good or bad substitute.

[2] Note that we are considering a firm that sells one product. Alternatively we can consider multi-product firms: *h* firms promoting *m* products, with *h*<*m*.

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