The Economics of File-Sharing

Is Piracy Killing Music?

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Master Thesis for the degree Master of Philosophy in Economics

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UNIVERSITETET I OSLO

15. November 2010

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Summary

The recording industry has seen a massive decline in sales since 1999. This decline has by many, especially the recording industry itself, been attributed to the introduction of file-sharing services on the Internet. But despite lawsuits and campaigns advertising moral behavior, sales continue to decline. Moreover, individuals seem to treat music as a 'public good' more than a 'private good'.

This thesis investigates the claim put forth by the recording industry that internet file-sharing is to blame for the decline in record sales. It provides an overview of relevant literature on the subject, and uses this to analyze if piracy can have other effects on the industry and the economy than just displacing sales. It finds that, under certain assumptions, piracy might act as a promotional tool, potentially increasing the sale of a subsequent album, or increasing demand for complimentary goods, like live performances. The thesis also looks at how the current copyright and copy protection schemes have been designed, and discusses whether there is room for changes that might improve social welfare. It concludes that targeted enforcement is a better option than current broad-based enforcement, if possible. It also concludes that of the three government options tax, subsidy, and fine, a subsidy is the socially preferred alternative. Enforcing a tax on copy complementaries, like CD-burners, recordable CDs or a multimedia tax, is a second-best option, whereas a fine only lowers the consumer surplus without positively benefiting the publisher.

Preface

This master's thesis was written between August and November 2010. It has seen several variations in themes before the current topic finally was decided upon.

First of all, I would like to thank my supervisor, Tapas Kundu, for invaluable advice, help and patience during this writing period.

Secondly, I need to thank my friends, both on- and off campus. The coffee breaks have provided necessary breathing space, as well as inspirations for topics, themes and methods.

Lastly, my must humble thank you's and appreciation to all my professors, teachers, and co-students at the University of Oslo, University of Minnesota, and Universität Mannheim, for providing me with invaluable experiences and making these past 6 years a magnificent journey.

Special thanks to Craig Taunton, Malene Fregil, and Sigurd Thune for proof-reading all of or parts of my thesis. All remaining errors are purely my own.

Oslo, November 15th 2010

Espen Willassen Hoel

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1 Introduction

Few industries have experienced more rapid change the past decade than the entertainment industry. The widespread penetration of broadband internet access has made downloading of music, movies and books an easy and quick activity. Musical recordings are now leaked to the Internet before they are even released officially from the record company, and a movie can be downloaded to a laptop in Norway as it premieres in Hollywood. At the same time, the entertainment industry reports declining sales and bleak prospects for the future.

Considering its part in the economy, the focus given to the crisis in the entertainment industry is highly disproportionate. It is estimated that the entertainment industry only contributed between 5 and 7 percent of the American gross domestic product (GDP), and the music industry made up only 0.11 percent of the world GDP in 2000 (Liebowitz, 2006; Romer, 2002). However, the consumption of these goods tell us something about their importance: a U.S. Census Bureau report from 2003 showed that the average American spent 4.5 hours a day watching television, and more than 3 hours listening to music (Liebowitz, 2006).

Illegal downloading, file-sharing, or piracy as it is commonly known, has exploded during this past decade. As technology has improved, it has become easier and cheaper to find and download illegal copies from the Internet than ever before. Downloading a pop album could take more than 15 minutes in the late 90s (not including the time it took to find working links). Today, it is done in a matter of seconds (Oberholzer-Gee and Strumpf, 2009; Zentner, 2006). The introduction of portable music players like the iPod has also increased the demand for digital music files.

The recording industry argues that illegal downloading displaces record sales. And surely, record sales have declined drastically around the world this past decade. This thesis examines the claim put forth by the recording industry and copyright advocates that file-sharing and illegal downloading is to blame for the decline in record sales. By use of existing literature on the topics of file-sharing, piracy, the music industry and copyrights, it also examines the potential consequences that file-sharing might have on an economy, and how it might affect the music industry as we know it today. I show that the losses reported by the recording industry are most likely overblown. Furthermore, I find that under certain criteria,

piracy might actually work in a positive way, as it increases the number of individuals listening to an artist. This increases demand for complementarities to records, and I show that there therefore might arise a conflict of interest between the artist and the record company publishing her album.

The thesis focuses mainly on U.S. numbers and U.S. industries. This follows as a consequence of the geographical location of the entertainment industry of the Western world. Where applicable, however, global numbers and effects are analyzed.

This rest of this thesis is organized as follows: section 2 gives us the background of the economics of copying, and explains what is meant by file-sharing, piracy, and copyrights; section 3 examines the claims made by the recording industry of how much piracy costs society annually; section 4 introduces the concept that piracy might increase demand for subsequent releases from an artist, while section 5 shows that it might increase demand for complementary goods like live performances; section 6 then shows that the artist might not oppose piracy in the same way as the publisher will; section 7 investigates how piracy affects innovation within the music and recording industries, and section 8 provides some policy implications regarding copyrights; section 9 concludes.

2 Background

The economics of copying can be traced back at least as far as Plant's seminal 1934 study 'The Economics Aspect of Copyrights in Books'. There, he acknowledges the need for a copyright on intellectual goods like books to make sure authors are remunerated for their effort but he is also aware that monetary reward is not the only reason why authors write books. He also claims that the copyright makes sure that more authors will write, and that there will be a greater variety in books as a consequence of the copyright. On the other hand, there will be fewer copies of the books that people actually want to read. Plant also finds an increase in publishers as a consequence of the copyright, something that would give the authors more bargaining power when choosing with whom to sign publishing agreements, and that the prices of books will be higher than the competitive level. Plant, in other words, is aware that the copyright will lead to a monopoly situation in the sale of books.

Plant argues that the copyright monopoly is not the most efficient way to remunerate authors, and makes the case that government subsidies financed by taxation might be a better option, if feasible. If this is not feasible, Plant argues that copyright monopolies should be restricted by an agency in the same way that patents and licenses are distributed. He does, however, comment on the practical difficulties of granting some books and authors a copyright while leaving others without.

The economics of copying has, in the aftermath of Plant, been a popular subject since technology has lead to new innovation that threatens existing business models. In the 70s and 80s, the introduction of photocopiers led economists to study its effect on journal sales. Then the focus turned to the effect of VHS players on the movie theaters, and then on movie rentals when the VHS players were turned into recorders as well. In the late 90s and the 2000s, the focus has shifted to the consequences of internet and file-sharing on the media industry.

File-sharing has been subject to media attention since the late 90s, especially in the case of the file-sharing network Napster, which led to an explosion of opinions and press coverage. Economists, business analysts, lawyers, and sociologists have all undertaken studies on the topic, in order to explain how and why file-sharing happens, who the file-sharers are, what the consequences on the media industry will be, and how the legal system is to react to this new digital threat.

The copyright of an intellectual good makes for a legal dilemma. Publishers and producers have, since the development of the photocopier argued that the copyright is infringed in every occasion where copying occurs and, on occasion, the courts were in agreement (Gordon, 1982). Proponents of copying have claimed that the so-called 'fair-use' doctrine allows them to make copies of journals, movies, TV-shows, or musical records for their own benefit. 'Fair-use' is a doctrine that allows for copyrighted work, or parts thereof, to be copied without remuneration or the copyright holder's consent, if it is in the general social interest. This is by no means an easy task to decide, and the 'fair-use' doctrine was, in the case of Universal City Studios v Sony Corp. of America in 1981, called "the most troublesome in the whole law of copyright" (Gordon, 1982, p. 1600). In the cases regarding photocopiers, Betamax-players, VHS-players, and cassette-recorders, the legal precedent eventually became that copying was considered 'fair-use', and the affected industries found new business methods to compensate for losses incurred by copying (Liebowitz, 2006). The results regarding online file-sharing have been markedly different.

The file-sharing network Napster was launched in 1999 and turned out to be an immediate success. In November 1999, there were 1 million registered users, and by July 2000 this had grown to be 20 million (Hong, 2005). As much as 2.8 billion music tracks were estimated to be downloaded in February 2001 alone (Romer, 2002). The music industry, led by the Recording Industry Association of America (RIAA), acted swiftly and took Napster and its creators to court. Napster was closed in July 2001 as a consequence of these legal actions, but the damage done was irreversible. Its millions of users switched to other file-sharing software to get a hold of the latest songs rather than buying them at the record store. Napster had opened a brand new market, and software like LimeWire and Gnutella followed in its immediate footsteps. LimeWire, which was founded in 2000, was finally shut down by American legal authorities in October 2010 after the RIAA had sued the company behind the LimeWire software, Lime Wire LLC, for enriching themselves through copyright infringement.[1] In Sweden, the file-sharing site PirateBay is the subject of numerous legal claims. Having operated since 2004, the site is claimed to be the 94th most popular web page worldwide.[2] Its founders were found guilty of "assistance to copyright infringement" in 2009 and sentenced to 1 year in prison, as well as fined approximately $3.6 million.[3]

[1] http://www.reuters.com/article/idUSN2616212420101026?pageNumber=1, accessed Nov 1st 2010
[2] http://www.alexa.com/siteinfo/thepiratebay.org, accessed Nov 1st 2010
[3] http://www.economist.com/node/13518830, accessed Nov 1st 2010

Piracy and file-sharing has, over the past decade, become household terms, and to the worry of the entertainment industry, it has also become a norm. Teenagers and adults alike seem to experience little or no moral qualms in downloading a copyrighted file, even if they are aware that it is illegal. Consumers feel that music and movies should be sold at their marginal cost, and also that the artists and record companies make enough money as it is (Chiou et. al, 2005). Not witnessing the effect of their activities displaces their feeling of guilt or injustice, and consumers are, to an increasing extent, becoming accustomed to attaining their media goods free of charge (ibid.). The rise of the political Pirate Party across the world underlines this tendency. Founded in Sweden in 2006, they are now represented in over 40 different countries worldwide. Based on a platform that today's copyright system is flawed and unable to handle the free flow of information made possible by the internet, the Swedish Pirate Party has been elected into parliament in Sweden, while three other nations have Pirate Party members elected into district- and local governments. This rise in the 'Napster mentality' might be more alarming to the media industry than file-sharing itself (Bach, 2004).

Before moving on to the economic effects piracy and file-sharing might have on the music industry and the economy as a whole, it might be useful to define what piracy and file-sharing actually is.

2.1 What is Piracy?

The term 'piracy' is used a bit carelessly in both media and in academic studies, and will be used carelessly in this paper as well. The more precise definition of piracy, according to the digital goods industry, is the act of copying or counterfeiting in order to derive a profit on resale (Rayna, 2004). Classic examples would be copies of a CD or DVD sold on the black market or at flea markets. These items are physical copies, and they represent physical sales. An IFPI estimate says that 1.2 million pirate CDs were sold in 2005 (Siwek, 2007).

The more relevant aspect for this paper is often referred to as 'softlifting' by the industry (Rayna, 2004). This is defined as the copying of software, music, or movies without authorization from the publisher, but for personal use and not with the purpose of selling it to others in order to derive a profit. Thus, what is usually referred to as 'piracy' in the media is actually 'softlifting', but the possibilities brought forth by the Internet have blurred these lines. In this present paper, I shall therefore use the term 'piracy' to cover both 'softlifting' and the industry's definition of 'piracy'.

2.2 What is File-Sharing?

File-sharing is a technology for easy and quick distribution of digital media on the Internet. Popularized by peer-to-peer (P2P) software like Napster at the dawn of the millennium, file-sharing is now looked upon as the biggest threat to the entertainment industry. In essence, a P2P-software connects two or more computers and allows a user to copy files which the other user ('host') has made available. The file-sharing software allows the user to search for a specific file and produces a list of all other users who are hosting that specific file and offers it for 'sharing'. The user who makes the file available neither experiences a reduction in the quality of her internet-connection, nor on her enjoyment of the file being shared. More than one user can copy the same file from the same host at the same time, even while the host is using the file at her own computer. Therefore, the file no longer possesses the rival quality that it did while on the CD, and it moves closer to being a public good. As these files are offered free in monetary terms, and the penetration of high-speed broadband internet connection is steadily increasing, at least in the Western world, the exclusiveness of a media file is also becoming a thing of the past. New file-sharing software, like BitTorrents, even allows the user to copy small parts of the media files from a variety of hosts at the same time, thus substantially lowering the time spent on downloading a file.

Publishers of file-sharing software have been taken to court by special interest groups like the RIAA on numerous occasions. Howver, apart from Napster, and more recently PirateBay and LimeWire, it has proved difficult to get legal consensus to shut down the services. This is because the above-mentioned Betamax-case states that a company is "not liable for customers' acts of copyright infringement if their technology is capable of substantial non-infringing uses" (Oberholzer-Gee and Strumpf, 2009, p. 8). Most software producers, however, have chosen to settle legal disputes from the entertainment industry out of court, after a court decision in 2005 ruled that "their goal was to induce copyright infringement" (Oberholzer-Gee and Strumpf, 2009, p. 9). LimeWire proved the only notable exception but, as of October 2010, they have also been shut down on order by a U.S. federal court.[4]

[4] http://www.reuters.com/article/idUSN2616212420101026?pageNumber=1, accessed Nov 1st 2010.

2.3 What is Copyright?

As intellectual goods like music, movies, and books have a near zero marginal cost of producing when first produced, copyrights have been installed to ensure remuneration to the producers of the good. This is based on the concept that in order to stimulate further production of these goods, there is a need for a financial incentive. Though the origin of the copyright can be traced all the way back to England during the 1600s, music was not included until the U.S. Copyright Act was revised in 1909 (Varian, 2005).

An intellectual property protection has three dimensions: length, width, and height. 'Height' is perhaps the most loosely defined of these terms. It is an indication of how 'new' an idea put forth must be in order to be protected. In this respect, copyrights can usually be considered to be quite low, and almost everything created is protected by a copyright as soon as it exists in a tangible form (ibid.). This means that it is the expression of an idea that is covered by the copyright, not the idea itself. By 'width' one means the extent to which an expression is covered by the protection. A copyright offers quite narrow protection in that only the expression is covered. For music, this means that it is legal to copy methods, ideas, concepts and inspirations, as long as the expression differs. Lastly, 'length' is a reference to how long the protection will be in place. The copyright's purpose is to give protection of the good for a limited time, for the holder to reap the economic profit arising from it. At the moment, this limited time is internationally set at default as "the life of the author plus seventy years" (Varian, 2005, p. 127).

As the terminology and concepts now should be clear, I shall move on to discussing the effects piracy can have on the economy in general, and the recording industry in specific. This is the topic of the next section.

3 The Cost of Piracy

Illegal copying, or piracy, has several potential effects on an industry and on an economy. The most obvious effect would be that it displaces sales of the legal product. If an illegal copy is close enough to the original in quality, the two become close substitutes. If this is the case, then consumers would choose the cheaper of the two goods. Disregarding moral costs, this would most likely be the illegal copy. Faced with a competitor that has near-zero marginal cost, the publisher of the legal good is at a disadvantage as it bears the fixed cost attached with producing digital media goods. And if producers are unable to cover their losses, they will eventually go out of business

This has also been part of the basis of the recording industry's campaign against piracy. With slogans such as 'Piracy is killing music', industry associations and lobbyists have, at times viciously, argued that unless governments and enforcement agencies step up their fight against copyright violations, the entire digital media industry faces almost certain death. In the US, the Recording Industry Association of America (RIAA) launched lawsuits, firstly against those responsible for file-sharing networks and sites, and then later against individuals caught sharing copyrighted material.[5] There is no denying the obvious: record sales have gone down drastically during the past 10 years, and the decrease coincides suspiciously with the introduction of file-sharing networks like Napster.[6] This 'perfect fit' surely calls for an investigation as to whether there really is a cause-effect connection, or if it is all just a coincidence. After all, the turn of the decade saw an economic downturn, especially in the U.S., highlighted by the bursting of the so-called 'dot-com bubble'. Another reason could be that music consumers switched to consuming other goods that can be viewed as substitutes. Evidence does point to an increase in spending on movies and computer games at the same time as record sales declined (Oberholzer-Gee and Strumpf, 2007). But if there is a negative correlation between file-sharing and legal sales, what is the full economic consequence of this?

The recording industry is the industry that has been hit the hardest by file-sharing so far. RIAA numbers reveal that per capita sales of recorded albums have gone down from approximately 5.5 in 1999 to a predicted 2.5 in 2005 (Liebowitz, 2006). With the exception of

[5] http://www.riaa.com/faq.php, accessed Oct. 20th 2010.
[6] See, for example, Liebowitz (2006), Ehmer and Porsch (2008), Oberholzer-Gee and Strumpf (2009), or BPI Research & Information (2009).

2004, there has been a marked and steady decline in sales every year since Napster started the file-sharing revolution mid 1999. Some have argued that the percentage increase in record sales in 2004 proves that file-sharing's impact on record sales has been grossly exaggerated by the recording industry,[7] while others believe that this temporary rise was a result of RIAA's legal action against individuals who were caught file-sharing (Liebowitz, 2006). The latest available statistics from the RIAA indicate that sales of physical albums on CD have decreased by 20.5 per cent in units between 2008 and 2009, while sales of albums on cassettes have gone down by 102.8 per cent. Even though the sales of CD-singles and albums on vinyl have increased, their market share is too small to make much of an impact: Total retail decreased by 18.2 per cent in units between 2008 and 2009. In dollar terms, this change means 20 per cent less retail value in one year, or approximately $1.1 billion.[8]

The above discussion is by no means the full economic picture but merely points out that the obvious direct effect of the decline in record sales is of significant proportions, and this is for the United States alone. The other major music markets also suffered a decline in physical sales. Germany saw a decline of 4 per cent in physical units in 2007 (Ehmer and Porsch, 2008), while the United Kingdom had a decline of 8 per cent in 2009.[9] These are, of course, quite serious setbacks to any industry. Sadly, it is not the only consequence displaced record sales will have on an economy.

When consumers are choosing to illegally download recorded music, they deprive record companies and artists of their income. It also deprives record stores of their sales, as they are the link between the publisher and the consumer. Indirectly, it will also hurt producers of supplies to the record companies and stores, as well as the industries selling complementary goods to recorded music, like CD-players or plastic casings (jewel boxes) for CDs. There will therefore be a multiplier effect arising from displaced record sales that has consequences far beyond just the publisher's profit or artist's income. This loss of revenue will in all industries potentially lead to fewer jobs available. Lastly, there will be a loss of government revenue due to less tax being paid. This decrease arises from both the loss of income tax, as fewer people are employed in the affected sectors, and from the loss of sales

[7] http://www.guardian.co.uk/music/2004/jul/22/netmusic.digitalmedia, accessed Oct 20th 2010.
[8] Numbers taken from RIAA (http://76.74.24.142/A200B8A7-6BBF-EF15-3038-582014919F78.pdf), accessed Oct 20th, 2010.
[9] Authors calculation using numbers from the British Recorded Music Industry (BPI) (http://www.bpi.co.uk/assets/files/UK%20Market%20-%20Top%20Lines%20%282000-2009%29.pdf), accessed Oct 20th, 2010,

tax, as consumers switch to the free-of-charge illegal good instead of the legal product. As these losses add up, the consequences to the economy increase as well.

Few studies exist that try to fully measure these effects. Most existing studies have measured the impact of file-sharing on record sales. An article by Oberholzer-Gee and Strumpf (2007)[10] created quite a bit of controversy when released as it claimed that the overall effect of file-sharing on record sales was minimal, if there even was one. Their article has later been subject to a lot of scrutiny, and especially Liebowitz (2007) was almost vitriolic in his criticism of Oberholzer-Gee and Strumpf's result. In general, most economists do disagree with Oberholzer-Gee and Strumpf: Michel (2006) finds that file-sharing has lead to a decline in the sale of recorded music, while Hong (2004) estimates that approximately 20 per cent of the sales decline while Napster was in operation can be attributed to file-sharing. Others who have found similar results include Zentner (2006) and Rob and Waldfogel (2006).

The evidence of piracy's effect on record sales thus seems overwhelming. Accepting the hypothesis that record sales indeed have suffered because of illegal file-sharing and physical piracy, we turn to the question of how much harm illegal copying has caused the economy. The studies mentioned above estimate that sales displacement has been somewhere between 10 and 30 per cent, so it seems natural to follow Siwek (2007) who assumes that of every five songs illegally downloaded, one of them would have been purchased legally absent of piracy. Siwek is also, to my knowledge, the only study that aims to quantify the total impact of piracy on the economy. He also includes physical piracy, meaning the selling of bootleg-copies at flea-markets etc, to his analysis. When it comes to physical piracy it is assumed that displacement of sales is much higher, and based on survey respondents a substitution rate of 65.7 per cent is used in this study (BPI Market Information, 2006).

Using these displacement numbers combined with the cost of acquiring the music legally, we can make estimates of the loss incurred in monetary terms. We shall assume a retail price of $14.13 per album, as this is the world average retail price, and use the average trade price of $8.58 (Siwek, 2007). The loss suffered by the recording industry in the US alone from piracy is estimated to be $5.333 billion a year. This consists of a $1.630 billion loss from physical piracy and $3.703 billion from file-sharing. Next, the retail industry suffers loss of sales worth $1.041 billion as a result of music consumers opting for the pirated versions of their favorite albums instead of purchasing it at the record store. The direct effect

[10] This article was first released as a working paper in 2004.

of piracy in the music market thus leads to a yearly direct loss of $6.374 billion to the US recording industry. The numbers are given in table 1 below.

Table 1: Direct Effect Losses Incurred by Music Piracy

	Billions of U.S. dollars
Recording industry	$5.333
Retail Sector	$1.041
Total	$6.374

Source: Siwek (2007), tables 1 and 3

Next, the indirect effect needs to be calculated. These are the numbers that are usually unaccounted for in most economic studies available. They are also the numbers that are the most difficult to estimate and to which there is the most uncertainty attached. One method to estimate the indirect effects is to use an input-output model like the RIMS II model. The RIMS II model provides multipliers for several U.S. industries, including the sound recording industry. The multipliers include 'final demand' multipliers for output, earnings, and employment, and also 'direct-effect' multipliers for earnings and employment. By using these multipliers one can get estimates on how the piracy affects these areas in all other industries. A drawback is that the RIMS II is only applicable at local level, and our estimates are for a national level. However, since approximately three fourths of sound recording in the U.S. is divided between five states,[11] one can use the RIMS II model independently on each of these states to get estimates of how piracy has affected output, earnings, and employment in the other industries in those particular states. A similar approach can be used to estimate the spillover effect of lost retail sales to other industries.[12]

By use of the RIMS II model, one can find the counterfactual increase in the economy absent of piracy. For the recording industry the counterfactual 'final demand' would have increased output by $10,211 million, earnings by $1,997 millions, and employment by 46,114 jobs. The numbers from the retail sector are $2,290 million, $699 millions, and 24,946, respectively. Adding them up would then give the overall effect on output, employment, and earnings accruing from piracy.

[11] The states in question are California, New York, Tennessee, Florida, and Texas.
[12] For the retail sector, eight states have been used as reference points. They are California, New York, Texas, Ohio, Pennsylvania, Illinois, Florida, and New Jersey.

In addition, the RIMS II model gives the estimates for direct employment and direct earnings, meaning jobs and respective earnings lost. For the sound recording industries these numbers would be 12,019 and $712, respectively. For the retail sector they are 14,841 and $342. These estimates are summarized in table 2 below.

Table 2: Estimates from the RIMS II model

	Final Demand (millions)	Output (millions)	Earnings (millions)	Employment	Direct Employment	Direct Earnings (millions)
Recording industry	$5,333	$10,211	$1,997	46,114	12,019	$712
Retail	$1,040	$2,290	$699	24,946	14,841	$342
Total		$12,501	$2,696	71,060	26,860	$1,055

Source: Siwek (2007), tables 6 and 7.

Lastly, one can calculate the loss from taxes. This will depend heavily on the findings from the RIMS II model. There will be a loss of personal income tax from the direct earnings in the recording industry and retail sector of $114 millions, and a total tax revenue loss of $291 million when including all input industries.[13] For the recording industry, lost corporate income tax amounts to $81 million and lost production tax of $50 million. [14]

Based on these findings we conclude that the overall effect on the U.S. economy caused by piracy of recorded music is a loss of $12.5 billion in economic output each year. In addition, 71,060 jobs are lost, and the government loses $422 million in tax revenue each year. If these numbers are correct, there is no wonder that the recording industry wants the government to support their fight against piracy.

An important caveat is that the estimate is based on how global piracy affects the U.S. economy. This might be a natural simplification since the United States is the leading provider of copyrighted entertainment goods subject to piracy, but it is still worth keeping in mind when these numbers are presented. Also, the use of the RIMS II model is dubious at best. The states representing the sound recording industries only make up 75 per cent of the American industry but the entire sales decline are attributed to these five states. This will

[13] Using an average tax rate of 10.8 per cent.
[14] Assumed corporate income tax rate 14.8 per cent, and production tax 4.8 per cent.

potentially make the result overblown. This is because the five states are divided according to their market share among themselves, but not according to the U.S. market. For example, California, the most important recording industry state in the U.S. makes up 41.46 per cent of the collective five states. The analysis above then treats California as if they have 41.46 per cent of the entire U.S. market, not 41.46 per cent of the 74.3 per cent of it that the five states collectively make. Thus, California is given a share of 0.4146 instead of 0.3080, which would have been a more accurate share.[15] This could significantly increase the effect on the recording-intensive states, and treat them as relevant for the entire country. The error is more significant in the retail sector where the sample of eight states only account for half of the American market but still receive the entire loss of sales effect attributed to them. It is therefore reasonable to believe that although the numbers might have the correct sign, their size might be overrated.

The analysis by Siwek has often been cited by the recording industry as justification for their actions against piracy. It has, a bit surprisingly, not been subject to criticism by other economists, nor has it been a much cited analysis. This is problematic since it is the main survey portrayed when organizations like RIAA put their opinions across. The criticism that does exist of Siwek's study usually revolves around him assuming each song downloaded is a displaced sale.[16] As we will see later this criticism might be justified. Another point of interest is that all though Siwek claims that he finds the true cost of piracy, he completely disregards any potential positive effects. Several other surveys have found that piracy can actually have positive effects on the music industry or on society, through promoting an artist to an audience that previously would not bother to bear the cost of introducing themselves to the music; by selling complementary goods like concert tickets, t-shirts, etc.; or by increasing the share of the population able to enjoy the music produced. We will explore all of these topics in the following sections.

[15] Author's calculations.
[16] See Hui and Png (2003)

4 Promotional Piracy

The set-up provided by Siwek and the recording industry holds some questionable assumptions. As mention, it treats every downloaded file as a lost sale. Other early contributions to the economics of copying also do this for every copy.[17] In addition, these studies treat all agents as if they are fully informed, and assume that all valuations of the product are independent of the other consumers. These are strong assumptions, and as we shall see, they might not be justified.

A strand of literature has been written emphasizing the role of network sizes.[18] The general claim is that a larger user base will increase an individual's valuation of that particular good. Typical examples would be computer software, where one text document software is not compatible with a different text document software. Thus, a company like Microsoft may hold a competitive advantage just because the size of its network, and potential customers might be willing to pay more to buy Microsoft Office programs than those from a competitor. Another aspect where the network size might be applicable is the learning process. If most firms use one brand of text writing systems then chances are that new employees are familiar with these systems when hired. The firm could therefore save themselves costs of training by acquiring the same systems themselves. The case for network effects in software should therefore be straight forward. When it comes to music, it might seem more dubious to talk about network effects. I will nonetheless argue that most individuals find it a heightened experience to attend a concert with other people than by themselves, or that discussing an album with friends (and, increasingly due to various internet-forums, strangers) increases their valuation of the music. Also, the larger the network size, the more likely is it that the artist will tour or release new music.

The assumption that all individuals are fully informed might be even more inappropriate in today's music scene than the independent valuation assumption. There are thousands upon thousands of different artists releasing recordings in all different sorts of musical genres. To be fully informed of all of them is literally impossible even for the most zealous music fan. This is probably why record companies spend millions of dollars each year on promoting albums and artists. It is fair to say, however, that some artists receive more

[17] See, for example, Novos and Waldman (1984) and Johnson (1985)
[18] See, for example, King and Lampe (2002), Silva and Ramello (2000) and Quah (2002).

promotional spending from their record company than others. This section will argue that rather than just 'stealing' potential record sales, piracy might under certain circumstances potentially act as a promotional tool. More specifically, it introduces a two-period economy where the size of the initial market is limited due to incomplete consumer awareness, and illegal consumption in the first period might help spread the word about a product and thus increase the legal consumption of the product in the second period. In line with Croxson (2009), we shall first develop a 'no-piracy' benchmark case, and find that a monopolist publisher will choose to offer a 'promotional price' in the first period in order to increase the consumer awareness the next period by sacrificing some potential profit. We will then introduce piracy, and show that a 'promotional effect' might arise as a consequence of this new consumption channel. Note that the model also finds a displacement of sales as a potential result from piracy, so the overall result is ambiguous and depends on the assumptions and the nature of the pirated good. A generalization will say that software intended for offices and research institutions, which would mostly be consumed by adults and individuals with higher costs attached to copying, will be more likely to benefit positively from piracy, while computer games and music will be more likely to suffer from sales displacement.

4.1 No Piracy Benchmark

There are two periods, $t = 1,2$, and the monopolist releases a new product in each of the two periods. A good example for this paper would be two different albums released by the same artist. As throughout this paper, we assume the marginal cost of production (and hence also of copying) and distribution to be zero. A consumer consumes either one or zero units of the product each period, and she has a valuation v for it. The individuals are distributed in the population according to $F(v)$. Unable to price discriminate, the monopolist charges a uniform p_t to all consumers for the product released in period t. Since awareness of the product is limited, only a fraction $\alpha_t \in [0,1]$ of individuals will be in the market considering purchasing the product. All others will be blissfully unaware of the product's existence, and will thus be deriving zero utility from it. We shall assume that initial awareness, α_1, is exogenously given, while awareness in the second period, α_2, depends positively on total consumption in the first period, q_1, and negatively on the price set by the monopolist in the first period, p_1, meaning $\frac{\partial \alpha_2}{\partial q_1} > 0$ and $\frac{\partial \alpha_2}{\partial p_1} < 0$.

The marginal buyer is the consumer who is indifferent between buying the product and being without. Her valuation in period t is therefore $v = p_t$. Since only a fraction α_t knows about the product, and there is no possibility of piracy, the number of consumers is equal to the number of buyers,

$$q_t = q_t^b = \alpha_t[1 - F(p_t)]$$

We shall solve the model backwards. Since there is no third period in this model, the publisher does not care about future sales. Knowledge of the product in the second period, α_2, is treated as exogenous as the publisher cannot influence it in this period. The publisher thus seeks to maximize the current profit function

$$\pi_2 = p_2[1 - F(p_2)]$$

Standard models of monopoly sales then say that the optimal price is given by the first-order condition, so

$$p_t = \frac{1-F(p_t)}{F\prime(p_t)} := p^M$$

By use of this monopoly-price, the maximized second-period profit will be

$$\pi_2^* = \alpha_2 p^M[1 - F(p^M)]$$

Note that this is simply the standard maximization of profit in a monopoly model, but multiplied with the awareness-indicator α_2. Since $\alpha_2 < 1$ is a plausible assumption according to the discussion above, this means that limited-awareness leads to lower second-period profits in our model than in standard monopoly models.

The negative correlation between first period price and second period awareness means that the forward-looking publisher will maximize total discounted profit with this in mind in the first period. Denote her intertemporal discount factor as $\delta \in [0,1]$. The publisher will then seek to solve the following problem

$$\max_{p_1} \Pi = \alpha_1 p_1[1 - F(p_1)] + \delta\alpha_2\pi^M$$

The first-order condition implies

$$\frac{\partial \Pi}{\partial p_1} = 0 \;\Rightarrow\; p_1^* = \frac{1-F(p_1^*)}{F\prime(p_1^*)} + \frac{\delta\pi^M}{\alpha_1}\frac{\alpha_2'(p_1^*)}{F\prime(p_1^*)}$$

Above we saw that the standard price setting in a monopoly model implied $p_t = \frac{1-F(p_t)}{F\prime(p_t)}$. Our optimal price features a second term on the right-hand side. By our assumptions, this extra term will be negative since we have assumed a negative correlation between first period price and second period awareness, meaning $\alpha_2'(p_1^*) < 0$. All other components are positive, by assumption.

Our results then give us the following implications: In the second period, the publisher acts as a standard monopolist, and sets price accordingly; $p_2^* = p^M$. In the first period, however, the publisher is aware of the negative effect a high price will have on future awareness and consumption, and she therefore opts for a price lower than the monopoly price, a so-called 'promotional price'; $p_1^* \leq p^M$. The effect of this 'promotional price' is that it allows all individuals with valuation $v \in [p_1^*, p^M]$ to purchase the product in the first period, given that they are aware of its existence. The idea now is that this extra consumption in the first period might lead to increased demand in the second period, through 'word-of-mouth' or user experience.

Lets define all individuals with valuation of the product high enough to purchase, $v \geq p^M$, as 'high types'. Those who has a valuation lower than the monopoly price, $v < p^M$, are by analogy referred to as 'low types'. This means that in the second period, only 'high types' who are aware of the product will consume it. Unaware 'high types' as well as all 'low types', be they aware or not, will not be consuming the product. In the first period, however, the 'promotional pricing' set by the publisher allows for some of the aware 'low types' to consume the product as well. This is done at a potential cost to first-period profit, however, as the publisher has to set this lower price equal for everyone. If there was a way for the publisher to allow some of the 'low types' to consume, and thereby raise second-period awareness, without sacrificing her first period profit, then the publisher would find this a more optimal option.

4.2 Pirates, O'Hoi!

Above, the consumer only had two options; either she purchased the product at the price in period t, or she went on without it. Now, we shall introduce the third option, namely the option of copying the product. We assume that there is a cost, $c \geq 0$, attached to copying. This could be the alternative cost of searching the web for the correct files; the cost of

purchasing necessary equipment to make copies; the risk of downloading files with viruses; or the risk of being caught downloading and prosecuted by authorities. Assuming that she is aware, an individual would now choose to purchase the product only if her valuation of it exceeds the price, and only if this price is lower than her cost of copying. If this latter requirement does not hold, the consumer would rather copy than purchase. If her valuation is lower than both the price and her cost of copying, she'll choose to not consume the product at all. Formally, her utility is

$$u = max\begin{cases} v - p_t \\ v - c \\ 0 \end{cases}$$

We can illustrate our situation graphically in a v, c space. A 45-degree line through the origin will represent the marginal copier; at any price on this line she would be indifferent between copying and being without. By drawing the monopoly price p^M on both the horizontal and vertical axis, we obtain a threshold of valuation, and can divide the space into four different categories, depending on the behavior of individuals located there.

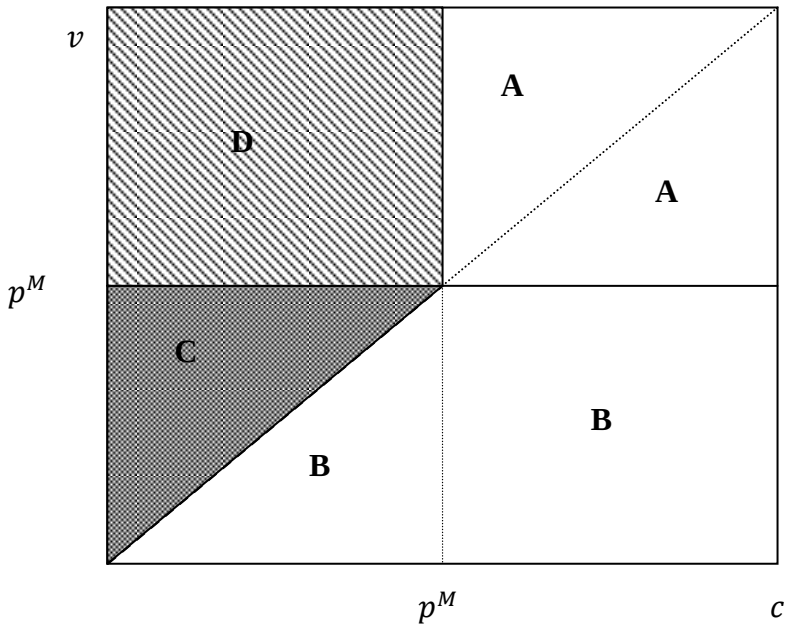

Figure 1: *v, c* **space**

Source: Croxson (2009)

The areas marked A in the figure above are safe sales. An individual in these areas would always have a valuation v higher than the monopoly price p^M. As their cost of copying

also exceeds the monopoly price they will never be prone to copy. Individuals in the areas marked B will always have a valuation lower than the monopoly price. As their cost of copying will always be higher than their valuation of the product as well, an individual in these areas will never choose to consume. The individuals in these areas are, in other words, of little interest to our analysis.

The area labeled C is however of greater interest to our analysis. This is where you will find 'low type' individuals who would copy if they had the opportunity. As can be seen in the figure, they have a higher valuation of the product than their cost of copying but their valuation is not high enough to purchase the product legally at the monopoly price. Given the possibility to copy it, they would. Since these individuals would not have been consuming the good absent of piracy, the extra consumption cannot represent lost sales. Rather, this would be extra promotion to the publisher, as it raises awareness of the product in the second period.

The area labeled D is its negative counterpoint. These are 'high type' individuals who are more than willing to copy. Since these individuals will maximize their utility by copying rather than purchasing, if piracy is an option, these are potentially lost sales to the publisher. Therefore, the areas C and D are those who are of interest to the publisher, and also to the economist doing the analysis. It should be fairly obvious that whether piracy has a positive or a negative effect on the publisher will depend on how individuals are distributed in the v, c space.

Determining the distribution of individuals is by no means a trivial task. We shall make the assumption that there, in many markets, may exist a third variable that relates v and c monotonically. This would mean that there is a perfect correlation between the marginal distribution functions, $F(v)$ and $G(c)$, for valuation and cost of copying, respectively. A natural example of such a variable could, for example, be personal income and age. For example, it could be natural to think that business software is more valuable to business professionals than to private consumers. As these individuals also tend to have a high opportunity cost from copying, this would indicate a positive v, c relationship. On the other hand, computer games are often targeted at young individuals, who are also more likely to have less income and thus lower opportunity cost from copying. This would then indicate a negative v, c relationship. The idea is illustrated graphically below.

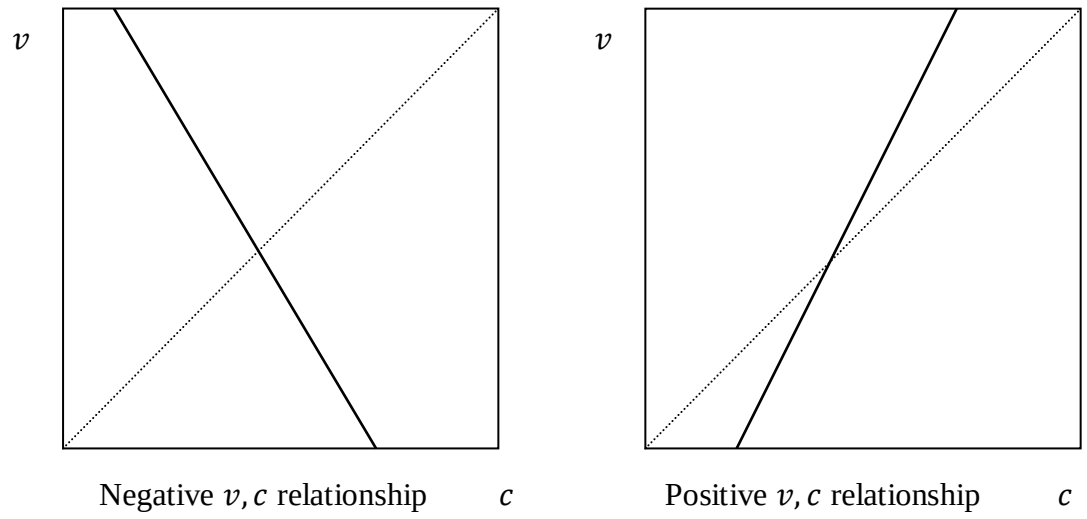

Figure 2: Possible v, c relationships

Source: Croxson (2009)

Compare these figures to the v, c space initially shown in figure 1. It is easy to see that a negative v, c relationship curve will pass through the areas labeled B and D, but not A and C. In other words, piracy will in this case be weakly harmful to the publisher, and will never be unambiguously beneficial. In the positive v, c relationship cases, however, the distributions will never pass through B and D, but through A and C. Thus, piracy can, in this case, be beneficial to the publisher as the consumer base increases without a displacement of sales. The question is now: which distribution relationship will be the most applicable to music?

To the best of my knowledge, there exists no study that proves or disproves any such relationship. There are several studies that claim or imply that low-income groups, like teenagers and young adults, are more likely to download music illegally, but this does not necessarily mean that these listen more to music than other age- and income groups.[19] What it means is simply that these low-income individuals have a lower cost attached to copying and will therefore copy more, something that is in line with our arguments above. Note that the characteristics of a normal good imply a positive v, c relationship in our model since both valuation of the good and the cost of copying it increases with income. If we are to adapt to the norm, however, it would be natural to assume that the market for music is defined by a negative v, c relationship. This would then imply that piracy of music will have a negative effect on a publisher's profits, and that the copiers mostly will consist of individuals who otherwise would have bought the product. Record companies have been active in enforcing copy control mechanisms to avoid piracy of their products. The rationale behind this is

[19] Such studies include, but are not limited to, Mortimer and Sorensen (2005), Hong (2005), Oberholzer-Gee and Strumpf (2009) and Dapp (2010). Reyna (2004) provides a notable exception.

explained within this model. Note also that a change in copy controls will alter the distribution curve. This is explored further in our section on policy implications.

The model above has outlined a theory where both imperfect awareness and network effects have been included. It has shown that there might be cases where piracy actually may be beneficial to a publisher. Whether this is the case for music is ambiguous given our knowledge on the v, c relationship of individuals who are in the market for consuming music. Unlike business software, music is a good consumed by individuals from all social spectrums and backgrounds. It is therefore difficult to say with any assertion that music necessarily has a negative v, c relationship, despite popular assumptions. Another important application would be the effect piracy might have on complementary goods like live performances, which is the subject of our next section.

5 New Demand Gives New Supply

Whatever the reason, it is an undisputed fact that record sales indeed have gone down markedly since the introduction of file-sharing technology and broadband connections to the Internet. It is also easily verified that the recording industry blames piracy for this decline. From the point of view of an economist, the interesting aspect is not as much who or what is to blame, but rather what are the effects and responses to these changes in market structure. Above we argued that, given certain criteria, piracy might actually not be a negative thing. The main effect is, of course, that the overall number of active listeners could increase, which is something that could lead to an increased demand for complementary goods.

Mortimer and Sorensen investigate this claim in their 2005 paper "Supply Responses to Digital Distribution." In this paper they collect an impressive data-set of releases of recorded music and live performances. Nearly 2,000 musical artists over the course of 10 years are included in the data set, and both time and location-specific variations are controlled for. They show that album sales and the number of new recording artists has declined since the dawn of file-sharing but that the number of performing artists as well as concert revenues have increased. Overall, this could potentially mean that the artists themselves might be better off after the introduction of piracy than in a world without piracy.

In line with Mortimer and Sorensen, we present a one-period, two-goods model where the two goods in question are the recorded product and the live performance. For simplicity, we assume that the artist only gets a share ϕ of the recorded product but the entire profit from the live performance. The artist's profit function is therefore written as

$$\pi = \phi[(p_1 - c_1)Q_1 - K_1] + (p_2 - c_2)Q_2 - K_2 - h(e_1, e_2)$$

where $p_j, c_j,$ and K_j indicate price, marginal cost, and fixed cost, respectively, and Q_j is the demand for product j. The fixed cost of the recorded product includes producing, marketing and distributing the album, while the fixed cost of performing live could include the opportunity costs attached to the artist devoting her time to rehearsal and performance. In addition, the artist puts down effort levels e_1 and e_2 on album production and live performance, respectively. These effort levels come at a cost $h(e_1, e_2)$ and can be interpreted as the time spent on the two products; how often the artist releases a new album for e_1; or how often she goes on tour for e_2. We shall assume an increasing and convex cost of effort

function and that the cross-derivative is positive ($\frac{\partial^2 h}{\partial e_1 \partial e_2} > 0$). By including this assumption we acknowledge that there is a tradeoff between spending effort on recording and spending effort on touring.

The consumers valuate the efforts the artists put into their work, and the quality of it. Denoting the quality of an artist as θ, the valuations, v_j, for the two goods will be drawn at random from a joint distribution $F_\theta(v_1, v_2; e)$. It is of course dangerous to enter the minefield of 'quality in music', but the assumption made is that higher-quality artists will meet a higher demand, meaning that if $\theta > \theta'$, then $F_\theta(v_1, v_2; e) < F_{\theta'}(v_1, v_2; e) \forall v_1, v_2$. An important implication of these assumptions is that the marginal distributions $F_i(v_i; e)$ are decreasing in both e_1 and e_2. This allows for spillover-effects between the two goods. For example, increased effort on live performances, e_2, might lead to an increase in the demand for recorded albums, and vice versa. It will still be assumed, however, that such an increased effort on live performances will boost demand for live performances more than it affects the demand for recorded albums.

We introduce piracy by saying that the consumer can attain good 1 for free at a probability of $\gamma \in [0,1]$. Since good 2 is not a tangible good like good 1, piracy only affects the purchasing of good 1. The actual share of consumers who purchase good 1 is now $(1-\gamma)[1 - F_1(p_1; e)]$. The key assumption that ties this present model to the one presented above in section 4 is that they both assume that only those who have obtained the album, legally or illegally, will attend a concert held by an artist. The demand for good 2 is therefore contingent on the distribution of good 1. As we saw above, this means that piracy can theoretically lead to a promotional effect, only that in this case it promotes complementarities. Above, piracy could potentially have a promotional effect on the very same good. But when piracy might affect complementarities only, the share of consumers who will now purchase good 2, the live performance, is given as

$$Q_2 = (1-\gamma) \int_{p_1}^{\infty} \int_{p_2}^{\infty} dF(v_1, v_2; e) + \gamma \int_{0}^{\infty} \int_{p_2}^{\infty} dF(v_1, v_2; e)$$

The first part on the right-hand side is the share of the population who has become aware of the artist by buying the recorded product and who also has a valuation for the live performance higher than the ticket price. This part is $(1-\gamma)$ lower than in the no-piracy case. The second part represents those who have obtained a pirated version of the album but have a

high enough valuation of the live performance to purchase tickets. This second part is, therefore, nothing else than the increased demand for good 2 (live performances) that occurs because of the possibility of piracy of good 1 (recorded product).

Note that the loss incurred in the first part on the right-hand side is always recovered in the second part of the equation. This is because the first integral in the second part runs all the way from 0 to infinity, and therefore includes the lost share of potential record buyers who have a positive valuation of the live performance. The demand for good 2, when piracy is an option, will therefore always be at least as high as when piracy is impossible.

We shall assume that only artists of a quality higher than a certain threshold level, $\theta > \theta^*$, will be able to tour. This assumption hinges on the repayment structure a contract between a record company and artist stipulates. Since the record company does not make any direct profit from a concert it can only recover its expenses if the album is of a sufficient quality to be profitable in the market. An album that does not sell will not be produced, and an artist without an album will not be giving live performances.

Lastly, we shall also assume that the price of good 1, the recorded product, is exogenous to the artist. Prices are set by the record labels, and have proven to be almost immune to changes in their surroundings. According to data, album prices did not change significantly between 1999 and 2003, and only in 2004 did we witness a decline in the price level (Mortimer and Sorensen, 2005).

The framework should now be sufficient to make predictions on how an artist will act facing increases in file-sharing. Remembering that the demand for good 1 is given by

$$Q_1 = (1-\gamma)[1 - F_1(p_1; e)]$$

and demand for good 2 is given by

$$Q_2 = (1-\gamma)\int_{p_1}^{\infty}\int_{p_2}^{\infty} dF(v_1, v_2; e) + \gamma\int_{0}^{\infty}\int_{p_2}^{\infty} dF(v_1, v_2; e),$$

the first-order condition of the profit function with respect to effort spent on good 1 is

$$\frac{\partial \pi}{\partial e_1} = \phi(p_1 - c_1)\frac{\partial Q_1}{\partial e_1} + (p_2 - c_2)\frac{\partial Q_2}{\partial e_1} = \frac{\partial h}{\partial e_1}.$$

Assuming that the profit function is concave in e_1, we find that $\frac{\partial e_1^*}{\partial \gamma} < 0$ as long as

$$\frac{\partial^2 \pi}{\partial e_1 \partial \gamma} = \phi(p_1 - c_1)\frac{\partial^2 Q_1}{\partial e_1 \partial \gamma} + (p_2 - c_2)\frac{\partial^2 Q_2}{\partial e_1 \partial \gamma} < 0.$$

Due to the assumptions made, it can be shown that both $\frac{\partial^2 Q_1}{\partial e_1 \partial \gamma}$ and $\frac{\partial^2 Q_2}{\partial e_1 \partial \gamma}$ are negative, which leads to the conclusion that, ceteris paribus, an increase in file-sharing will reduce the effort artists spend on producing albums. The intuition behind this result is that as piracy increases, the marginal benefit of effort on good 1 decreases, while the cost remains constant. The artist will, therefore, shift her effort from producing records (good 1) to giving live performances (good 2).

By the same analogy, it is not surprising that we now find that increased piracy will lead to an increased effort on live performances. This can be shown by taking the first-order condition of the profit function with respect to effort on good 2

$$\frac{\partial \pi}{\partial e_2} = \phi(p_1 - c_1)\frac{\partial Q_1}{\partial e_2} + (p_2 - c_2)\frac{\partial Q_2}{\partial e_2} = \frac{\partial h}{\partial e_2}.$$

Assuming that the profit function is concave in e_2, we will find that effort on live performances will increase with piracy if

$$\frac{\partial^2 \pi}{\partial e_1 \partial \gamma} = \phi(p_1 - c_1)\frac{\partial^2 Q_1}{\partial e_2 \partial \gamma} + (p_2 - c_2)\frac{\partial^2 Q_2}{\partial e_2 \partial \gamma} > 0$$

The assumptions used mean that the first part of this expression is negative. This captures the effect that spillovers from concert effort to album sales exist but will decrease when piracy is possible. The second part of this expression is positive, by result of our assumptions. However, since the first part is multiplied with the artist's share of profits, ϕ, the equation will hold as long as ϕ is sufficiently small so the second, positive part can outweigh the loss captured in the first, negative part.

The arguments presented above also imply that revenue from concerts will increase. This is because we have argued that profits will (weakly) increase with file-sharing through the increase in demand. Since we have assumed marginal costs to be constant (zero), this will also mean that revenues must also increase (Mortimer and Sorensen, 2005). This does not mean that the price of good 2 will increase, however, as file-sharing's impact on concert prices is ambiguous. This can be shown by taking the first-order condition of the profit function to determine p_2^*

$$(p_2 - c_2)\frac{\partial Q_2}{\partial p_2} + Q_2 = 0$$

As the demand increases with piracy, there will also be a negative effect on demand from higher prices, so the result of increased piracy on concert prices is unclear.

Finally, as positive profits from album sales are a necessary assumption to produce albums, the effect of piracy will be a higher threshold θ^* to produce an album. An implication of this is that there will be fewer artists producing albums, and perhaps also less desire, from the publisher's side, to release albums of new and unproven artists.

Using the data provided by Mortimer and Sorensen it is possible to test the theory presented above with actual developments in the recording industry. These data are very much in correspondence with what we expect to find. Firstly, the data shows that artists who were already established when file-sharing was introduced used more time before releasing new albums. Secondly, we see that artists were more likely to tour. Thirdly, it shows that revenues from concerts indeed had increased, while the fourth finding is a decline in new artists releasing a recorded product. See Appendix A for data.

The second and third findings are also confirmed in a report written by Ehmer and Porsch for Deutsche Bank Research (2008). They present numbers from the German market, the fourth largest in the world,[20] and find that the music market has changed significantly since the mid-90s, a change they partly attribute to the introduction of digitalization of media and file-sharing. Since 1995, the market for live concerts has increased by 18 per cent in Germany. At the same time the unit sales of the recorded product has declined by 38 per cent (Ehmer and Porsch, 2008). Ehmer and Porsch do not test the hypothesis that downloading is to blame for the decline in sales but rather accept it as a norm.

The article by Mortimer and Sorensen shows that while sales of a good might decrease, piracy might lead to an increase in complementary goods. A result brought forth by both Croxson and Mortimer and Sorensen is that, given some assumptions, piracy might actually increase overall profits due to the effect on complementary goods. If this is the case, why do we see such hostility towards piracy from the industry?

[20] See IFPI (2010b) for an overview of the largest markets.

6 Artists vs. Publishers

The answer lies within the basis of Mortimer and Sorensen's article: the potentially increased profit does not benefit the publisher, as the artist takes the entire revenue from live performances. In a sense, there is a conflict of interest between the record label and the artist. This is the essence of an article by Gayer and Shy called "Publishers, artists, and copyright enforcement" (2006). In their article, Gayer and Shy treat publishers and artists as two separate agents, whereas most other articles on this topic treat the copyright holder as one and the same. This is, of course, simplifying reality. It is tempting to believe that publishers and artists might view piracy differently, especially when one considers the results put forward in the Mortimer and Sorensen paper, regarding the increased demand for live performances. We shall therefore build a model in line with Gayer and Shy (2006) to test the hypothesis that piracy might indeed affect the two agents differently.

The key assumption is that, as above, the artists only earn a fraction of the income generated by the copyrighted good but receive the entire revenue from a complimentary good, usually assumed to be the live performance. Demand for the live performance is assumed to be positively related to the distribution of the copyrighted good, regardless of it being legally or illegally obtained. Consumers can choose to hold a legal or illegal copy of the copyrighted good, or they can choose not to obtain a copy. A network effect arises from holding a copy, which is increasing in the number of consumers who obtain a copy. This is denoted by γN, where $\gamma > 0$ is a measure of the marginal benefit from the network size N. In addition, consumers are indexed by $x \in [0, +\infty)$ according to a declining preference for obtaining the copyrighted product. The utility function of a consumer is then

$$U_x \stackrel{\text{def}}{=} \begin{cases} \alpha(1-x) + \gamma N - p_r \\ \beta(1-x) + \gamma N \\ 0 \end{cases}$$

where the top line indicates the utility of a consumer who buys a legal copy; the middle line is the utility of a consumer who obtains a pirated copy; and the bottom line is the utility of a consumer who does not obtain a copy at all. The declining preference assumption can be observed by setting $x > 1$ in the utility functions above, where such negativity in the first part may indicate that the consumer is unhappy about spending time and effort finding the product. The price of purchasing a legal copy, p_r, also enters negatively in the utility function

of the consumer who buys the copyrighted product. Note also that even though these aspects enter negatively, the user will still derive a positive utility if she consumes, as she will rather go without and derive zero utility than obtaining a good that gives her disutility.

Two assumptions are implied by the utility functions given above. Firstly, there is a vertical differentiation of the legally- and illegally obtained goods, $\alpha > \beta > \gamma > 0$. $\alpha > \beta$ is needed for consumers to prefer the legal good, should the price of this be set to zero. Imagine that the legal good is easier or safer to use than the pirated version (no virus, etc.) or that it contains a booklet with artwork not given when downloading online. We also need γ to be bounded below the utility parameters. This is a basic assumption in network models to ensure that the number of user does not approach infinity. Secondly, we assume that the production cost, c, is lower than the utility difference for a consumer of obtaining the legal copy rather than the illegal. Formally, we note this as $c < \alpha - \beta$. This is needed for there to be a production of the legal copy at all.

We then assume, as we did above, that the demand for the live performance is increasing in the distribution of the copyrighted product, both legal and illegal distribution. Denoting the price of a concert ticket as p_p the demand is given as

$$q_p \stackrel{\text{def}}{=} \max\{\delta N - p_p, 0\},$$

where $\delta > 0$ is the intensity in which distribution of the recorded product affects the demand for live performances. This specification of the demand hinges on our previously stated assumption that live performances and recorded products are compliments.

Acting as a monopolist, the artist now sets ticket prices for the live performance in order to maximize profits for a given number of consumers. She thus solves

$$\max \pi_p = p_p q_p = p_p(\delta N - p_p),$$

which yields the following price and profit from live performances

$$p_p = \frac{\delta N}{2}$$

$$\pi_p = \frac{\delta^2 N^2}{4}$$

These expressions show how the ticket price and the profits increase linearly and quadratically, respectively, with the number of distributed recordings. In other words, the artist could theoretically find it profitable to allow piracy of her own copyrighted works.

None of this is new or very exciting at this point. Showing that the artist might find it profitable to allow piracy is the basic result from section 4 and section 5. Our current model differs from these models however, as we now go on to show how the artist and the publisher might have different opinions on the profitability of piracy. In order to do so, we solve for the equilibrium sales, with piracy and without piracy, for both the copyrighted recorded product and for the live performance, and compare these static results. This way we show that, given the assumptions made, there is a plausible reason to believe that the artist will be better off with piracy, while the publisher will be worse off.

Using the marginal user from the middle and bottom line in the utility function above we find that the number of users is equal to the marginal user's indexed variable, meaning $x = N$. Substituting this into the middle line gives

$$N = \frac{\beta}{\beta - \gamma}$$

as the number of users of the copyrighted good, regardless of whether it was obtained legally or not. The marginal buyer, defined as $\hat{x}$, is the one indifferent between the top and middle line in the utility function above. Setting those equations equal to each other and inserting the number of users N from above gives us the marginal buyer as

$$\hat{x} = \frac{\alpha - \beta - p_r}{\alpha - \beta}.$$

In line with what has been done in similar articles, we shall also attribute only a small share, ϕ, of the profit from the copyrighted product to the artist, while the rest goes to the publisher, where $0 < \phi < 1$ is a necessary and unsurprising assumption. Recalling that there is a cost $c > 0$ attached to produce each copyrighted product, the publisher sets the price of the product, p_r, to solve

$$\max_{p_r}(1 - \phi)\pi_r \stackrel{\text{def}}{=} (1 - \phi)(p_r - c)\hat{x} = (1 - \phi)(p_r - c)\frac{\alpha - \beta - p_r}{\alpha - \beta},$$

which gives us the following characteristics of the legal product:

$$p_r = \frac{\alpha-\beta+c}{2}$$

$$\hat{x} = \frac{\alpha-\beta-c}{2(\alpha-\beta)}$$

$$\pi_r = \frac{(\alpha-\beta-c)^2}{4(\alpha-\beta)}$$

For the artist, the profit will stem from selling tickets to the live performance and the royalties from the sale of the recorded product. Formally, this is written as

$$\pi_a = \pi_p + \phi\pi_r = \frac{\beta^2\delta^2}{4(\beta-\gamma)^2} + \phi\frac{(\alpha-\beta-c)^2}{4(\alpha-\beta)}$$

For any conclusion to be made we need to find the no piracy counterpoints to these results. Eliminating the opportunity to obtain a pirated copy, the number of users also becomes the number of buyers. The utility function then gives us

$$N = \frac{\alpha-p_r}{\alpha-\gamma}$$

The publisher's problem can then be written as

$$\max_{p_r}(1-\phi)\pi_r = (1-\phi)(p_r-c)N = (1-\phi)(p_r-c)\frac{\alpha-p_r}{\alpha-\gamma}$$

Solving that problem yields the following results for the publisher

$$p_r = \frac{\alpha+c}{2}$$

$$N = \frac{\alpha-c}{2(\alpha-\gamma)}$$

$$\pi_r = \frac{(\alpha-c)^2}{4(\alpha-\gamma)}$$

The artist's total profit is still the profit made from performing live and the royalties from selling the copyrighted product. Using the new size of the network and new profit found in the no piracy case, the total profit accruing to the artist is now given as

$$\pi_a = \pi_p + \phi\pi_r = \frac{\delta^2(\alpha-c)^2}{16(\alpha-\gamma)^2} + \phi\frac{(\alpha-c)^2}{4(\alpha-\gamma)}$$

The information above can now be used in order to analyze who would gain from piracy and who would lose, and under what circumstances would those results hold. Whereas previously,

our results only stated that there is a potential result in favor of piracy, we now look at a result where this might still be the case but where it would also explain why the recording industry has spent vast amounts of time and resources on lawsuits against civilians and organizations to stop file-sharing. To see why, we first compare the profit expression for the publisher in the no piracy case with the result in which piracy prevailed. Using these, and the assumption that the publisher prefers no piracy, we see that advocating enforcement and pursuing stronger copyright protection is the preferred action if

$$(1-\phi)\frac{(\alpha-c)^2}{4(\alpha-\gamma)} \geq (1-\phi)\frac{(\alpha-\beta-c)^2}{4(\alpha-\beta)}$$

A brief inspection of the above condition tells us that such a result is not straight forward. On the one hand, β enters the right hand side of the equation in the numerator in a negative fashion, making the expression smaller than the left hand side. On the other hand, β also enters the denominator in a negative way, but this will make the expression larger, especially since we earlier stated the assumption that $\beta > \gamma$. The condition therefore hinges on the size of the parameters but the result above is still valid as a necessary condition for the publisher to pursue stronger copyright enforcements.

By analogy, the artist will also seek stronger copyright enforcement if her profit without piracy exceeds what she could get when piracy is possible. Formally, we state this as

$$\frac{\delta^2(\alpha-c)^2}{16(\alpha-\gamma)^2} + \phi\frac{(\alpha-c)^2}{4(\alpha-\gamma)} \geq \frac{\beta^2\delta^2}{4(\beta-\gamma)^2} + \phi\frac{(\alpha-\beta-c)^2}{4(\alpha-\beta)}$$

The implication of this condition is that the artist will prefer no piracy to piracy if δ is sufficiently small, and/or ϕ is sufficiently large. In other words, if the distribution of the copyrighted good does not have much of an impact on the demand of the live performance (small δ) or if the artist's share of the profit from album sales (large ϕ), then the artist will want a stronger protection of her copyrighted work. Formally, this will be the case if

$$\phi \geq \vartheta\delta^2$$

where ϑ can be shown to satisfy

$$\vartheta \overset{\text{def}}{\equiv} \frac{(\alpha-\beta)\left[c(c-2\alpha)(\beta-\gamma)^2-\alpha^2\left(3\beta^2+2\beta\gamma-\gamma^2\right)+8\alpha\beta^2\gamma-4\beta^2\gamma^2\right]}{4(\alpha-\beta)(\beta-\gamma)^2\{c^2(\beta-\gamma)+2c\gamma(\alpha-\beta)+(\beta-\alpha)[\alpha(\beta+\gamma)-\beta\gamma]\}}$$

If the condition above holds, then both artist and publisher will wish to seek stronger protection of the copyrighted material in order to maximize their own profit. However, should the networking spillover effect, as captured by δ, be stronger or the royalties given to the artist, measured by ϕ, be smaller, then it might be the case that the (weak) inequality sign runs the other way. If that is the case, then the artist and publisher will have conflicting interests in the fight against piracy. The spillover value, where the artist will be indifferent between allowing piracy or not, will be

$$\delta = \sqrt{\frac{\phi}{\vartheta}}$$

We can illustrate in a $\langle \phi, \delta \rangle$ diagram how this trade-off between distribution effect and royalties will unfold for the artist.

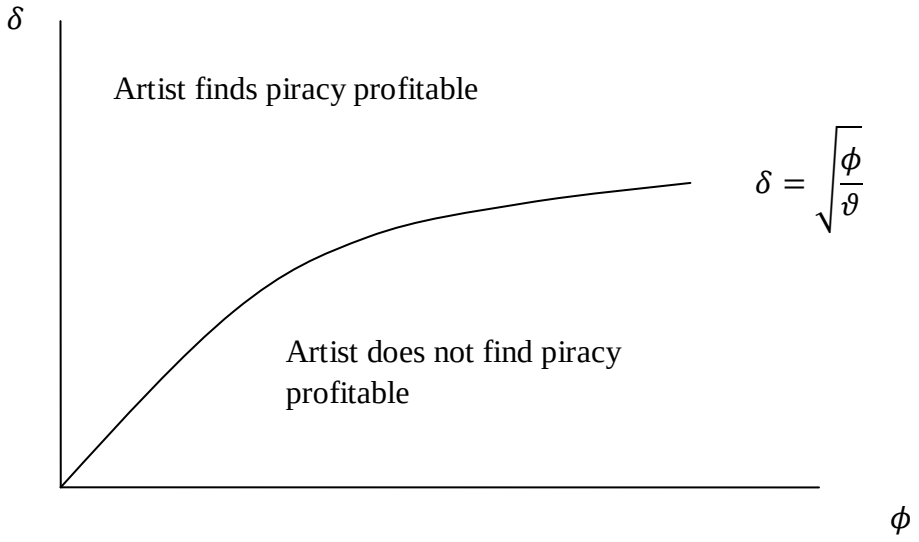

Figure 3: $\langle \phi, \delta \rangle$ **diagram**

Source: Gayer and Shy (2006)

The above figure depends on piracy not being profitable for the publisher. The trade-off is therefore only valid for the artist. It shows that, the higher the value of ϕ, the more unlikely it is that piracy will be profitable for the artist. Likewise, the higher the spillover effect from the distribution of the copyrighted good, δ, the more likely is it that the artist will prefer piracy to prevail in order to reap the benefits of sold out live performances.

The model above, and its predictions, is important when actual numbers are taken into consideration. A Pew Internet & American Life Project survey from 2004 found that 43 per cent of paid artists agreed to the statement "file-sharing services are not really bad for artists, since they help to promote and distribute an artist's work to a broad audience" (Gayer and Shy, 2006, p. 375). Moreover, 35 per cent of the artists felt that file-sharing should be legal (ibid.). At the same time, the Recording Industry Association of America (RIAA) announced its plans to file lawsuits against individuals who were caught file-sharing, as well as against individuals and organizations that set up or hosted the servers the file-sharing networks used (Liebowitz, 2006). These lawsuits commenced in late 2003, and the first wave saw 261 individuals sued for illegal sharing of copyrighted music online. Clearly, these are indications that the artist and the publisher might have conflicting interests in the case of file-sharing. The RIAA has now stopped its lawsuit campaign against individuals and states that it has been a success, claiming awareness of the illegality of piracy has been raised from 35 to 72 per cent as a result of the legal actions taken.[21] In this paper, however, we have also argued that individuals do not care that file-sharing is illegal, implying that this awareness might not be worth much.

The model above has assumed that artists only get a small share of the profits from sales of the recorded good but the entire profit from the live performance. This is a model that describes the previous reality in a realistic, yet simplified, manner. Having witnessed the changes in income and the decline in sales the past decade, both record companies and concert promoters have increasingly started using "360-degree deals" (Ehmer and Porsch, 2008). These are contracts where the record companies take upon themselves the responsibilities, and hence also profits, arising from live performances. Where the record companies usually paid for production, distribution and advertisement of a recording, they now also have an increasing say in the marketing of concerts and merchandising, on behalf of the artist. The line between label, agency, distributor and promoter has thus become increasingly blurred as a result of smaller profit shares from the recorded product. An example of how this has already become a reality is the introduction of "American Idol"-style TV-shows, where the winning artist usually wins a recording- and touring deal with the affiliated recording company.

[21] http://www.riaa.com/faq.php, accessed October 5th 2010

7 Piracy and Innovation

Standard economic theory tells us that piracy should decrease a firm's incentives to innovate and to engage in research and development (R&D). When potential profits are lowered, the firm will see less reason to spend money on new inventions. To avoid this, copyrights have been installed to make sure that the owner of a good is financially compensated, and given incentives to innovate. Despite the threat of piracy, digital media industries like the music, movie, and software industries are among the most innovative we have today, and estimates say that record companies on average re-invests almost 30 per cent of their revenue into discovering and releasing new artists (IFPI, 2010a). Rayna (2004) attributes this paradox to piracy breaking the monopoly created by copyrights, leading producers and publishers to compete with the pirates for market share.

The economics of copyrights is a two-step analysis: first, one distinguishes between rival and non-rival goods. Then, one analyses the welfare effects of the copyright on the two types of goods. If the good in question is a rival good, then strong copyrights will lead to efficient outcomes (Romer, 2002). We have, however, argued that due to the technological change the past ten years that has made file-sharing frequent, music files have now become more similar to non-rival goods. This, according to Nordhaus (1969), means that there will be a trade-off arising from copyrights. With weak copyrights we will get an under-provision of the good, while strong copyrights will create a monopoly situation. Hall (2003) argues that a copyright system might be a needed to give incentives for further innovation if the product is easily copied.

The concept of innovation is diffuse when it comes to music. In most industries, innovation would mean inventing new technologies or making existing technologies more productive. If music is considered innovative, it usually means that they have taken their genre one step further, but this by no means implies that they will be more productive. Rather, innovation, when it comes to the music industry in the economics literature, either refers to its ability or willingness to release new artists,[22] or to its methods of attaining and retaining market share.

This latter type of innovation can take two different forms: it could refer to technological innovations to make it more costly for the pirates to copy the product, or it

[22] As in Oberholzer-Gee and Strumpf (2007)

could refer to innovations to enhance the quality gap between the original and the copy. According to Rayna, this first kind is "useless" innovation and does nothing but increase the size of the deadweight loss caused by copyrights. The second kind of innovation could, however, lead to welfare enhancements and is thus looked upon as desirable.

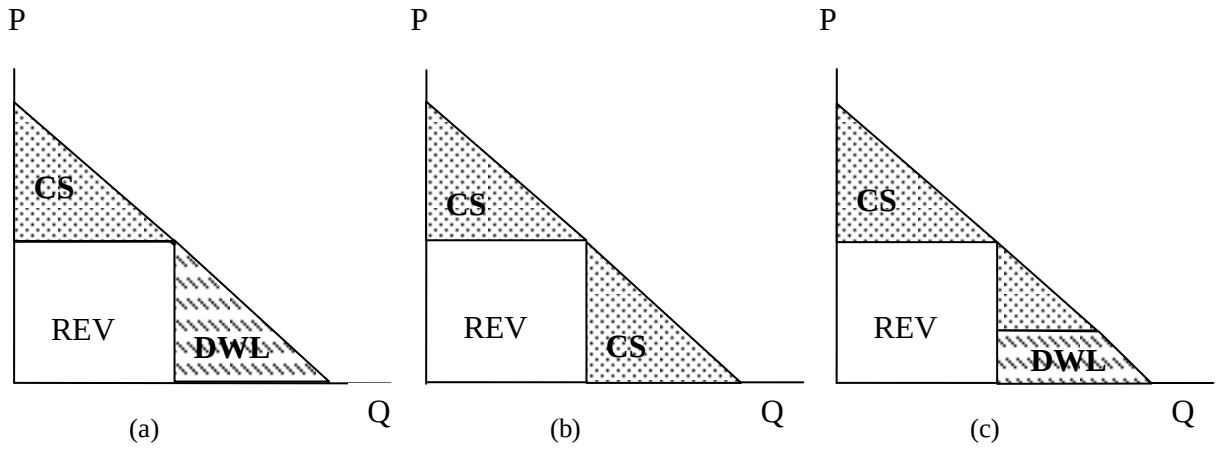

Figure 4: Evolution of consumer surplus and deadweight loss

Source: Rob and Waldfogel (2004)

In panel (a) above, we have depicted the standard monopoly case, with no piracy possible. The publisher then sells at the monopoly price, causing a deadweight-loss, as pictured in the lower right corner. In panel (b) we have introduced piracy at zero marginal cost, and assumed that only 'low value' consumers will commit piracy. This means that there is no displacement of sales, and the deadweight-loss in panel (a) simply turns into a consumer surplus. As the 'high value' consumers still purchase, the publisher will still act as in a standard monopoly case, and her revenue is unchanged. In panel (c), we have still allowed the opportunity of 'low value' consumers to pirate, but this time there is a cost attached to it because of copyrights. We see that there is a deadweight-loss arising, compared to the "no cost to copying" case of panel (b). Note, however, that the results are quite different if the pirates are 'high value' consumers. This will lead to quite an increase in the consumer surplus but at the expense of the publisher's revenue.

The intuition behind Rayna's comment is straight forward. Innovations to make piracy more costly could, for example, include copy controls. Though these, theoretically, would decrease the number of illegal copies in circulation, the discussion above has shown that the increase in sales might not be substantial. The copy control would indisputably decrease the

number of those able to enjoy the product as illegal acquirement becomes much more difficult and time consuming. Moreover, it would decrease the possibility of those who have acquired the product legally to use it where they see fit, since copy control usually puts restrictions on compatible players, thus decreasing the overall enjoyment of the product. So while the effect on producer surplus might be ambiguous, the effect on consumer surplus is unambiguously negative. Total welfare will thus be ambiguously affected, but most likely negatively.

On the other hand, innovations that increase the quality gap between copies and originals will unambiguously increase total welfare. These kinds of innovation will still allow for copies to be made and thus for piracy to exist. However, if there is a significant difference in quality between the original and the copy, only those who have a valuation under the price level will choose to obtain a copy. This means that those who copy would not have bought the product if piracy was not an option anyway. This will unambiguously increase total welfare as consumer surplus will increase and producer surplus will not be negatively affected.

Håkonsen and Løyland (2009) argue that an opposite form of product differentiation innovation has become reality. Rather than producers innovating at such pace as to keep copiers at bay, they say that innovation with respect to the copies moves at a more rapid pace than innovation in the legal product. This would then have the effect of enticing an increasing number of consumers to opt for the pirated version, as the quality of it becomes increasingly better and closer to that of the original. One should note that this kind of innovation, from the pirate's side, is not necessarily negative, as seen from the social welfare side, though this has largely been ignored in the literature. Innovations intended for illegal use might very well help encourage new, legal and socially beneficial innovations as well. As an example, legal online broadcast technology, as well as file compression techniques for 3G mobile phones, are both based on Mpeg4-algorithms, which started as an algorithm of compressing video files to a downloadable size (Rayna, 2004).

An analysis of how copyrights might affect digital goods is presented in Bae and Choi (2006). They assume that there are two different types of costs attached to copying, namely 'reproduction' costs and 'degradation' costs. The first cost is our standard cost of actually copying, and thus an opportunity cost. The latter is a representation of the lesser quality offered by the copy. For instance, this could be the lack of manuals for software, or the lack of cover art and lyrics in the case of music. Their finding is that the effect on welfare and innovation depends on which of these two costs is affected by the copyright. Moreover, the

standard economic rationale for copyrights only applies if the copyright increases the degradation cost. This would increase the publisher's market power in the short run which has a negative effect on social welfare. The increased market power, however, will induce the publisher to provide higher quality through innovation, thus benefitting social welfare in the long run (Bae and Choi, 2006). The copy protections advocated and used on musical recordings, however, cannot be said to increase the degradation cost, as we have previously argued. Instead, it is aimed at increasing the reproduction cost. This will have an opposite effect, as there will be less incentive in the long run for the publisher to provide higher quality when copying is difficult (Rayna, 2004).

Jaisingh (2009) has analyzed the effect of copyright control on the software market. He builds a framework where there is a software company, a copier, and an alliance of businesses campaigning against piracy. He finds that if the company has the market leading product and the effort by the alliance is low, the company should set prices low in order to drive the pirate out of the market. If it has a weaker product and the alliance is heavily involved in the fight against piracy, the company should rather set higher prices and leave a small part of its market to the pirate. The most interesting finding is that even though strict anti-piracy measures increase the cost of using a copied version, it might have a negative effect on product quality. This will, in turn, give increased incentive for copying. Thus, he finds that stricter copyright enforcement policies might actually lead to more piracy.

These findings sound counter-intuitive, but are in line with what have been discussed above. Facing competition from piracy, it might be in the producer's own interest to develop new and better versions of its product. If the difference between the original and the copy is small, then the incentive to purchase the original might decline. In this respect, the copyright might therefore have the opposite effect than intended when competition arises from an illegal market.

Another aspect of strengthening the copyright is that there might be high costs attached to strengthening it to a level where it has an impact on illegal copying. Not only will there be direct costs, like surveillance and legal prosecutions, but also indirect costs like the spillover effect of the stronger copyright (Romer, 2002). These indirect costs might very well outweigh the direct ones, especially if they put constraints on consumer's legal use of a good, or if these constraints also hinders innovation in other technological industries (Håkonsen and Løyland, 2009).

It seems that the current copyright scheme is not able to stem file-sharing online. Liebowitz (2007) attribute the trend-breaking increase in record sales in 2001 to the Napster-case. Nonetheless, consumers willing to settle for pirated versions rapidly found other alternatives to attain copies of their favorite songs virtually for free. Therefore, the industry has lobbied intensively for stricter copyright enforcement. These enforcements could potentially come at a much greater cost than the music industry is worth. Despite the relatively large numbers presented in the 'Cost of Piracy' section above, the total worldwide revenue for the music industry in 2000 was $37 billion. This translates to approximately 0.11 per cent of world GDP (Romer, 2002). Thus, the world economy would not tremble if record companies went out of business due to piracy.

A more likely scenario is that the record companies alter their business methods. We have already witnessed innovations in the distributional platform, such as iTunes and Spotify.[23] Sweden was one of very few markets that had an increase in record sales in 2009. The industry itself attributes this to an increase in digital sales, led by iTunes and especially Spotify. A study found that 60 per cent of file-sharers stopped downloading music after the introduction of Spotify (IFPI, 2010b). Innovations like these, it seems, both increase legal sales and reduce illegal downloading. A report by the Council for Economic Development (Horn et. al, 2004) argues that the only way for the music industry to survive is to adopt new business models.

A study by Harbaugh and Khemka (2010) shows that the tradeoff between stricter enforcement and incentives to innovate can be avoided if discrimination is possible. By discrimination they mean both price discrimination and enforcement-discrimination. Like the studies mentioned above, Harbaugh and Khemka also show that more efforts spent on copyright enforcement will not necessarily work in line with textbook economic theory. Their claim is that piracy will be reduced, prices will increase, and consumer surplus will be lower when enforcement is more intensive. However, if the enforcement effort is targeted at specific groups, the trade-off can be avoided. This is particularly true where the copyright holder is charging super-monopoly prices to high-value customers.

The idea is that when the copyright holder charges super-monopoly prices to high-value customers (e.g. institutions or governments, if the good in question is software, libraries if it is journals and magazines) then this might lead low-value customers to switch to pirated

[23] Neither of these, interestingly enough, were innovations by the record companies.

copies instead of the high-priced legal copies. If the copyright holder now extends her narrow enforcement further down the demand curve it will benefit inframarginal consumers when the price is lowered down towards the monopoly level.[24] The important finding in their paper is that this gain to inframarginal consumers will outweigh the losses incurred by marginal consumers who now must buy the expensive legal version rather than obtaining the cheaper pirated copy. If so, then the more extensive copyright enforcement will lead to higher profits for the copyright holder and also higher consumer surplus.

A requirement for this increase in consumer surplus to arise from more extensive enforcement is that the pirated copies are poor substitutes for the legal original versions. Following the intuition from Reyna (2004), this means that there is a case for innovation incentives arising from this increase in enforcement. However, it is reasonable to believe that the copyright holder does not take consumer surplus into account when deciding whether or not she wants to engage in R&D. Chen and Png (2003) find that it is more plausible that the copyright holder rather chooses a too high level of broad-based enforcement. Unlike in the extensive enforcement discussed in Harbaugh and Khemka, more intensive enforcement here will have a negative effect on consumer surplus. Chen and Png's finding is thus that there will be an inefficiently high level of enforcement, and indirectly an inefficiently low level of innovation resulting from the copyright (Harbaugh and Khemka, 2010).

Stepping away from the question of copyrights and copy controls and into the minefield that is the discussion of quality of music, there have been voiced concerns about innovation in this area as well (Rayna, 2004). We have previously argued that innovation within music can be looked upon as the industry's willingness to release new albums and new artists. Though numbers are difficult to come by, an IFPI estimate says that 25 per cent of all artists signed on a typical international record label were signed during the previous 12 months (IFPI, 2010a). The same study does say that these numbers are in decline, however, and attribute this to file-sharing. Other signs of this reluctance to invest in new artists and albums are indicated by the high number of compilations released worldwide. A compilation is an album consisting of songs previously released. It could either be a 'Greatest Hits' compilation, featuring only songs by the same artists, or it could be a 'genre' compilation, featuring songs by different artists. Such albums constituted as much as 30 per cent of some

[24] The inframarginal consumer is the consumer whose willingness to pay is right below the marginal consumer's.

markets in 2009 (IFPI, 2010b). Releasing the same songs on new albums is surely not a sign of innovation.

Also, fears have been raised that this decreasing willingness to sign new artists will lead up-and-coming musicians into a "Keynesian beauty contest" (Rayna, 2004). By this is meant that the artists rather than sounding the way they want to sound, they try to sound like they think that the record company wants them to sound. Musicians then "devote [their] intelligence to anticipating what average opinion expects the average opinion to be" (Keynes, 1936, p. 140). Again, this will most likely not be a very innovative outcome.

8 Policy Implications

The discussions and models presented above should make one thing quite clear; there are many aspects to consider when facing a problem such as piracy. The situation is much more multi-faceted than media discussions might have us believe. Publishers are claiming that every illegally downloaded item is a lost sale. We have shown that this is probably not true and at best an over-simplification. But it is still true that the publishers are losing money, and it might be reasonable to attribute at least parts of this loss to the emergence of a digital piracy market. This raises another important question on how piracy and the digital market should be dealt with from a governance perspective.

A supervising organ's aim should always be to maximize the total welfare of its society. However, all policy instruments will have altering effects on the economic situation. While the welfare-optimal situation might be to leave the market alone, this might very well lead to an under-provision of the recorded product, since the potential profits are lost to piracy. A policy instrument to implement a second-best situation might therefore be needed. There are usually three tools that are deemed suitable for evaluation: taxes on copying mediums, subsidies on buying the legal product, or imposing penalties if caught acquiring the illegal product. Chen and Png (2003) analyze the various instruments in the case of software and piracy but their results can easily be interpreted to apply to the music industry as well.

8.1 Effect on the Publisher's Price and Detection Cost

The implementation of taxes on copying mediums is a strategy that has been frequently advocated and used in the history of copying. In the 80s, taxes on blank video cassettes were put into place to shield off competition from home recorders, and taxes on CD-burners and blank recordable CDs also existed during the late 90s and early 00s. Recently, we have also seen the introduction of multimedia-taxes, as in Denmark, where computer, phones, or other devices that can connect to the Internet are subject to taxation. These taxes have also been an instrument favored by the recording industry (Chen and Png, 2003).

We shall continue to make assumptions in line with what we have done above: there is a cost attached to catch copiers, but the marginal cost of producing (and hence copying) is zero. In addition, there are some consumers who will not copy the product at all (referred to as 'ethical'), and there are some consumers who would copy the product if the benefits from

doing so are greater than the costs (referred to as 'unethical'). In this model, the government first chooses a fine, a tax, and a subsidy. Note that it may choose combinations of the instruments. Then, the publisher will set its price and how much it chooses to spend on detecting pirates. Lastly, the consumers decide whether they will buy, copy, or not use the product.

The model can be solved backwards. First we find under what conditions the ethical and unethical users will be indifferent between purchasing and not purchasing the product. An important finding is that for the unethical consumer there will be two cut-off values; one where she is indifferent between buying and copying, and one where she is indifferent between copying and not using the product at all. These cut-off values will depend on the benefit the consumer derives from the product; an unethical user with a relatively high value will rather copy than be without the product, while an ethical user will be more likely to purchase if she has a high valuation of the product. A graph indicates these points clearly:

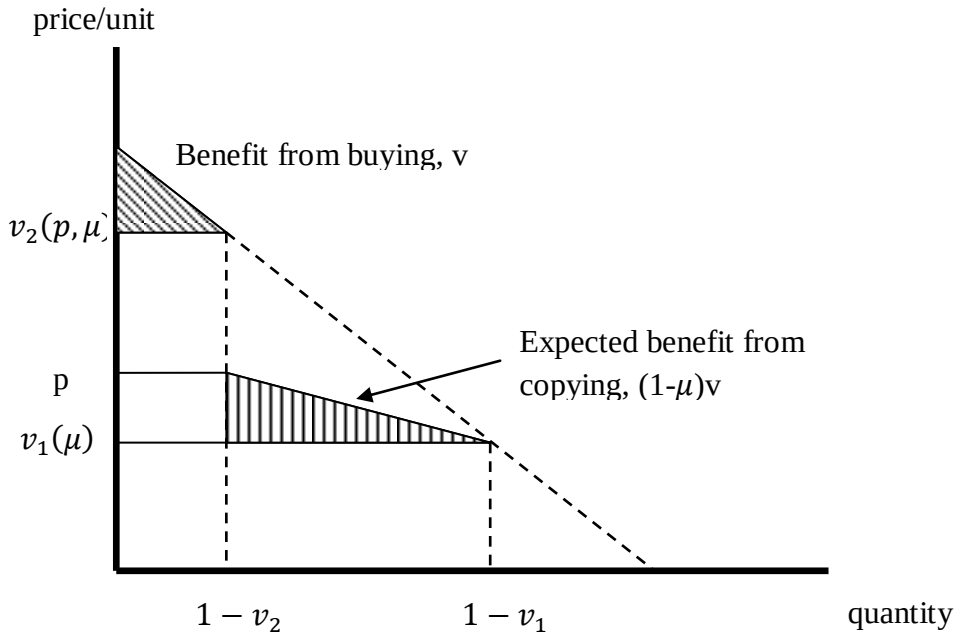

Figure 5: Benefits from, and demand for, good, with piracy

Source: Chen and Png (2003)

The figure indicates that those unethical individuals who have a valuation that is high enough, $v \geq v_2$, will buy the product. The individuals who have too low of a valuation, $v < v_1$, will be without the product. It is the intermediate cases that are of the highest interest.

These are the individuals who are prone to copy. Notice that the expected benefit from copying will increase if the price is higher, or if the possibility of detection increases.

Since copying does occur, the publisher will set its price and detection expenditure subject to the government policy instruments, which is taken as given, so as to maximize its own profit. Doing this we find that the price will be increasing in the penalty, and that it will increase more slowly than the subsidy. The detection rate will also be increasing in the fine, but it will be decreasing in the tax and in the subsidy.

The intuition is as follows. If the penalty for being caught increases, then fewer individuals will opt for the pirated version. This is indicated by the figure above. This can lead the publisher to increase her price. Likewise, if the potential reward for catching pirates increases then it will make sense to increase spending on detecting them. Also, as the product is sold at a higher price, the potential loss from copying has increased, leading the publisher to increase her spending on detection.

A tax increase, however, would affect the marginal return of detection in a negative way. This is because some of the lost revenue from a sale would accrue to the government instead of the publisher. Hence, the publisher will be lead to decrease her spending on detection of pirates. Note, however that a tax increase will indirectly lead the publisher to increase her price, something that should lead to an increase in detection spending. But as this indirect effect will be outweighed by the direct effect from the tax, the overall effect will be a decrease in the detection spending.

8.2 Effects on Social Welfare

In economic theory illegal copying is usually seen as affecting social welfare in two ways: it reduces the incentive of publishers to innovate and produce, leading to an underprovision of the product; and it allows some users who have a valuation higher than the marginal cost of production, but lower than the price to consume the product (Novos and Waldman, 1984). Chen and Png (2003) add that the publisher's expenditure on detection also will be a welfare consequence of copying. Since the product in their framework already has been developed there is no such thing as underprovision. We can therefore look at detection expenditure and the possibility of improved utilization. Adopting a utilitarian viewpoint, the

total social welfare will include the net expected benefit of both ethical and unethical consumers, as well as the publisher's profit and the government's net revenue.

The results from this exercise are that both the price and the detection rate can be reduced in a welfare enhancing way without affecting the publisher's sales. The intuition is that a lower price can substitute for detection. Note that detection deprives consumers with too low valuation to purchase the good the possibility to use it. Thus, detection has a negative impact on a utilitarian social welfare model. An increase in the detection rate will lead to less copying and a lower consumer surplus, but this reduction will not benefit the publisher. This follows from the fact that she spends at least as much as she earns from the reduced piracy on detecting the piracy. The overall result is therefore that more detection will not lead to an increase in social welfare.

A lower price will also induce the lower segment of copiers to purchase the product legally. In addition, it will also induce more ethical consumers to make a purchase. Thus, though both a lower price and a lower detection rate have similar effects on social welfare, pricing should be viewed as a more socially responsible way to act facing competition from piracy.

Intuitively, these results tell us that a government should impose a tax on the complementarities rather than a fine on copying. Recall that the price is increasing in the fine, and that the detection expenditure is increasing in the price. Above, we have seen that both of these effects will negatively affect social welfare. Since the effects of a tax on the price are ambiguous, and a tax has been shown to reduce detection expenditure, we can make the conclusion that a tax should be preferred to a fine if the policy aim is to increase social welfare.

An obvious drawback of the tax on recording mediums is that its reach is too wide. Although recording mediums as blank CD-Rs and CD-burners are used for illegal copying there are also legal uses attached to these products. A tax will therefore 'punish' someone for a crime they are not necessarily committing. It could therefore be that a subsidy on the legitimate purchase of the recorded good would be the better policy instrument of the three discussed. A subsidy will decrease the price and thus stimulate more legitimate purchases. Also, facing a lower price on her good the publisher will expend fewer resources on detection

which will also lead to increased usage and higher social welfare. This is in line with the arguments put forth by Plant (1934), as mentioned in section 2.

8.3 What Kind of Enforcement is Optimal?

Above, we have been focusing on broad-based enforcement. This is the standard case in copyright economics, and it raises the price equally for all individuals facing piracy. Examples could be taxes on piracy complementaries like recordable CDs, portable mp3-players, VHS players, photocopiers etc. Thus, broad-based enforcement induces a cost to piracy. We can illustrate this graphically like below:

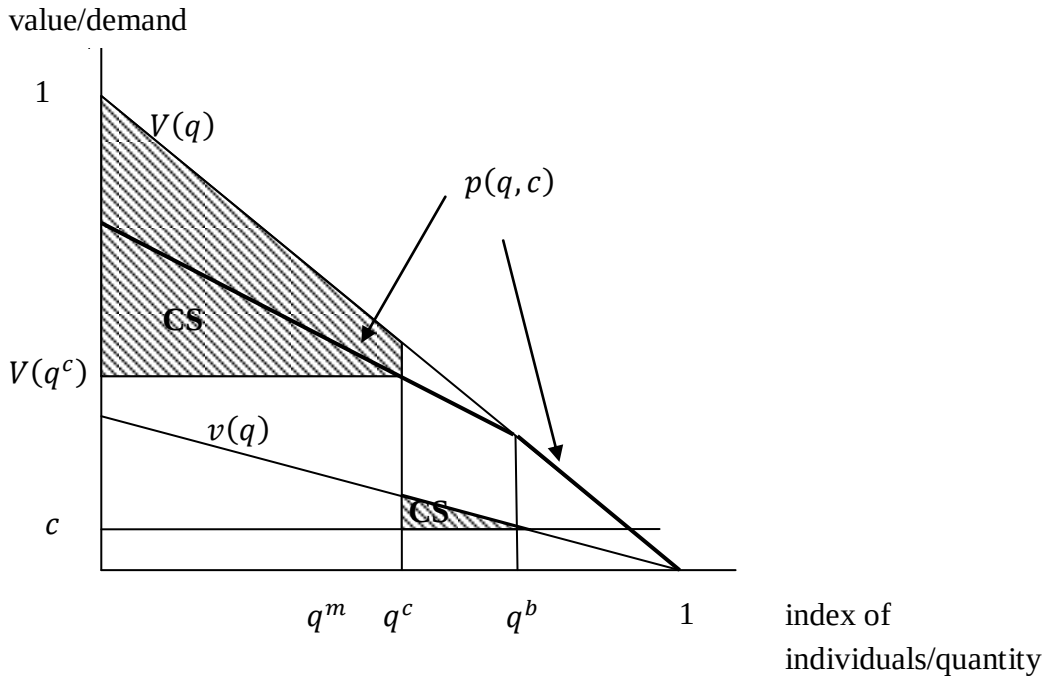

Figure 6: Effect of broad-based enforcement

Source: Harbaugh and Khemka (2010)

In the figure, q^b is the marginal pirate. She will be indifferent between copying or not using the product at all. The marginal consumer, indicated by q^c, will be indifferent between buying the product, or copying it. This is therefore also the quantity of sales, and the price is indicated by $V(q^c)$. An increase in the price of copying will be represented by an upward movement of c. It is quite clear that consumer surplus decreases as the cost of copying goes up. A higher level of c will move q^b to the left, and the price curve to the left of the kink will

be shifted upwards. This allows the copyright holder to charge a higher price for the good, since the competition from illegal copying has become more expensive. Thus, broad-based copyright enforcement will have the effect wanted by the record industry, as it lowers the level of piracy. However, from a policy perspective, it might not be the desirable result. Higher prices for both legal and illegal copies will unambiguously decrease consumer surplus. Higher prices for the same quantity will, however, increase the publisher's profit, leaving the effect on total surplus ambiguous.

This transition will only go as far as to the point where the publisher can charge monopoly prices. After this, more broad-based enforcement will not result in higher profits for the publisher as she will still choose to produce at the monopoly level. Thus, further increases after q^m will not affect consumer surplus, publisher's profit, nor total surplus.

A study by Harbaugh and Khemka (2010) finds that targeted, rather than broad-based, copyright enforcement might increase both the publisher's profit and the consumer surplus. Targeted copyright enforcement works in a similar manner as price discrimination,[25] and can be viewed as the relevant case for both the music industry and the software industry. The software industry usually charges higher prices to institutions, governments, and companies since they know that these are usually not prone to making illegal copies. Similarly, record companies usually enjoy higher copyright enforcements in richer countries where the demand for their products is higher than in poorer countries. Thus, the situation where a copyright-holder enjoys targeted enforcement can be drawn as in figure 7 below.

In the graph below, $V(q)$ is the demand for the legitimate product while $v(q)$ is the demand for the pirated copy. The point q^e is the index of copyright enforcement. All buyers $q \leq q^e$ are subject to enforcement discrimination and can only purchase the legal version, while all buyers $q > q^e$ may purchase a pirated copy. This gives two separate demand curves; the publisher charges a super-monopoly price, $V(q^e)$, in the market with strict enforcement, $q < q^e$. For quantities higher than q^e the publisher faces competition from the piracy market, and can therefore not set a price higher than $V(q) - v(q)$. The inverse demand functions, $p(q, q^e)$, is marked in the graph as the thicker downward sloping lines.

[25] If there is targeted enforcement there might also be possible to have price discrimination.

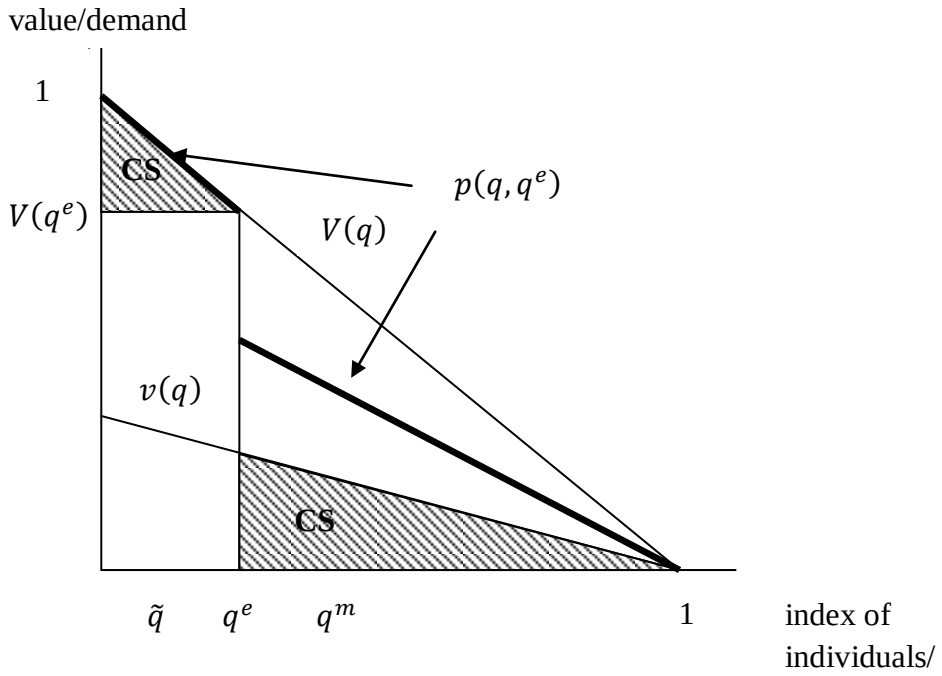

Figure 7: Effect of targeted enforcement

Source: Harbaugh and Khemka (2010)

Denote the lowest quantity that would that leaves the publisher indifferent between competition and no-competition as $\tilde{q}$. When the enforcement extent is lower than this, $q^e < \tilde{q}$, it will be profitable for the firm to engage in competition with the piracy market, selling its quantity at a competitively low price. When the enforcement reaches $\tilde{q}$ the firm will switch to selling fewer units at a super-monopoly price, inducing higher profits. Further enforcement increases will only benefit the publisher who can now sell at the higher price to even more consumers. This will be the case until the enforcement reaches the monopoly level, q^m, where the firm will engage in standard monopolist sales.

Consumer surplus will not surprisingly be higher the less enforcement there is, even with targeted enforcement. Therefore, the consumer surplus falls dramatically when enforcement is changed at $q^e = \tilde{q}$. Any further increases of the enforcement will act slightly positive on consumer surplus since the price is falling slightly towards the monopoly level, until we reach $q^e = q^m$. If the enforcement is extended further after this, it will only hurt those who would not buy but would copy as the quantity and price would still have remained at monopoly level. Thus, any $q^e > q^m$ surely will only have a negative effect on consumer surplus.

Comparing broad-based enforcement with targeted enforcement provides important results with policy implications. We saw that increasing broad-based enforcement not only reduced consumer surplus, but it also reduced piracy. Targeted enforcement on the other hand, had first a very negative effect on consumer surplus as the publisher shifted from engaging in a competitive environment to acting as a super-monopolist to a 'captured' market. As enforcement continued to increase, however, the price was lowered in the 'captured' market, and consumer surplus grew as consumers chose the superior legal good instead of the pirated copy. If the digital media industry is a market such that enforcement targeted at high-value individuals is possible, then this shows that enforcement strong enough to induce monopoly level output is the socially preferred options.

Worth noting is that consumer surplus is the highest when enforcement is not in place, forcing the publisher to compete with piracy and set prices low enough to capture parts of the market. However, this would not be the most profitable situation for the publisher. But, unlike the situation with broad-based enforcement, both consumer surplus and the copyright holder's profit can be seen to increase when enforcement increases from its minimum level to the monopoly level. Thus, targeted copyright enforcement would be a more socially-preferred option to broad-based enforcement.

8.4 Effect on Consumer Distribution

In section 4 on promotional piracy, we argued that there are different distributional relationships in different markets. Products aimed at a young consumer base will usually depict a negative relationship between the valuation of the good and the personal cost of copying it. The distribution function is thus a downward sloping curve in a v, c space. A typical product that fits this description would be computer games. On the other side, goods aimed at a more mature and professional clientele, like business software, will be represented by a positive v, c relationship. We argued that the relationship for musical recordings is unclear but noted that most other studies assume a negative relationship, arguing that music is mostly a product aimed at a teenage and young adult audience. If this is the case, then piracy will not have a positive promotional effect on the publisher's profit, but rather act as a displacement of sales. We'll now see that the policy tools can alter the distribution curve.

Stricter copyrights or copyrights enforcements, or taxes on piracy complements, will all increase an individual's perceived cost of piracy. Remember that we said that personal

income was a third factor that connected the valuation of the product and the personal cost of piracy. A suitable form for the cost of piracy function is then[26]

$$c = \kappa + \gamma y$$

where κ is a fixed cost component of piracy, say, the cost of a blank recordable CD, and γ is a measure of sensitivity to changes in income y on piracy costs. For example, γ could be a measure of how easy it is to copy a record to a blank recordable disc, or how long it takes an individual to find a non-corrupted file online. γy is then simply the opportunity cost of spending your time finding or producing the illegal copy rather than working.

A tax on piracy complements like recordable discs will now be seen as an increase in κ. The marginal cost of piracy is, in this case, the same as before but the fixed cost to enter piracy increases. This will lead to a straight parallel shift to the right in the downward sloping distribution curve, as illustrated below:

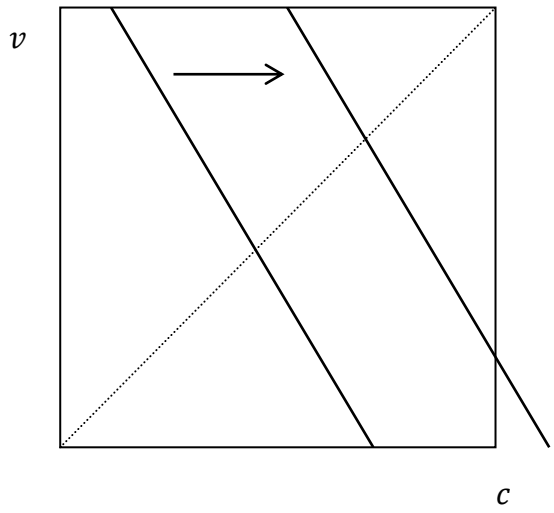

Figure 8: Effect on distribution curve, κ increases

Source: Croxson (2009)

A publisher can, in this scenario, rid the market of harmful piracy, which as we remember related to the individuals in the top-left corner of figure 1, by increasing κ enough, while keeping the price at the monopoly level, p^M. It is shown in Appendix B that setting $\kappa = \underline{c} = p^M$ ensures that harmful piracy does not occur.

[26] As in Croxson (2009)

A stricter copyright protection, heavier copyright enforcement efforts, or higher penalties for those who copy illegally will increase the γ variable. Straight derivation shows that an increase in γ changes the slope of the distribution curve. Graphically, it can be represented as below:

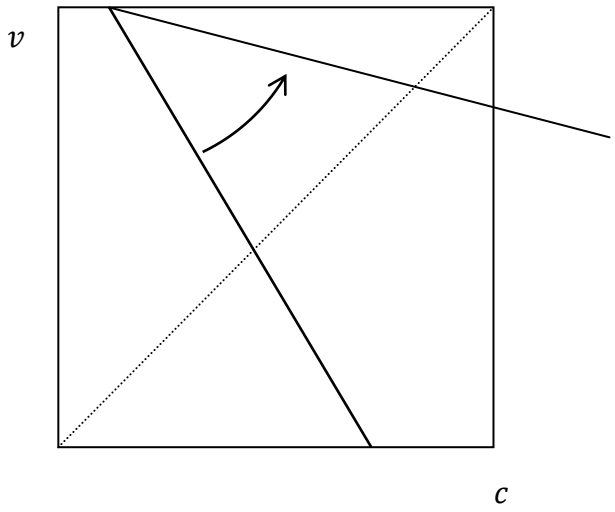

Figure 9: Effect on distribution curve, γ increases

Source: Croxson (2009)

Again, the publisher can rid the market of harmful piracy by increasing γ sufficiently. It is easy to understand from the figure above that 'sufficiently' in this current example is in fact 'infinite', since the locus of the new curve still is situated in the top-left corner that indicates displaced sales.

Notice, however, that if the music market is characterized by a positive v, c relationship, the results become the opposite. An increase in the fixed cost, κ, would now remove the promotional piracy from the market, without increasing sales. An increase in γ would give the distribution curve a flatter slope. This means that the potential of promotional piracy would decrease in this case as well. A publisher therefore needs to be sure of the distribution of potential customers to be sure of the market effects of copy protection.

This section has shown that the publisher can limit the amount of piracy of her products but that it might not always be desirable of her to do so. Moreover, it has shown that denying 'low type' individuals the opportunity to copy a product they would otherwise not buy lowers the consumer surplus. We have looked at the traditional anti-piracy measures of copy controls and tax on complementary goods, and the effects these might have on piracy

and the consumers' susceptibility to copy. We have shown that targeted enforcement, in the sense that enforcement discriminated between 'high value' and 'low value' consumers, was a preferred option to broad based enforcement, as it helped bring prices down from a super-monopoly level to standard monopoly pricing. Lastly, we saw that the publisher can rid her market of piracy, if her market is characterized by a negative v, c relationship, if the fixed cost component of piracy costs is set to equal the monopoly price.

9 Conclusions

In this thesis I have looked at potential effects arising from illegal copying. The focus has been on downloading of music files, due to its popularity in the media and to have a fixed idea of the concept. The general idea is applicable for other industries however, especially within the digital media industry. Though these sectors only make up a small part of the global economy, they make up for a huge part of people's lives.

The recording industry is losing money by the minute, and intense battles are being fought both in the courts of law and within political decision making in order to stem illegal file-sharing, or 'piracy' as it is usually referred to. We have seen that a vast array of literature has been dedicated to this subject, and that conclusions and opinions have varied as technological progress has made copies better and easier to make. We have also seen that economists differ in opinion as to the effects of file-sharing on the recording industry and on the economy today.

The general idea put forth in this thesis is that illegal downloading might not be as bad as portrayed by the industry and its lobbyists. In some cases, we have seen that it might actually have positive effects on record sales. This hinges on assumptions regarding the distribution of individuals who are buying records. Most studies argue that teenagers and young adults make up the consumer group of records. I have argued that this might be a simplification of reality but used this assumption myself when needed for my analysis. I have also showed that policy instruments like taxes on copying complementarities, subsidies, and fines might alter the distribution of consumers. I concluded that from a social point of view, it is more desirable to implement subsidies, as this will lower the price facing the consumer. Fines will not help increase the legal sales, as those who are deterred from piracy by the potential penalty will usually not be in the market for purchasing the product anyway. Thus, it will have a negative effect on consumer surplus without compensating the publisher. Taxes will reach too wide as they also deter some of the potentially legal uses of the copying complementarities.

I have also discussed the difficulties in copy protection and copyright enforcement. As publishers seek to retain their business model, they have relied on intensive use of copy protection, as well as appealing to law enforcement agencies that pirates are violating copyright laws. Proponents of the existing laws and the industry argue that these copyright

violations hinder further innovation and harms music. I have shown that, contrary to its intent, the copyright might actually be bad for innovation, as it provides the copyright holder a cushion to rest on. The introduction of pirates has forced the industry to innovate in order to stay in business. Interestingly, it has been outside-agents like iTunes and Spotify who have made the most profitable musical innovations this past decade, and those innovations have probably done more in the battle against piracy than the legal actions undertaken on behalf of the record industry.

The most important finding in my opinion is that, contrary to industry claims, piracy is not killing music. Rather, it is the recording industry as we know it that is in trouble. The past decade has seen a dramatic shift in popular attitudes towards the music industry, and to how we treat music as a consumer good. The Internet has offered a whole new distribution channel and made it possible for previously obscure and unsigned artists to build a fan base without the involvement of a record label. In addition, by the widespread broadband access in the Western world, it has rendered the physical container music usually has been sold in useless. Now, music is being downloaded directly into our computers and portable music players, and the packaging has been substituted with a digital file consisting of a sequence of 0s and 1s. As a result, we no longer put the same monetary value on recorded music. On the other hand, our demand and our willingness to pay for a live performance have increased. Artists thus spend more time touring than before, and the consequently also spend less time recording. This might be bad news for the recording industry, but can be good news for music lovers.

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Appendix

Appendix A

Table A1: Time Between Album Releases	
Year of Album Release	Average # Years Since Previous Album
1995	1.163
1996	1.318
1997	1.460
1998	1.623
1999	1.647
2000	1.637
2001	1.702
2002	1.757
2003	1.755
2004	1.832

Source: Mortimer and Sorensen (2005), table 7

Table A2: Probability of Touring			
	1993-1998	1999-2002	Relative % Change
Genre			
Country/Folk	3.04	3.02	-0.7
Jazz/Latin	1.04	1.42	36.5
Rock/Metal	4.13	3.88	-6.1
Urban/Rap	1.31	2.11	61.1
Age of Band/Artist			
<5 years	2.64	3.28	24.2
6-10 years	3.51	3.57	1.7
11-20 years	3.57	3.12	-12.6
21+ years	2.96	2.98	0.7
Overall	**3.20**	**3.33**	**4.1**

Source: Mortimer and Sorensen (2005), table 5

Table A3: Concert Revenue*					
	Tickets Sold	*Concerts Held*	*Ticket Price, avg.*	*Revenue*	*% Change in Revenue*
1993	10.0	2956	18.87	189	
1994	12.1	3890	21.40	258	36.5
1995	13.8	4588	20.66	285	10.5
1996	12.8	4803	21.22	272	-4.6
1997	14.3	5170	26.21	375	37.9
1998	16.0	4610	26.36	422	12.5
1999	16.0	**4846**	31.34	**501**	**18.7**
2000	14.6	**4788**	33.66	**490**	**-2.2**
2001	16.0	**6537**	37.56	**601**	**22.7**
2002	17.4	**7609**	35.77	**622**	**3.5**

**Tickets and revenue divided by 1,000,000. Revenue and ticket price in US December 1997 dollars. % change author's calculations. "The Napster Years" in bold. Source: Mortimer and Sorensen (2005), table 1.*

Table A4: New Artists Releasing Records*					
	Country/Folk	*Jazz/Latin*	*Rock*	*Urban/Rap*	**Total**
1995	642	1,982	1,359	902	4,855
1996	621	1,537	1,422	1,006	4,586
1997	565	1,315	1,301	1,056	4,237
1998	596	1,217	1,395	1,177	4,385
1999	644	1,453	1,984	1,493	**5,574**
2000	1,563	1,894	3,257	1,983	**8,697**
2001	924	1,331	2,667	1,758	**6,680**
2002	785	1,252	2,519	1,477	**6,033**
2003	676	1,337	2,316	1,174	**5,503**
2004	904	1,627	1,919	1,297	**5,747**

***"The Napster Years" in bold. Source: Mortimer and Sorensen (2005), table 6.*

Appendix B

Why $\kappa = p^M$

The argument hinges on a negative correlation between v and c. This must mean that the person with the highest valuation of the product has the lowest cost of piracy. Lets denote these values $\overline{v}$ and $\underline{c}$, respectively. If $\underline{c} \geq p^M$, then the individual with the lowest cost of piracy will not be tempted to copy at the monopoly price. Since no one has a lower cost, no one will be copying in this market. The possibility of piracy will have no impact on the publisher's profit.

The picture changes if $\underline{c} < p^M$. This condition implies that the individual with the highest valuation of the product would rather copy it than purchase it legally. Piracy is thus damaging to the publisher's profit. These are the individuals the publisher wants to rid the market off. By increasing the fixed cost of piracy, every individual's cost of piracy increases by the same amount (illustrated by the parallel shift of the curve). The individual with the lowest cost to piracy will therefore be the one who has the lowest γy value. The lowest value this will have for an individual will be zero. Then it is easy to see that the lowest value of κ that will rid this market of piracy, is if $\kappa = \underline{c} = p^M$.

■