Making Use of File Sharing in Music Distribution*

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Abstract

The use of filesharing systems, so-called P2P networks, to copy music files has dramatically increased since the arrival of Napster. The music industry claims huge losses whereas members of the internet community claim that the music industry can actually increase sales. In this paper we take the view that consumers copy music for sampling purposes, that is, they download music to find out what they like. Hence, P2P networks may actually improve the matching between products and buyers – this is called the matching effect. The downside of P2P networks is that consumers receive a copy which, although it is an imperfect substitute to the original, may reduce their willingness-to-pay – this is called the competition effect. We model these two effects and show that in some cases the matching effect may dominate so that a label's profits are higher with P2P networks than without. In particular, we show that if there are many varieties in

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the market the potential gains from information transmission can be large. Furthermore, we show that the existence of P2P networks may alter the standard business model: sampling may replace costly marketing and promotion. This may allow labels to increase profits in spite of lower sales in a world with P2P networks.

1. Introduction

Digital music files (mostly in MP3 format) have become omnipresent on the internet. Filesharing system pioneered by Napster and nowadays dominated by Kazaa have become popular among certain online communities and a target for legal prosecution by record companies. Industry representatives partly attribute the recent drop in CD sales to a rise in online filesharing, which, from the point of view of the record companies simply reads as piracy of copyrighted material.

In the US alone an estimated number of 40 to 50 million people have downloaded MP3 files. Since the vast majority of material on filesharing systems is copyrighted material this means that almost the same number has downloaded copyrighted material. In some cases, downloading files may be within fair use, namely if a consumer who downloads an MP3-file already owns a CD containing the same song (even this use is contested by the Recording Industry Association of America, short RIAA). However, in most cases consumers download files which they do not already own in some other format.[1]

The surge in downloading has taken the music industry by surprise. It is still trying to find viable business models for online music distribution. At the same time it is trying to restrict the use of filesharing systems with legal measures (as in the Napster case) and what they call educational measures, which also contain threats to consumers and firms (for a survey of the technological, legal, and business aspects see Peitz and Waelbroeck, 2003c). An example is instant messages sent to users of Kazaa and of other filesharing systems. The text of the instant message begins: "It appears that you are offering copyrighted music to others from your computer. Distributing or downloading copyrighted music on the Internet without permission from the copyright owner is ILLEGAL. It hurts songwriters who create and musicians who perform the music you love, and all the other people who bring you music. When you break the law, you risk legal penalties." (cited from press release by the RIAA, "Music Community Steps Up Educational Efforts, Communicates Directly With P2P Users", April 29, 2003). As another example, in May 2003 major US companies received lists from the RIAA of copyrighted MP3-files that allegedly had been downloaded through their server. They were warned by the RIAA of legal action if the downloading does not stop.

[1] In a survey, 28% of all downloaders responded that they downloaded music they already own in a different format (PEW Internet tracking July-August 2000, see Peitz and Waelbroeck, 2003c, for details).

While the music industry is experiencing falling revenues there exists some evidence that online filesharing has added to other exisitng problems in the music industry. Indeed in Peitz and Waelbroeck (2003b) we show that online filesharing is a significant explanatory variable of CD sales, using cross-country data. Given data limitation, these results have to be interpreted carefully. However, for the US these estimates are consistent with numerical exercises using survey data. We therefore acknowledge that the claim that an important part of the drop in CD sales is due to the circulation of MP3 music files via file-sharing systems at least cannot be rejected with our data set.

Advocates of online filesharing argue that free filesharing should not be restricted and that the music industry may actually benefit from it. They give as the reason that downloaders use the downloaded files for sampling and that they buy a legal copy (on CD) if they like the music. This view is to some extent supported by survey data which say that a large share of internet users downloads files for sampling (69% of downloaders listen to new music and 31% to music by artists never heard before according to PEW internet tracking, July-August 2000, for more details see Peitz and Waelbroeck, 2003c). We believe that these numbers understate the potential of file-sharing systems for sampling purposes because cross-recommendations and profiling of downloaders can largely be improved so that it becomes much more attractive for consumers to engage in sampling.

We claim that the argument of sampling fits well many types of music — individually acquired information is very important for music because of the nature of the good (experience; important horizontal product differentiation and taste heterogeneity). This implies that an MP3 download and a CD are complements because the first gives relevant information on the value of the second. Of course, this is a partial view as consumers will download and listen to much more music than they will actually purchase so that some substitution will take place. This substitution may lead to a fall in the number of units sold. The important question is whether record companies can actually benefit from free filesharing although some substitution takes place.

To address this question we analyze a simple multi-product monopoly environment in which the original and the copy are imperfect substitutes. We make the extreme point that sampling may actually increase the label's profits Currently, this seems not to be the case. However, this may also be due to the fact that current file-sharing systems are not very helpful as a sampling device and that the music industry may actually gain if it focuses on consumers' demand for online music and CDs on demand and designs business models around it. (This is, what

Bertelsmann claimed to do with the attempted purchase of Napster). Possibly, fee-based systems can still be introduced successfully. This would give the music industry an additional source of revenues.

Our starting point is the hypothesis that the consumers' sampling technology exhibits increasing returns to scale. This is made concrete by introducing a fixed sampling cost and zero marginal costs for sampling an additional extreme. Sampling allows consumers to find out about their favorite music so that they can make informed purchases. A consumer who likes a particular song or album is assumed to have a higher willingness to pay for the CD (he wants the real thing including lyrics and other complementary material). Hence, through sampling the participation constraint for a consumer's favorite is relaxed. However, after sampling, the outside option for the consumer is different because he owns a digital copy which he can use even if he does not buy. This effect reduces the willingness to pay for the original CD ceteris paribus.

In the simplest version of the model, we postulate that consumers make uninformed purchasing decisions in the absence of sampling. If the information acquired through sampling sufficiently increases the willingness-to-pay then consumers are willing to spend more on a favorite song or album although copies are available than if they had to make an uninformed choice.

Extending the argument, labels may trnasmit information to consumers by marketing and promotion. In the music industry, these marketing and promotion costs constitute an overwhelming part of the unit cost of a CD (*****some numbers here). Sampling then provides an alternative channel of information transmission, which allows labels to save on marketing and promotion. That is, the optimal business model in the music industry may change in the sense that a significant part of the marketing and promotion efforts may no longer be needed with P2P. We find that copying and sampling may reduce revenues but at the same time increase profits. Hence, although the claim by the music industry that revenues fall holds for certain specifications, online filesharing, if it is properly designed, has the potential to reduce the costs of marketing and promotion — in our simple model the need to spend on marketing and promotion is completely eliminated. That is, copying, which is an information-pull technology, substitutes for an information-push technology.

There exists a growing literature on end-user copying (for a review see Peitz and Waelbroeck, 2003a). However, most of the literature does not address copying as a means of information transmission. Exceptions are Duchene and Waelbroeck(2002), Takeyama (2002), and Zhang (2002).

Duchene and Waelbroeck (2002) analyze the effect of extended copyright protection on a firm's distribution and protection strategies, when digital copies available through P2P play an informational role. They consider a one-product firm that decides how much costly technological protection to implement in different legal enforcement regimes. Technological protection increases the consumers' disutility of consumers of a copy but at the same reduces the fair use value of the original product (although they assume that the first effect dominates the second). A strengthening of legal protection reduces the surplus of copiers through the increase in the expected penalty if caught copying. In this framework, they show that increasing copyright protection has both a direct effect on copiers but also an indirect effect on buyers as technological protection and prices increase with legal protection, unambiguously reducing consumers' surplus.

Zhang (2002) argues that sticking to the traditional distribution technology is wasteful from a social point of view when P2P technologies are available. He considers an asymmetric environment in which a star performer can distort demand in its favor using the traditional distribution channel. Niche performers can partly compensate this disadvantage by using P2P that gives them the opportunity to expose a share of consumers to its music, increasing consumers' willingness-to-pay. Thus P2P may be beneficial for the niche performer.

Takeyama (2002) analyzes how copies that provide information on the quality of a product can solve an adverse selection in a two-period durable good monopoly. In particular, if a consumer copies the product in the first period, she learns its quality and can decide whether to purchase in the second period. However, there are some consumers, call them captive consumers, who never copy. Takeyama shows that there exists a pooling equilibrium in which the monopolist intertemporally price-discriminates, selling to the captive consumers in the first period and charging the price equal to the difference in valuation between the original and the copy to the other consumers in the second period. Takeyama then makes the availability or non-availability of copies part of the firm's strategy. She shows that the absence of copies (in other words, the enforcement of copyright) is a (cheap) signal for low quality.

Our contribution to this promising literature is to show that copying increases the fit between an original and its copy, an aspect which can make sampling by consumers beneficial to a label, which is a multi-product firm.

Our plan of the paper is as follows. In section 2, we shortly present some facts, which motivate our modeling strategy. In section 3, we present the model. Section 4 contains the analysis: subsection 4.1 analyzes sampling in isolation, subsection

4.2 analyzes sampling as a possible substitute to marketing and promotion efforts by the label. Section 5 concludes.

2. Four facts about the music industry and digital copies

In this paper we present an information-based story for the usefulness of P2P as part of a label's strategy. Central to our analysis will be that there is a large variety of different titles and albums available. This means we take the multi-product feature and the substitutability between products explicitly into account. As far as we are aware, we are the first to do so. To build our model we first present a number of facts.

1. List prices are rather uniform across albums.

Although some albums generate larger sales than others (and we will not account for this), this observation leads us to believe that we can start with a symmetric model. The uniformity implies two things: (i) labels mostly do not use prices as a discrimination device at least for new titles and albums within its repertoire and (ii) big labels do not follow different pricing strategies. We will abstract from strategic interaction between labels. To the extent that the big labels collude in prices, it does not really matter for the analysis whether we consider a single label, as in this paper, or several labels, as observed in reality.

2. Downloading is strong among the youth. Also, the young cohorts of consumers tend to spend more on CDs than other age groups.

This suggests that the music industry has reasons to worry about downloading since this affects an important part of its revenues. That is, downloading digital music is not a marginal phenomenon but, instead is likely to have a gobal impact on the music industry.

3. An important share of consumers use P2P for sampling.

This means that copying and downloading can be a complement to purchasing some CDs. Listening to downloaded files enables consumers to make more informed purchasing decisions. As we will show, this may actually be beneficial for the label.

4. While sampling seems an important reason for downloading, a share of consumers uses copies as substitutes of originals.

We acknowledge that our model is focusing on the sampling aspect and other less beneficial (from the viewpoint of the labels) downloading activities are largely ignored. However, we present a framework in which consumers can use downloads as a substitute to the original: sampling increases the willingness-to-pay for the

original of the favorite album, whereas the availability of free copies reduces the willingness-to-pay for originals.

3. The model

We consider the problem of a multi-product monopolist facing the decision to advertise and price its products. In section 4.2, we compare the situation of traditional marketing and promotion to the situation in which free digital copies of an original product via a P2P distribution technology is available. For simplicitly, we place our analysis within a discrete-choice setting.

Products in the market. Suppose that the monopolist offers N symmetric products. We use the simple structure of the Salop circle: products are equidistantly positioned on a circle of unit length. Good i is located at l_i on the circle. This particular structure makes the analytical problem easy to solve.[2]

Consumer Preferences. Consumers have an ideal variety ω. This ideal variety is uniformly distributed on the circle. A consumer experiences a disutility $\tau|\omega - l|$ when consuming the good at location l. Consumers at their ideal point obtain a certain value of listening to music which is denoted by $r > 0$, regardless of whether they purchase the original product or downloaded the digital copy. If they purchase the original product and like the good, they obtain an additional utility $\gamma(1/2 - |\omega - l|)$ that corresponds to the value of the original over the copy (such as additional songs, lyrics, booklet, pictures, song information, ...) at a price p. The parameter γ reflects the value added for an original at the ideal location. This value added is assumed to increase linearly with the attractiveness of a product. The underlying motivation for this assumption is that orignal cover with lyrics and other bundled services are very valuable for somebody's favorite band or album, whereas they are of little value if the music is not much appreciated. Note that the maximal distance is $1/2$ in which case the original does not give any value added.

If consumers neither download nor purchase the product they obtain an indirect utility

$$u(0,0) = 0$$

[2] Other models (such as the multinomial logit) may be chosen alternatively. In particular, the one-dimensional spatial structure is merely assumed for convenience.

where the first argument of the utility function corresponds to the decision to purchase the original or not and the second argument to the decision to download the digital copy or not.

When consumers purchase the original product they obtain $v(1,0 \mid \omega; l) = r + \gamma(1 - |\omega - l|)$. This gives an expected surplus

$$u(1,0) = r + \gamma(1/2 - |\omega - l|) - \tau|\omega - l| - p$$

when consumers download digital files using the P2P technology, they can decide to only copy the product or after downloading they can purchase the original product. When a consumer only downloads a digital copy wihout purchasing the original product, she obtains a utility

$$u(0,1) = r - \tau|\omega - l| - s$$

where s is the opportunity cost for sampling (see below). We observe that for $r > s$ there exists a number of products beyond which $u(0,1) > u(0,0)$ for each consumer's preferred product. If we see the choice not to buy as the outside option, then downloading increases the value of the outside option. We call this effect the competition effect because the original enters into competition with the download, which is "priced" at s.

If she downboads and purchases the original version of a product she gets

$$u(1,1) = r + \gamma(1/2 - |\omega - l|) - \tau|\omega - l| - p - s$$

Here, downloading enable consumers to buy the music they like. In this sense, there is a good match between a consumer and the purchased product. The corresponding increase in the willingness-to-pay is referred to as the matching effect.

Denote the buying decision by $b \in \{0,1\}$ and the downloading decision by $d \in \{0,1\}$. We can then write indirect utility as

$$u(b,d) = \max\{b,d\}r + b\gamma(1/2 - |\omega - l|) - \max\{b,d\}\tau|\omega - l| - bp - ds.$$

Consumer sampling. Consumers incur an opportunity cost s for sampling. This costs captures the time and opportunity cost to go on-line and use file-sharing technologies. It also includes time spent searching and downloading files with the P2P technology (the opportunity cost of this activity is assumed to be

negligible). Because of this simplifying assumption, we do not need to develop a model of consumer choice from which to derive the optimal number of samples. In our specification, given his previous information, a consumer either downloads all or none of the relevant files. Downloading all digital files, which are potentially of interest to the consumers, is assumed to give perfect information on the type of products. Hence, the consumer selects the most attractive brand available. In the scenario in which downloads are available we assume that a song which is liked by a consumer gives a positive utility net of a download, i.e., $r > s$.

Precision of information and likelihood to buy. We consider unit demand so that total potential demand is insensitive to the monopolist's marketing strategy. However, as we have described above the consumers' willingness-to-pay is influenced by the label's marketing strategy that can shift the demand curve.

Information precision and likelihood to buy are inversely related. Without any information (no advertising, no uses of P2P technology), the probability to buy a particular product is $1/N$. If a particular product is advertised and the ideal variety is element of the set of possibly ideal varieties, then the probability to buy is $1/(\mu N)$ where $\mu = n/N$, $n \in \{1, 2, ...N\}$ is the length of the circle segment of potentially ideal varieties. If the consumer has sampled all relevant products and selected the one, which is closest to her ideal location, then this good is purchased with probability 1.

The monopolist's decision problem. The monopolist has to choose the amount of marketing and the prices of its products under two different scenarios: (1) only the original good is available; that is, there do not exist digital copies (2) a digital copy is available for free online and consumers can decide whether to download the digital copy and whether to purchase (possibly in addition to the download) the original product. These scenarios are exogenous or part of the marketing strategy. The latter is the case if the download of illegal digital copies can effectively be made impossible. The firm charges a price p for the original products; this price is uniform across products. The digital copy can be obtained free of charge if the P2P distribution technology is available.

The monopolist's technology. The production technology is the following. The marginal cost of production of the original and the digital copy is set to zero because the goods are information goods. Since we consider a particular project and its promotion as given we do not need to include the fixed costs of creating it. The advertising technology is the following. The monopolist uses informative

advertising which reaches all consumers. Advertising provides information about the existence of a product and partial information on the horizontal characteristic of the product. The degree of informativeness is captured by the precision μ, which we treat as a choice variable. Advertising all products with precision μ leads to advertising costs $A(\mu)$ which is assumed to take the form $(a/2)(1-\mu)^2$. This implies that advertising costs convex in the precision.

4. Peer-to-peer technology as a profit enhancer

4.1. Free downloads and consumer information: sources for profits

No P2P. To point out the basic trade-off between availability and non-availability of P2P we analyze the model under the assumption that a firm cannot use advertising. This implies that the only way to transmit information about the characteristic of a particular album to consumers is P2P. Without P2P consumers cannot distinguish ex ante between the different albums and buy at random. Their expected utility therefore is

$$\begin{aligned} Eu(1,0) &= r+\gamma(1/2-\frac{1}{4})-\tau\frac{1}{4}-p \\ &= r+\gamma/2-(\gamma+\tau)\frac{1}{4}-p. \end{aligned}$$

Since all consumers are identical ex ante (because they do not know where albums are located) the monopolist's profits are

$$\pi^m(p)=\begin{cases} p & \text{if } p\leq r+\gamma/2-(\gamma+\tau)\frac{1}{4} \\ 0 & \text{if } p>r+\gamma/2-(\gamma+\tau)\frac{1}{4} \end{cases}$$

Hence, a profit maximizing monopolist sets $p^m=r+\gamma/2-(\gamma+\tau)\frac{1}{4}$ and makes profits $\pi^{m*}\equiv\pi^m(p^m)=r+\gamma/2-(\gamma+\tau)\frac{1}{4}$.

P2P. Consider the other extreme scenario in which all consumers use P2P, download all albums, and consider buying their favorite album. If all consumers buy the album then the maximal distance between the characteristic of the album and the ideal location of any consumer is $1/(2N)$. Suppose for the moment that it is optimal for the monopolist to serve all consumers. Then a consumer with $|\omega-l|=1/(2N)$ has [the] utility

$$u(1,1)=r+\gamma(\frac{1}{2}-\frac{1}{2N})-\tau\frac{1}{2N}-p-s.$$

Alternatively, he may decide not to buy any album after downloading. This gives utility

$$u(0,1) = r - \tau|\omega - l| - s.$$

A consumer with $|\omega - l| = 1/(2N)$ is weakly better off with decision $(1,1)$ than with decision $(0,1)$ if $u(1,1) \geq u(0,1)$ which is equivalent to

$$p \leq \gamma \left(\frac{1}{2} - \frac{1}{2N}\right) \tag{4.1}$$

If inequality (4.1) holds all consumers find that buying their most preferred album after sampling is worthwhile. Note also that $u(0,1) \geq u(0,0)$ for all consumers if

$$r \geq s + \tau/(2N). \tag{4.2}$$

Furthermore, we have to check that consumers want to download, i.e. $u(1,1) \geq u(1,0)$. For this the opportunity cost of sampling has to be sufficiently low, namely

$$s \leq \frac{\gamma + \tau}{2} \left(\frac{1}{2} - \frac{1}{N}\right) \tag{4.3}$$

Then, under P2P the profit-maximizing price (assuming full market coverage) is

$$p^n = \gamma \left(\frac{1}{2} - \frac{1}{2N}\right) \tag{4.4}$$

Comparison. We can now compare profits. Since all consumers buy one unit profits with P2P are greater than without P2P if $p^n > p^m$. This is equivalent to

$$r < \frac{\gamma}{2} \left(\frac{1}{2} - \frac{1}{N}\right) + \frac{\tau}{2} \tag{4.5}$$

This means the larger the number of products the more likely that condition (4.5) is satisfied. We also observe that a higher transportation cost and a higher value of the original (for $N > 2$) favor P2P. This is explained by the advantage of P2P: consumers obtain the good which better fits their tastes; this results in a lower transportation cost and a higher willingness to pay for the original. We can now state our first result.

Proposition 1. *Installing P2P increases the label's profits if inequalities (4.2), (4.3), and (4.5) are satisfied. If $r < \gamma/4 + \tau/2$ and $s \leq \gamma/4 + \tau/4$ then for there exists a critical number of albums $\tilde{N}$ offered by the label such that for all $N \geq \tilde{N}$ the monopolist makes higher profits in the presence of P2P-technology than in its absence.*

The intution behind Proposition 1 is the following. By assumption, the original has two advantages: it provides added value and not using P2P avoids the negative downloading experience. The added value is relevant if the number of albums offered is greater than 2. Note that there is a disadvantage for a single album offered by the label. The reason is that with P2P the utility of the marginal consumer is relevant whereas without P2P consumers have to take expectations over added values — the average added value is greater than the added value at the margin. If there are more than two albums available the sampling of albums allows consumers to pick an album which come quite close to their ideal album. In the absence of P2P an increase in the number of albums does not lead to better choices on average. While this is an extreme formulation we believe it captures the sampling aspect of free downloads in its pure form. Our result also highlights the role of labels under P2P: it provides consumers the possiblity to make more informed choices. Effectively, the corresponding matching effect may dominate the competition effect.

Downloads and loyal CD buyers. Proposition 1 was derived under the assumption that all consumers download. A straightforward extension is to consider a population mix in which a share λ of the population never downloads. We call consumer belonging to this group loyal CD buyers because they do not consider substituting CDs for downloaded files. If these consumers are informed about the different albums (perfect precision) then, if λ is not too large, the label's maximization problem has the solution that both groups buy the original. The price is determined by the incentive constraint of the downloaders. If loyal CD buyers are less informed about the albums then, for certain parameter values, the price is determined by the participation constraint of the loyal CD buyers. Even if loyal CD buyers have the same ex ante information as downloaders profits may be higher with P2P (a necessary condition is that λ is not too large). However, in this case loyal CD buyers do not buy at all when P2P are available.

4.2. A Comparison of two channels to Transmit Information to Consumers

In this subsection we introduce marketing and promotion (an example would be advertising) as an alternative way to transmit information to consumers. The idea here is that the label can transmit information on the desirability of its products to consumers. The label can incur large marketing expenditures such that the information is so precise that all consumers make the optimal choice

(*extreme marketing*). The label may alternatively engage in moderate marketing expenditures which leads consumers to improved choices ex ante compared to a situation without marketing efforts (*moderate marketing*). However, under prefect information they would have chosen a different product with positive probability.

The label can choose the level of precision $1-\mu$ where $\mu = n/N$ and $n \in \{1, ..., N\}$. Here, $1-\mu = 0$ represents no precision and $1-\mu = 1$ full precision. The associated marketing expenditure is $A(\mu) = (a/2)(1-\mu)^2$.

Note that in order for consumers to obtain a higher expected net surplus with marketing expenditures the precision has to be better than 1/2. The expected utility of consumers receiving information with precision $1-\mu$ can then be calculated as

$$E_\mu u = r + \gamma + (1 - \mu/4) - \tau\mu/4 - p.$$

This is the same expected utility independent of the location of the consumer on the circle. We make a couple of observations:

- $E_1 u = Eu(1,0)$ as defined in the previous section. This means that $A(1) = 0$ does indeed give the same expected utility as the model without marketing expenditures.

- $E_{1/N} u > u(1,1)$ for a consumer located in the middle of two products. This implies that transmitting information with precision $1/N$ is more attractive than perfect revelation of the products' positions. The reason is that if consumers perfectly learn the location of the goods they become heterogeneous. The label then has to price such that the marginal consumer is still attracted (located in $1/2N$ distance from a product, provided that full coverage is optimal).

All consumers buy a product if $E_\mu u \geq 0$. This is equivalent to

$$p \leq r + \gamma + (1 - \mu/4) - \tau\mu/4.$$

Hence, for a given precision level μ the label sets its price equal to $r + \gamma + (1 - \mu/4) - \tau\mu/4$. To solve the maximization problem of the label, we will treat μ as a continuous variable. The maximization problem is the following:

$$\max_\mu r + \gamma(1 - \mu/4) - \tau\mu/4 - (a/2)(1-\mu)^2$$

where the price is replaced by its profit-maximizing value. From this follows the optimal precision of the unconstrained problem as

$$\mu^* = 1 - \frac{1}{4a}(\gamma + \tau).$$

The optimal precision $1 - \mu^*$ is thus increasing in the transportation cost.

Consequently, we have the following result:

Proposition 2. *Without P2P the following marketing strategy is chosen:*

- *extreme marketing if*
$$1 - \frac{1}{4a}(\gamma + \tau) \leq \frac{1}{N}$$
- *moderate marketing if*
$$1 - \frac{1}{4a}(\gamma + \tau) > \frac{1}{N}$$

We observe that it is always optimal to engage in some marketing activity (using the continuous approximation). The reason is that improving the precision is relatively cheap when the precision is low.

Profits under extreme marketing are

$$\pi^x = r + \gamma\left(1 - \frac{1}{4N}\right) - \tau\frac{1}{4N} - \frac{a}{2}\left(1 - \frac{1}{N^2}\right).$$

We can first compare profits with extreme marketing to profits in the presence of P2P, given by $\pi^{n*} = \gamma(1 - 1/(2N))$. Even if the label optimally uses extreme marketing introducing P2P increases the labels profits if

$$(\tau - \gamma)\frac{1}{4N} + \frac{a}{2}\left(1 - \frac{1}{N^2}\right) > r. \tag{4.6}$$

We state this result as our next proposition.

Proposition 3. *Even when it is optimal for a label to use extreme marketing in case P2P is not available, installing P2P increases the label's profits if inequality (4.6) is satisfied (and* $(1, 1)$ *is optimal for consumers at* p^{n*}*). This is more likely the larger the label, that is, the larger* N*. If* $a/2 > r$ *there exists a number* $\tilde{N}$ *such that, for all* $N \geq \tilde{N}$*, P2P increases the label's profits.*

[analysis of moderate marketing missing here]

5. Conclusion

We have presented a multi-product monopoly model in which there exist two channels of information transmission: information push via promotion and marketing and information pull via sampling on P2P networks. Although the use of P2P networks gives consumers a costless imperfect copy which may reduce their demand for the original P2P networks may actually improve the matching between products and buyers and in some cases can be used as a channel for information transmission which increases profits. In particular, we show that if there are many varieties in the market the potential gains from information transmission can be large.

A critical assumption was that promotion and marketing are costly channels of information transmission. We made the simplifying assumption that the owner of the original does not incur costs when information is transmitted via a P2P network. This gives a cost advantage to the use of P2P over promotion and advertising. It may overcompensate the competitive effect. The latter effect arises from the introduction of pirated products which may be used as substitutes for the original.

References

[1] *Anderson, S. and R. Renault (1999), "Product Characteristics and Price Advertising with Consumer Search", mimeo.

[2] Duchêne, A. and P. Waelbroeck (2002), "Peer-to-Peer, Pircy and the Copyright Law: Implications for Consumers and Artists", mimeo.

[3] Liebowitz, S. (2002), "Record Sales, MP3 downloads, and the Annihilation Hypothesis", mimeo.

[4] *Meurer, M. and D.O. Stahl II (1994), "Informative Advertising and Product Mix", International Journal of Industrial Organization 12, 1–19.

[5] Peitz, M. and P. Waelbroeck (2003a), "Piracy of Digital Products: A Critical Review of the Economics Literature", mimeo.

[6] Peitz, M. and P. Waelbroeck (2003b), "CD Sales and Internet Piracy – Cross Section Evidence", mimeo.

[7] Peitz, M. and P. Waelbroeck (2003c), "An Economist's Guide to the Technology, Law, and Business of Music Distribution", work in progress.

[8] *Rosen, S. (1978), "Advertising, Information, and Product Differentiation", in D.G. Tuerk (ed.), Issues in Advertising: The Economics of Persuasion, Washington, D.C.: American Enterprise Institute for Public Policy Research, 161–191.

[9] Takeyama, L.N. (2002), "Piracy, Asymmetric Information and Product Quality Revelation", mimeo.