

# **TECHNOLOGY AND THE MUSIC INDUSTRY: EFFECTS ON PROFITS, VARIETY, AND WELFARE**

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## **Abstract**

The aim of this paper is to theoretically investigate the impact of technological advances on the music industry. Much work has been done concerning the effects of peer-to-peer file sharing systems such as Napster and Kazaa on firms in the music industry. This paper goes deeper by considering other technological advances in addition to peer to peer networking, such as advances in the actual recording of music. Following the work of Cooper (2002), the first section extends further into the implications of technology and models potential remedies, such as investment in quality innovations, for firms in a music industry where copies of original music can be obtained at zero cost. The paper also examines many of the current strategies used by firms within the music industry in response to the advent of file-sharing networks, such as litigation. The following section focuses on implications on actual recording artists. Using cost-reducing technological advances in the production and distribution of music, it is now possible for artists to create and freely distribute their work with the hopes of receiving income in other entertainment related endeavors, such as live shows. This paper models these technological advances and shows how this progress leads to more artists and more variety within the music industry. Finally, the paper shifts focus to welfare considerations in an environment of technological advance and examines whether or not these advances will make society better off.

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## I. Introduction

The problems facing firms in the music industry in the face of new technology has been the subject of much research in the past few years. File-sharing technology, which allows for free transfer of digital media, combined with the advent of CD burning technology has threatened to turn music CDs into public goods. Before the influx of this new technology, firms in the industry were the only ones with the capability to produce artists' CDs and make them available to the public. File-sharing programs such as Napster, Kazaa, Gnutella, and others have eliminated the excludability aspect of many forms of intellectual property, and thus have opened the door to potential free-riders. The more widespread this technology becomes, the larger the problem. Under the situation of rampant file sharing and copying of original works, firms may not be able to get enough of a return to warrant further production of original CDs from artists.

The literature in this area concerning the music industry begins with Alexander (1994). That paper discussed digital compression techniques and examined how early file-sharing distribution networks might threaten the existing structure of the music industry. That paper dealt mainly with the (then) new MP3 compression technology and file-sharing networks<sup>1</sup>. Most early file-sharing technologies, such as Napster and MP3.com relied on a single, central server. The fact that centralized networks must share files through a single central server made them easy targets for legal prosecution. As a result, most centralized file-sharing programs like Napster have either closed themselves down or been forced to shut down through legal injunctions<sup>2</sup>.

Newer versions of file-sharing networks have emerged in the past several years. These networks differ from previous file-sharing technologies in that they do not rely on a single centralized server. This means that there is no longer a single entity for legal prosecution and it become much more costly to use the same sort of legal techniques. As a result, the music industry faces the same free-rider problem. As long as file-sharers on these networks are willing to share their resources at a small cost to themselves to sustain

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<sup>1</sup> MPEG-Layer 3 technology is a method of compressing audio in near CD quality at approximately 1/15<sup>th</sup> the size. This allowed the transferring of audio files through the internet. Combined with the advent of high speed internet access, the transfer of entire albums can take place in a matter of minutes

<sup>2</sup> "Judge Orders Napster to Halt Online Music Distribution", [www.cnn.com](http://www.cnn.com); 7/26/00

these networks, the structure of the industry could potentially be damaged (Alexander 2002). To combat this and protect their market power, firms in the industry have begun to sue individual file sharers in an attempt to deter consumers from free-riding and making copies of original recordings<sup>3</sup>.

Cooper (2002) adds to this literature by using theoretical and empirical analysis to investigate some of the effects of the increase of technology. Using a model of monopolistic competition, he finds that in a situation where firms don't have marginal cost advantage over consumers in producing CDs, there is no musical variety in the industry. If firms are unable to price high enough to recoup fixed costs, then artist CD's will not be produced by firms. This result holds as long as there is no difference in quality between original CDs and copies.

This paper seeks to extend the literature in several ways. First, I use a setup where firms exercise monopoly control over artists in the industry to examine the effects of technology on profits and the number of artists signed. This setup was chosen because it more accurately describes the real situation facing firms in terms of barriers to entry and potential for long-run profits.

Secondly, this paper attempts to model various steps that the firm can take in the face of widespread file-sharing technology. These potential solutions to the free-rider problem are broken down into two separate categories. First, firms have the ability to invest in a higher quality product. By adding bonuses or producing higher quality CDs, firms can stimulate the demand for original CDs. Record companies in the industry also have the option of pursuing legal remedies. Current copyright law makes it illegal to share copyrighted material through these file-sharing networks, so it is possible for firms to either seek injunctions for the networks themselves or to prosecute actual file sharers. This paper attempts to model both investments in quality and legal remedies and examines the effects that they have on variety and profits in the industry.

Finally, the paper also focuses on artists' decisions and the ability for artists to produce and distribute their own music to the public. In particular, the focus is on new technologies that facilitate the production of high quality music as well as the file-sharing technologies that make distribution possible. The free-rider problem is not as serious for

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<sup>3</sup> "261 Music File Swappers Sued; Amnesty Program Unveiled", [www.cnn.com](http://www.cnn.com); 1/23/04

artists as it is for firms in the industry because all of the revenue from the production of music does not come from the sale of CDs. Artists have the ability to hold live performances of their music to get a large portion of their revenue. As a result, the incentive to provide CDs may still exist for artists even when it does not exist for firms in the industry. This ability to use CDs as promotional tools for other sources of income has important implications for the kind of variety that exists for consumers.

The paper unfolds as follows. Section 2 presents the basic assumptions and structure of the theoretical model. Section 3 applies the model to the decision making process of the firms in the industry and analyzes profits and variety under various file-sharing and legal regimes. Section 4 examined decisions of artists in the industry and the effects of these decisions on variety. Finally, Section 5 looks at welfare considerations and discusses whether or not these increases in technology are beneficial or harmful overall.

## **II. The Model**

The model starts with the assumption that artists in the music industry are differentiated using a popularity parameter,  $\theta$ . Each artist  $j$  has an associated value  $\theta_j$  which reflects the type of music he/she makes. The variable  $\theta$  has an assigned distribution,  $s(\theta)$  which takes on only positive values. The higher the value of  $\theta_j$ , the more popular the artist

An important characteristic to note about this popularity parameter is that for the purposes of this model, it is a known parameter for both the artist and the record company in the music industry. This means that firms can make decisions regarding the signing of artists with full information on how successful a particular artist will be with consumers. The question of whether or not this is a realistic assumption is debatable, but I believe that firms can get a reasonably good knowledge of an artist's popularity through the various talent scouts they employ. Artists will theoretically get knowledge of their own type through their experiences with others who listen to their music and offer

feedback. Even if the exact value of  $\theta_j$  is never known by either side, both firms and artists should be able to get a close approximation of the true value and base their decisions off of the approximate value. In either case, the results don't differ significantly.

The general demand for CDs of a particular artist  $j$  depends on both the price of the CD and the popularity parameter  $\theta_j$ . This model uses linear demand for simplicity, but the analysis in subsequent sections can be extended to more general demand functions. Demand  $Q(\theta_j, p_j)$ , where  $\theta_j$  is the popularity parameter for artist  $j$  and  $p_j$  is the price for artist  $j$ 's CD is given by the following equation:

$$Q(\theta_j, p_j) = a - bp_j + m\theta_j$$

Marginal costs for each CD are assumed to be zero here. This is fairly reasonable as the actual costs for a CD are fairly small and are constant over any relevant range. The following sections explore how firms make decisions within this model under certain technology and legal setups. First, the situation without file-sharing technology is examined to provide a point of reference for variety and profits in the industry. Then, the situations with file sharing technology and legal prosecution by firms are considered to examine the effects on variety and profits.

### **III. The Firm**

#### *i. No file sharing technology*

In a situation without file sharing technology, firms in the music industry are free to exercise their market power. Firms, once they sign a particular artist, are the only ones who can produce CDs for that artist and therefore occupy a monopolist position over every artist that gets signed.

Each firm in the music industry faces a two-stage game. In the first stage, the firm makes a decision whether or not to sign a particular artist  $j$ , knowing the artist's type  $\theta_j$ . If the firm decides not to sign the artist, then the game ends for the firm and the artist

is left to his/her own options. If the decision is made to sign artist  $j$ , the firm basically faces the monopolist decision of choosing the profit-maximizing price given a certain demand for CD's. Firms are assumed to face a certain fixed cost  $C$  for each artist. This fixed cost would include things like promotion and artist development as well as costs connected with producing the material on the CD. By backwards induction, the firm would first choose  $p_j$  to maximize the following profit expression:

$$\max_{p_j} \pi_j = p_j(a - bp_j + m\theta_j) - C$$

This yields expressions for the profit maximizing price and quantity:

$$p^*(\theta_j) = \frac{a + m\theta_j}{2b}$$

$$q^*(\theta_j) = \frac{a + m\theta_j}{2}$$

The interesting thing about these two expressions is that the more popular the artist (higher value of  $\theta_j$ ), the higher the price for the CD and the more CD's that get sold. The maximum profit for a particular artist  $j$  can be obtained through these two expressions.

$$\pi^*(\theta_j) = \frac{(a + m\theta_j)^2}{4b} - C$$

Now that the profit maximizing problem has been taken care of, the focus shifts to the first stage of the game. A firm in the music industry has to decide whether or not to sign a particular artist based on the profitability of the artist shown above. A firm is only interested in signing an artist if they expect to make enough revenue to recoup the fixed costs invested into the artist. Since the maximum profit expression is increasing in  $\theta_j$ , it is possible to find the *break even* value of  $\theta_j$ . This break even value would represent the *least popular* artist that would be signed by a record label in the music industry. It is important to derive an expression for the least popular artist to be signed, because this

will give an idea of the variety of music available to the public. Artists below this least popular level, labeled  $\underline{\theta}$ , will not be picked up by any firm in the industry, and without technology to allow self-distribution they will not be available for public consumption. All artists above  $\underline{\theta}$  will be profitable for firms in the industry and therefore will be signed and made available to the public

The value of  $\underline{\theta}$  is going to be the popularity level that causes profits to be equal to zero. This leads to the following condition:

$$\frac{(a + m\underline{\theta})^2}{4b} = C$$

Solving this for  $\underline{\theta}$  yields the following expression for the break even level of popularity:

$$\underline{\theta} = \sqrt{\frac{4bC}{m^2}} - \frac{a}{m}$$

This expression can be used to find profits for the entire industry. Industry profits are simply the sum of all profits of individual artists that are signed by firms in the industry. Industry profits are just the sum of all individual artist profits with  $\theta_j > \underline{\theta}$ .

The above analysis provides a good summary of firms' behavior without any sort of file sharing or cost-reducing technology. It is a description of the industry before the music related technology explosion and will be used as a reference point throughout the paper to discuss changes caused by technological innovation.

*ii. The firm with the threat of file-sharing: the quality response*

In a situation with rampant file sharing technology, a firm in the music industry has to find ways to convince consumers to purchase artists' CDs. Since the cost to consumers of downloading a CD is virtually nothing, there are two main reasons why a consumer would purchase an original CD produced by a record label rather than a copy. First, if the quality of the original is better than the quality of the copy, a fraction of

consumers will spend money to get the original CD. Secondly, as I will discuss in the next section, consumers can be deterred by legal methods. Current copyright law makes it illegal to share copyrighted material through these file sharing networks such as Kazaa and Gnutella. This fear of facing a fine or jail for file sharing will be enough to convince a portion of the population to purchase original CDs.

For now, the focus will be on the difference in quality between originals and copies. As file compressing and CD burning technology improves, the quality difference between a copy and its original becomes less and less. It is reasonable to say that in the near future, the quality difference will not be enough to convince anyone to buy originals. Ignoring the legal issues for the moment, this means that the demand for originals would diminish to zero. Firms as a result would never make the decision to sign artists and incur any fixed costs for artist development and production and would eventually go out of business in the long run.

In order to prevent this scenario, firms have the option of increasing the quality differential between originals and copies<sup>4</sup>. That is to say, firms have to provide incentive for consumers to purchase original CDs provided by the firm and restore at least some of the original demand,  $Q(\theta_j)$ . In practice this is done in a number of ways. Oftentimes firms encourage CD sales by providing exclusive bonus DVD's with the purchase. Other techniques include special contests entered by purchasing a CD, autographed CD's, or higher quality CD's (SACDs). The purpose of all of the above is to stimulate demand for original CDs by increasing the quality differential, and in most cases, these are offered as a bonus without a change in the price.

For the purposes of this model, the focus shifts to the firm's profit maximization problem when it has to incur additional costs,  $C_q$ , to maintain a fraction,  $\alpha$ , of the original demand<sup>5</sup>. Firms still face a similar two stage game where they decide whether or not to sign in the first stage and then choose the profit-maximizing profit in the second stage. However the demand after the investment in quality,  $Q'(\theta_j)$ , is now:

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<sup>4</sup> It is important to note here that the firms are not making investments in the quality of the *artists*, but rather the quality of the physical CD that is produced and sold.

<sup>5</sup> For the purpose of simplicity, the cost of quality investment is kept fixed as is  $\alpha$ . It would be easy to imagine a scenario where  $\alpha$  depended on the amount invested in quality, or both  $\alpha$  and  $C_q$  depended on another variable that firms could choose, such as advertising. For the purposes of this paper however, the results hold in either case, so the simplest case is shown here.

$$Q'(\theta_j, p_j) = \alpha(a - bp_j + m\theta_j)$$

Given this new demand, firms choose  $p_j$  to maximize the new profit function shown below:

$$\max_{p_j} \pi'_j = p_j \alpha(a - bp_j + m\theta_j) - (C + C_q)$$

This yields new expression for profit maximizing price and quantity under quality investment:

$$p^{**}(\theta_j) = \frac{a + m\theta_j}{2b}$$

$$Q^{**}(\theta_j) = \alpha \left( \frac{a + m\theta_j}{2} \right)$$

Notice that the profit maximizing price is exactly the same as it was before. The fact that the new demand is a fraction of the original demand and the original parameters are the same ensures that the price. For values of  $\alpha$  between 0 and 1, the results above show that the equilibrium quantity has decreased by the same fraction that demand has decreased. The profit from signing artist  $j$  is obtained using the above two expressions:

$$\pi^{**}(\theta_j) = \frac{\alpha(a + m\theta_j)^2}{4b} - (C + C_q)$$

Compared to the situation where there is no file sharing technology available, the profits are lower when file sharing is unchecked through the industry and firms must invest in quality differentiation. Two forces cause this lower profit level. First, profits are lower for each artist because of the fact that demand is only a fraction of what it was before. The second cause for lowered profits comes from the increased fixed costs that firms are

forced to incur in order to survive in the industry where the difference between originals and copies is next to nothing.

Having solved the second stage of the firm's game, the decision whether or not to sign a particular artist  $j$  can be explored. As in the previous section, the expression for maximum profit for artist  $j$  can be used to find the *break-even* level of popularity under the file sharing technology regime. This will help show the effect that this technology improvement has had on the variety of music available for public consumption. The new break-even point,  $\underline{\theta}'$ , is the level of popularity where maximum profit from the artists is equal to zero, or:

$$\frac{\alpha(a + m\underline{\theta}')^2}{4b} = C + C_q$$

Solving for  $\underline{\theta}'$ , we get an expression for the new level of break-even popularity:

$$\underline{\theta}' = \sqrt{\frac{4b(C + C_q)}{m^2\alpha}} - \frac{a}{m}$$

Since  $0 < \alpha < 1$ , this means that the break-even level of is higher now than it was without file sharing. All artists below this break even level will not get signed. This means that the higher the value of  $\underline{\theta}$ , the fewer the amount of artists that will be signed.

Since  $\underline{\theta}'$  is greater than  $\underline{\theta}$  and  $\pi^{**}$  is less than  $\pi^*$ , it follows that industry profits are smaller in the scenario where file sharing is freely allowed as opposed to the scenario where there is no file sharing at all. Fewer artists are signed by firms and the profit per artist is smaller than it was before. Combine this with the reduction of variety in the industry and this suggests that even though firms can partially combat the public good aspect of increases in technology, there is still some serious effects on both consumers and firms.

*iii. The firm under the threat of file-sharing: the legal response*

The second major option that firms have in the face of rampant file sharing is to use the legal channels currently available to them. Precedent has already been set through landmark decisions against Napster.com and MP3.com which ruled that these file sharing technologies had to stop distributing copyrighted material. It is fairly easy to legally shut down file-sharing programs like Napster and MP3.com due to the fact that all files are shared on a central server. Future technologies like Gnutella do not rely on these central servers and instead rely on peer-to-peer connections. As a result, it has become more difficult to target any large company for litigation. The RIAA has since switched its target of litigation from the actual file-sharing networks, to *individual people* who offer files on these networks. The intent of the music industry seems to be to deter individuals from using these file-sharing networks and raise demand for original CDs through fear of fines. In this way, firms in the industry will be able to get back a portion of the demand that is lost when file-sharing technology becomes widespread.

The modeling of this scenario is similar to the previous section where firms invested in increasing the quality difference to reclaim a portion of demand. All firms in the industry contribute to pay a certain fixed cost of legal prosecution,  $C_L$ . As a result of this legal prosecution, the firms get a certain fraction,  $\rho$ , of the original demand<sup>6</sup>. The firm in the industry again faces the same two-stage game as explained in earlier sections. The new demand is given by:

$$Q^n(\theta_j, p_j) = \rho(a - bp_j + m\theta_j)$$

An important distinction between the previous section and this one lies in the profit function that firms solve to determine the price and quantity of CDs for a signed artist. The investment in legal costs does not take place on a *per-artist* basis. Rather, this action is taken by the RIAA and figures into the industry profit expression, not the artist profit expression. The firm in the second stage of the game solves the following artist profit expression:

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<sup>6</sup> As in the previous section, the cost of legal prosecution and the fraction of demand reclaimed is kept fixed for simplicity.

$$\max_{p_j} \pi_j'' = p_j \rho (a - bp_j + m\theta_j) - C$$

Solving for  $p_j$ , we get the following expression for price and quantity:

$$p^{***}(\theta_j) = \frac{a + m\theta_j}{2b}$$

$$Q^{***}(\theta_j) = \rho \left( \frac{a + m\theta_j}{2} \right)$$

For  $0 < \rho < 1$ , again there is a situation where the price is the same as before any technological advance and the quantity is less than it was before any technological advances. Whether or not this quantity  $Q^{***}$  is greater or less than  $Q^{**}$  depends on the values of  $\rho$  and  $\alpha$ . From this, the following maximum profit expression is obtained:

$$\pi^{***}(\theta_j) = \frac{\rho(a + m\theta_j)^2}{4b} - C$$

This expression can be used again to determine the break even level of popularity in the industry under this regime of legal prosecution,  $\underline{\theta}''$ . This is the level of popularity that solves the following equation:

$$\frac{\rho(a + m\underline{\theta}'')^2}{4b} = C$$

Solving for  $\underline{\theta}''$  yields the following expression for the new level of break even popularity:

$$\underline{\theta}'' = \sqrt{\frac{4bC}{m^2\rho}} - \frac{a}{m}$$

Again this expression shows that the break-even level of popularity is higher than it is under a situation with no file-sharing technology in the industry. Since a higher break-even level of popularity means less variety in the industry, this result shows that variety has also been lessened even when firms try to legally remedy the free-rider problem. Since  $\pi^{***} < \pi^*$  and  $\underline{\varrho}'' > \underline{\varrho}$ , it follows that industry profits are less under this scenario as well. Notice that the legal costs, which didn't show up in the firm's profit maximizing decision for artist  $j$ , will be taken from overall industry profits. The reason for this is that legal actions are not taken with each individual artist that gets signed by a firm in the industry. Rather, legal prosecution of file-sharing networks and file-sharers is taken by the Recording Industry Association of America (RIAA), which is a collection of firms in the music industry.

This section on the firms in the music industry provides a number of important insights. First, the model shows that no matter what the firms attempt to do to combat free downloading of CDs, they always end up with less profit than they previously enjoyed before technological improvements. However, the situation is not as drastic as to ensure that firms will no longer be able to survive in the long run. Secondly, the model shows that the variety of artists signed by firms decreases in any scenario involving file-sharing. This result is fueled primarily from the fact that firms are unable to reclaim all of their original demand by either quality investments or legal prosecution. As a result, artists have to be more popular in order to recoup the firms' fixed costs. Whether or not investment in quality is more profitable for the industry than legal prosecution depends on the values of  $\alpha$ ,  $\rho$ ,  $C_q$ , and  $C_L$ . In fact, the industry itself does not seem to be too clear as to which method performs better, as different methods are used by different firms. This problem facing the industry is a fairly new one and it may be a while before there is a clear cut best response for firms in the face of rapidly improving technology.

#### IV. The Artists

The previous section addressed the options that firms have in combating free riders caused by the advent of file-sharing technology. As a result, fewer artists end up getting signed by record labels, which is considered a welfare loss for both consumers and firms. However, this need not necessarily be the case. One aspect of increased technology that has been largely ignored by the literature is that these recent advances have made it feasible for artists to produce their own music. New programs such as Pro Tools, Sound Forge, Cool Edit Pro, and others have made it possible to make near studio quality recordings using a home computer. This drastically reduces the need for countless hours of expensive studio time that was previously necessary. And with the widespread nature of file sharing, it becomes very easy for music to be distributed to consumers. What this means is that potentially, there are opportunities for artists to take matters into their own hands and create and share their CDs. However, using these file-sharing networks to distribute material to consumers means that these artists will not receive any revenue in the form of CD sales.

What this means is that other sources of revenue must be large enough to cover the fixed costs of producing a CD. Artists differ from firms in the industry in that artists can take the exposure that they might get by giving away CDs for free and use the promotion to boost tour revenue. An artist that is not popular enough to be signed by a firm in the industry may be able to generate enough non-CD revenue to cover the costs of producing a CD. What this means is that the results from section 3, where variety was reduced due to widespread file-sharing, are not necessarily true.

To illustrate this, suppose an ordinary artist that gets signed receives revenue from two sources: tour revenue,  $T(\bullet)$ , and CD revenue  $R(\bullet)$ . Both tour revenue and CD revenue received by the artists depends on the quantity of CDs in the hands of consumers. That's to say, the amount of CDs out that consumers own is going to influence the amount of tour revenue an artist is able to generate.

In a scenario where file-sharing is widespread, for a regular artist that gets signed to a recording contract, his profit is given by  $T(Q^{**}) + R(Q^{**})$  or  $T(Q^{***}) + R(Q^{***})$ , depending on the method used by the firm to combat file-sharing

Under a system of file-sharing with quality investment by firms, an artist that is not popular enough to get signed ( $\theta_j$  less than  $\underline{\theta}$ ) can still produce and distribute CDs by themselves<sup>7</sup>. Since individual artist typically can not invest in quality in the same way firms can they essentially are forced to give away CDs for free in this scenario. So the associated quantity that is demanded is given by:

$$Q(\theta_j, 0) = a + m\theta_j$$

By assumption the artist, if he decides to produce and distribute his CDs for himself, must incur some costs  $C_A < C^8$ . This would include such things like buying the programs to create high quality music and paying for websites for basic promotion. It is less than the costs for firms because it does not include the staffs that work on the production of CDs, expensive studio time, or other firm specific costs. So the key for determining how variety is affected by file sharing lies in whether or not non-CD revenue,  $T(Q(\theta_j, 0))$ , is greater than the costs to artists,  $C_A$ . Particularly of interest are the revenues of values of  $\theta_j$  below the *original* break-even level of popularity,  $\underline{\theta}$ . If some of these artists have incentive to produce and distribute CDs, then this means that variety has actually increased. The analysis to the case where firms legally prosecute is similar.

This question of whether this non-CD revenue is greater than the costs to artists who can't get signed is an empirical one, but the theory suggests that it is highly possible to actually have an increase in variety despite what previous literature in this area suggests. This idea is bolstered by the growth of such websites like Soundclick.com, which is a website designed for artists without recording contracts with firms to promote

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<sup>7</sup> Another possible scenario, where artists who are popular enough to be signed instead choose to distribute their music themselves is not examined here. It is assumed that the CD revenue gained by signing with a record company is greater than the increase in non-CD revenue minus costs gained by not signing with a record company.

<sup>8</sup> This seems like an odd assumption to make, since the whole purpose of having a firm is to take advantage of certain economies of scale. However, it seems as though the main benefit of having a firm lies in the distribution and promotion. Since artists don't have to worry about distribution with widespread file-sharing, much of the economies of scale from firms is lost.

and distribute music. Soundclick.com reports that it now adds 6,000 new bands per month to its membership<sup>9</sup>. This suggests that artists are increasingly able to produce their own music and variety is increasing in the industry.

## V. Welfare Considerations

The effects of technology on welfare can be analyzed by looking at the individual welfare of each of the economics actors in this model: the firms, the artists, and the consumers. The model presented in section 3 of this paper clearly showed that firms' profits are going to be reduced if there is widespread file-sharing available to consumers. Whether the firms recapture some demand using investment in quality or legal methods, the outcome of lowered profits is unavoidable. Artists who were popular enough to get signed before file-sharing are also necessarily worse off under any technological advances. The artists who remain signed ( $\theta_j$  greater than  $\underline{\theta}'$  and  $\underline{\theta}''$ ) are worse off because the quantity sold is less in each scenario. Since both non-CD and CD revenue are increasing functions of quantity sold, this means that the artists' revenue is necessarily lower. The artists who are not popular enough to remain signed ( $\theta_j$  less than  $\underline{\theta}'$  and  $\underline{\theta}''$  but greater than  $\underline{\theta}$ ) are worse off because now they either have no incentive to create music, or they must incur costs and receive zero CD revenue. However, artist who were never popular enough to be signed by a firm in the industry ( $\theta_j$  less than  $\underline{\theta}$ ) are potentially better off because they may have the ability to create and distribute CDs using this new technology.

The effect of increases in technology on consumers depends heavily on both the methods used by firms to reclaim some of their demand, and the incentive for artists themselves to produce and distribute CDs. The best case scenario for consumers is when firms decide to invest in quality and artists that were previously not signed now produce and distribute. If this is the case, consumers now get higher quality for the same price as before and also enjoy a higher variety. A portion of that increased variety is available at no cost to consumers, as the unsigned artists provide CDs for free. This gain for

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<sup>9</sup> "What is SoundClick?", [www.soundclick.com](http://www.soundclick.com)

consumers is more than enough to offset the loss of profit incurred by firms and signed artists so society as a whole benefits.

Another beneficial scenario for the consumer is if firms use legal methods to combat file-sharing and artists who were previously not signed have incentive to produce and distribute. If this is the case, consumers pay the same price for CDs as they did before with the same quality. They also enjoy a greater variety due to the increase of CDs by previously unsigned artists at no cost to the consumer. However, the legal costs incurred by the firm are a deadweight loss to the industry, and if these costs are too great, the benefit gained by consumers in the form of higher variety may not be enough to offset the losses in profit suffered by firms and signed artists

The case where firms invest in quality and artists who were not previously signed have no incentive to produce and distribute is more ambiguous as far as consumers are concerned. On one hand, consumers enjoy a higher quality at the same price as before. On the other hand, consumers have less variety to choose from since the only artists that have CDs for consumption are those who get signed by firms in the industry. Since the effect on consumers is uncertain, the effect on society as a whole is also uncertain.

The worst case scenario for consumers and society as a whole is where firms use legal methods to combat file-sharing and artists who were not previously signed have no incentive to produce and distribute. Consumers pay the same price as before for the same quality of CDs. However, there is less variety here as artists who normally would be signed are no longer signed. The only ones who benefit here are individuals who escape legal prosecution and still download and share music for free. As discussed earlier, firms lose profit, artists lose profit and some lose their job, and consumers lose variety. This means that this technology has hurt society overall and the threat of free-riders has made everyone worse off.

## **VI. Conclusion**

Rapidly increasing technology in the music industry has posed a number of challenging problems to firms within the industry. This paper has argued that the increase in file-sharing technology need not cause severe damage to society or to firms. I

have presented a model which allows for firms in the industry to reclaim a portion of their original demand and survive even though consumers have widespread access to file-sharing networks. Also, it is possible that artists in the industry are benefiting from this increase of technology. Cost reducing technology in the hands of artists has allowed for the opportunity for artists to produce and distribute their own work. This in turn has lessened or offset some of the effects of the threat of free-riders on society.

An interesting result of this paper is that the best case scenario for society involves firms not using legal methods to combat the free-rider problem. This would suggest that firms are harming society currently as the RIAA steps up its legal assault on file-sharers. In effect, firms are stifling the spread of a more efficient technology in an attempt to protect their market power. In fact, the results raise questions in terms of copyright protection under law. Perhaps society would be better off if copyright protection did not extend to digital media and file sharing was allowed to spread to all households.

Empirical research in this area would provide more conclusive evidence of the effects on profits and variety in the industry. The theory in this paper is limited in that it can only tell the possibilities that may exist for the future of the recording industry. As the industry develops, there will be more and more data available to determine exactly in which direction the industry is heading

Further research in this area might include an investigation of smaller, independent labels and how technology helps/hurts their ability to survive. These kinds of labels are distinctively different from the major firms in the industry because they tend to have lower costs than major firms. This is fueled by a smaller amount of expensive promotion in the form of videos, smaller staffs dedicated to each artist, and less money spent on artist development. A particularly interesting aspect of the independent record label is that often times they are not a member of the RIAA, but they potentially benefit from any sort of legal action used by firms.

Other areas of interest would be a thorough modeling of the artist's decision in the industry, especially concerning the ability to promote themselves and get consumers to notice their product. Also, research in the area of how firms improve the quality of the CDs they sell would prove useful. The model used in this paper describes certain

methods, but as technology increases, consumer may be able to copy these methods and reduce the quality gap to zero again. Future methods of investing in quality may not have the same properties of zero marginal cost and may cause different effects within the model.

This paper is useful however in that it suggests that policymakers in society should consider the effects of technology on entities besides the firms. The inclusion of artists in the discussion radically changes the analysis of how consumers are affected by technological advances. This change in consumer welfare should be weighted against the profits lost by firms to determine the overall benefit to society.

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