

Economists Examine File-Sharing and Music Sales

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Forthcoming in *The Industrial Organization of Digital Goods and Electronic Markets* edited by Peitz and Waelbroeck, MIT press, 2005.

The decline in sales of music CDs has been much in the news over the last few years. Since this decline began at the same time that file-sharing became popular, and since file-sharing would be expected to lead to a decline in sales, file-sharing is the leading candidate among possible causes of this decline.

The recording industry has tried to stem this decline in the US and several other countries by suing, or threatening to sue, individuals heavily engaged in file sharing. The motion picture industry has expressed concerns that its sales are likely to suffer a similar fate to that of the sound recording industry if nothing is done to stem the unrestricted use of file-sharing software and it too has engaged in lawsuits against file-sharers. These law suits have attracted a good deal of publicity, discussion, and criticism. A rather influential school of thought has formed in opposition to the corporate players in these industries, and these lawsuits have provided fodder for their critiques of traditional copyright.¹

At the center of the file-sharing debate is the empirical issue of whether or not file-sharing decreases sales. I should note, particularly given the prominence given to this point in the Gayer/Shy paper found elsewhere in this volume, that file-sharing can have a strong negative impact on sales even when a majority of downloads do not replace a sale. I am unaware of any serious analyst who has ever claimed a 1:1 relationship between an unauthorized copy and a lost sale, whether we are talking about photocopying or whether we are examining file-sharing. There are several estimates that the number of music files exchanged on file-sharing networks is larger than the number purchased through legitimate channels. If so, file-sharing could cause a major loss of sales even if only a relatively small percentage

¹ These copyright critics, who are sometimes associated with the concept of the 'creative commons,' argue that copyright laws are being used by the sound recording, movie, and software industries so as to thwart competitive forces that would open up the market to new competition. This is the thesis of Laurence Lessig's recent book *Free Culture* which views the current controversies as extensions of long-running debates regarding the power of cartels to monopolize access to creative works. In this view of the world, file-sharing is a wealth enhancing innovation, likely to democratize the entertainment industry by allowing artists to broadcast and distribute their works without intermediaries such as record companies. In this view, file-sharing systems should be promoted and if necessary, copyright law should be altered to allow file-sharing to proceed apace.

of unauthorized downloads translated into a lost sale. Nevertheless, estimates of the number of music files downloaded in file-sharing networks vary widely (see Liebowitz 2004b).

In this paper I examine the different empirical methodologies that have been chosen in attempts to shed some light on this issue. These studies generally take different approaches in terms of their data analysis. The studies consistently find that file-sharing has led to a serious decline in record sales, except for one highly publicized study that reaches very different, and in my opinion, highly implausible conclusions.

I. Background

Sound recordings, movies, and television occupy the large bulk of our time spent on leisure activities, with the average American watching four and a half hours of television and listening to more than three hours of music each day.² The advertising industry is primarily based around these industries, as is the consumer electronics industry, which would include all forms of stereo equipment, televisions, DVD players, VCRs, and so forth. Sometimes it appears that the youth of our nations are interested in little else beside music, movies and videogames.

The products of these entertainment industries have proven amenable to digitization, allowing them to be transferred over peer-to-peer file-sharing networks. Napster was the first well-known peer-to-peer file-sharing system, but others have followed in the wake of the preliminary injunction that effectively shut Napster down. Current replacements have surpassed Napster in popularity. As an example, from a single website, Kazaa has been downloaded 350,000,000 times, Morpheus 131,000,000 times and iMesh 90,000,000 times.³ It has been claimed that file-sharing represents over one third of all material transferred over the Internet and that music files are downloaded to the tune of

² See Table No.909 "Media Usage and Consumer Spending: 1993 to 2003" in the 2000 US Statistical Abstract.

³ On the download.com website, as of March 2005 although the Kazaa figure comes from May 2004. Download.com was no longer providing totals for Kazaa when I looked in March 2005.

billions files per month, although Liebowitz 2004b suggests that these claims may be wildly exaggerated.

In what follows I will focus on the sound recording industry because that is that market that has attracted the most attention. Since most computer users have enough bandwidth to download MP3 files and also have in place the requisite CD burners with which to allow the listening of this music in locations not tied to a computer, this is the arena where most file sharing is taking place.

It is always useful to examine the predictions of economic theory. To that we now turn.

II. Economic Theory of File-Sharing's Impact

One topic that has received too little attention in the recent literature is the theory underlying predicted impacts of file-sharing on the marketplace.⁴

On the one hand, a downloaded file can substitute for the purchase of an original CD or single song. Substitution of a free alternative is easily understood to have a negative impact on sales and does not need any more elaboration.

On the other hand, the claim has been made that users might merely use downloaded songs to become more familiar with potential music. Although this was originally referred to as the *exposure* effect,⁵ it is currently called the *sampling* effect. Under this scenario users sample from available music and then purchase those songs and albums that are found to be most suitable to matching the tastes of the users. This sampling hypothesis is usually associated with a claim that sales will increase if consumers are allowed to become more familiar with the product before they purchase it, although, there has not been much analysis of this claim.

There is also a claim of potential network effects. As more downloaders listen to music, this theory goes, other consumers derive greater value from their legitimate purchases. It is suggested that

⁴ For discussions of the economics of copying and copyright see Watt (2004) or Varian (forthcoming).

⁵ See Liebowitz 1985.

this might lead to an increase in the sales of CDs. Gayer and Shy present such a model in their paper in this volume.

Finally, there is a possibility that sellers of original files can capture the value from later copiers indirectly in the price of originals, a concept known as indirect appropriability..

I examine each of these last three claims in turn.

A. Sampling

Although sampling is often put forward as having a positive impact on sales, the impacts of sampling are far more subtle. Indeed, a more complete analysis tends to lead one to expect that sampling would lead to a decrease in sales in this market.

The sampling story basically argues that file sharing allows consumers to experience music in a more complete manor prior to purchase than they would have been able to do were they to use the more traditional methods of learning about music: hearing it on the radio or at a friend's house. With file-sharing, listeners can become as familiar with a song as they wish, listening to it over and over again until they are certain they like it.

At that point, according to the sampling theory, the listeners go out and purchase the music. A natural question is to ask why they would make a purchase when they already have the item for free. There are several possible answers. First, they might be uncomfortable listening to music which they have not purchased. This discomfort might arise from a sense of honesty or a sense of wishing to support their favorite musicians. Alternatively, listeners might get to know three or four songs on an album which then allows them to feel comfortable buying the entire album and avoid the efforts involved with downloading the rest of the album.

Assuming that sampling occurs in the manner described above, what would be the likely economic impacts of sampling?

Assume that those engaged in sampling have no intention of listening to MP3 files after the sample period. Instead, they either purchase the music or throw it away. This is a pure analysis of sampling independent of any pirating motive.

There are few explications of the impacts of sampling.⁶ Presumably, after sampling, consumers have more information about which CDs to purchase, allowing them to purchase CDs that provide greater utility than they would have purchased without sampling. Although it is natural to think that consumers would be led to purchase more CDs if CDs can provide greater utility than they did without sampling, this is not necessarily the case.

To see this it helps to analogize the CD to a candy bar, following a line of reasoning developed by Jack Hirshleifer (1971).⁷ Each individual consumer has particular tastes in music and some CDs are better than others as far as satisfying these tastes. Consumers, after all, do not derive utility from the CDs *per se* but derive enjoyment from listening to the music contained within the CD. The underlying demand can be thought of as the demand for music-listening services, which is met to differing degrees of success by various CDs. Those CDs that better satisfy the consumer can be thought of as providing more music-listening services within the fifty or so minutes of music contained within the CD. Since those CDs contain more of what the consumer wants, they can be analogized to providing consumers larger candy bars containing more of the candy which the consumer ultimately desires. Sampling has the impact of increasing the amount of music listening services on the CDs purchased.

⁶ The closest might be a paper by Gopal, Bhattacharjee, and Sanders (forthcoming). They attempt to analyze the theoretical impacts of file-sharing using a fairly typical model. Sampling plays an important role in their model but they do not analyze the impacts of sampling by itself. If the full cost of sampling were zero, consumers in their model would sample all music, in order to find the most highly valued music. Whether they would then purchase the preferred music depends on other costs, such as costs of punishment if caught pirating, the sound quality differentials between sampled and purchased music, and the revealed value of music. If sound quality was identical between original and copies and if there were no punishment for copying, consumers would completely pirate and purchase no music.

⁷ By working with the underlying characteristic of the good we can avoid problems brought about by the fact that CDs are not perfectly homogenous. This is done by assuming that CDs are differentiated by the different quantities of the underlying music-listening service characteristic.

In the candy bar case, it is natural but wrong to think that if candy bars remain constant in price while increasing in size, that the quantity of candy bars sold will increase. After all, each large candy bar provides more utility than a small candy bar. This is apparently the thinking of those claiming that sampling MP3s increases the sales of CDs.

The story, however, is not so simple.

First note that the price of candy (music services) is effectively lowered when the bar (CD) becomes bigger, holding the price of the candy bar (CD) constant. If the demand *for candy (music services)* is elastic, then revenue in the market will increase when candy (music services) goes down in price, as it does when constant-price bars (CDs) become larger. If revenues increase in this way, and the price of bar is unchanged, then more candy-bars are purchased. The inverse of this story will hold when the demand for candy is inelastic. Making candy bars larger rotates the demand curve so that the price is higher at small quantities but lower at large quantities—in other words, the demand curve rotates and becomes steeper. Satiation occurs at a smaller number of bars since each bar is bigger.

Support for this style of analysis can be found in other markets, such as the introduction of cable television. Cable allowed television viewers who were previously accustomed to having a very constrained choice of only a handful of broadcast signals to instead to be able to choose from dozens of channels. This should have increased the probability that viewers would find, in any half hour period, a program more to their liking than they were likely to have found with only the limited original choices. The analogy to the sampling hypothesis is very strong since allowing viewers to find a better program in a thirty minute television time slot is similar to allowing listeners the ability to find better selections in their choices of CD, as sampling is claimed to do.

Yet, providing more choice to consumers did *not* increase the time they spent viewing television.⁸ Thus the claim that providing consumers the ability to fine-tune their product selections need not increase their consumption is seen to have real-world explanatory power.

Sampling, therefore, might lead to either an increase or a decrease in revenues. There is, however, some additional information in this market that helps to resolve this imprecision.

CDs are thought to have low variable costs of production and high fixed costs. It is common in theoretical models of markets like software or music to assume a zero marginal cost of production. Although this is merely a theoretical convenience, since the variable costs are clearly not zero, variable costs do appear to be quite low in the case of sound recordings.

What are some of these variable costs? The cost of a blank CD is only a few cents and putting the music on the CDs appears to cost less than a dollar. Although the artists normally receive a royalty that is expressed as a function of sales, those payments are usually paid up-front as a non-refundable advance against future royalties, so for most units sold, marginal royalties paid by the producers are effectively zero. Promotional costs for CDs are also usually also taken out of up-front advances, removing another potential variable cost from the variable cost column. There is a variable payment made to the composers of songs that are included in the CD, however, with a statutory maximum payment (in the US) of approximately seventy cents per CD.⁹

⁸ See Liebowitz (1982) who compares the link between viewing hours and cable penetration across different Canadian metropolitan areas and finds an insignificant but sometimes negative relationship. Also see Weimann (1996) who examines viewers in Israel after the introduction of a multi-channel cable system where previously there had been but a single public channel (a more extreme increase in choice than would normally be found). After a year, there was virtually no difference in changes in viewing between a group with cable and a control group that did not receive cable (the cable group increased its viewing by 16 minutes over the control group). There are several papers looking at the impact of cable on different European countries and reaching largely the same conclusions that can be found in Becker and Schoenbach (1989).

⁹ This is a compulsory license which amounts to ninety cents for each CD. In the common case where the performer is the composer, however, it is typical for there to exist a “controlled composition” clause which pays less than (75% appears to be a typical rate) the statutory payment.

It seems reasonable to conclude, therefore, that variable costs are quite low relative to the wholesale price of CDs, which is in the vicinity of twelve dollars.¹⁰

This datum of variable costs being a relatively unimportant component of costs provides some important additional information about elasticity of demand facing each CD. Profit maximization, when marginal costs are zero, is equivalent to revenue maximization and the elasticity of demand is one at the profit maximizing price.

The elasticity of demand for CDs maps directly into the elasticity of demand for music-listening services. If the price elasticity of demand for CDs equals one, so too must the price elasticity of demand for music-listening services. After all, if the marginal revenue of another unit of music service is negative, so too must be the marginal revenue of the CD containing that unit.

Because there is competition between record titles, we should expect that the elasticity of demand for music-listening services (whether defined by musical genre or the entire industry) will be less than the elasticity of demand individual firms or individual record titles, for the same reasons that price elasticities of demand for industries are have lower elasticities than their constituent firms. This implies that the elasticity for the industry will be less than one.

It matters little, however, whether the price elasticity is less than one or equal to one. In either case revenues (and profits) fall when the price is lowered.¹¹ The effect of sampling (more music-listening services at a constant CD price) is to lower the price of music-listening services. The net effect should be to lower the revenues generated by music-listening services. *With a price per CD that is independent of the sampling effect, this implies that the quantity of CDs will fall due to sampling.*

¹⁰ If the composer is not the performer of the song, and if the song has not been recorded, this payment will be negotiated. After a song has been recorded by one performer, however, anyone can record the song if they purchase a 'compulsory license' which is the statutory payment described in the text. According to statistics on the RIAA web page, the average price in 2003 was \$11.91.

¹¹ Boldrin and Levine (2003) assume that elasticity is greater than one in order to generate their results, discussed below.

This analysis assumes, as does the candy bar problem, that the price of CDs is exogenous to the change in music-listening services created by CDs.

B. Network Effects

Some products have network effects. These occur for when consumers' values of a product change depending on the number of other users there are of the product. Telephones and fax machine are two examples of products where the value of those products depends on the number of individuals using those products.

It has sometimes been claimed that network effects might be important to understand the impact of copying. Conner and Rumelt (1991), Takeyama (1994) and Shy and Thisse (1999) each examine models where the existence of unauthorized users creates additional value to the purchasers of legitimate copies and thus might increase the profits of the seller. These models are usually put forward in the context of software, where it appears to be a more natural fit, although elsewhere in this volume Gayer and Shy apply such a model to file-sharing.¹²

The network effects story applied to file-sharing goes like this: File-sharing is likely to increase the number of individuals who listen to prerecorded music (although it is far from clear that it increases either the number of people listening to music or the amount of time spent listening to music). If there is more 'consumption' of music on the part of file-sharers, the value of music for non-file-sharing individuals might increase and the non-file-sharers would then be expected to purchase more music.

¹² It is unclear how strong network effects are for different categories of software. For some categories, such as personal finance software, network effects might be expected to be weak or nonexistent. In other cases, such as spreadsheets network effects are thought likely to be large. Although there have been attempts to measure the strength of network effects for spreadsheets, these attempts were marred by using Lotus 1-2-3 file compatibility as measure of network effects when such compatibility was also important for upgrading spreadsheet users wanting to remain compatible with their old work independent of any network effects.

There are several issues to be addressed in the context of possible network effects for sound recordings. The first is whether there are even network effects at work at all in music listening and what the nature of those effects might be. The second is whether file-sharing strengthens network effects from a regime without file-sharing.

i. Are there Network Effects? If so, what kind?

As normally modeled, network effects depend on the number of other users of the product. The more telephones, the more valuable it is to have a telephone. It really doesn't matter whether the other telephones are used five minutes or five hours per day, the fact that more people have them increases the value to any potential telephone owner. In these models the utility of a user is a function of the number of other users. It is easy to show, in this type of model, that having additional unauthorized users of the product might increase demand for legitimate units.

Unlike telephones, where network effects are obvious, or software, where the ability to transfer files might be important, the linkage of values between different music listeners is far less clear.

What might be the nature of network effects in music? Although it is almost certainly a common event that one person hears music at a friend's house and decides to buy it, that is not sufficient for a network effect to exist. Just hearing new music is merely a form of sampling. For it to be a network effect, the value of the music once it has been heard must be higher because others also like to listen to this music. Alternatively, consumers may enjoy being part of a crowd and value particular songs more highly when they understand that others also listen to those songs. .

Which brings us to the question of whether network effects, if they exist for musical works, have the impact mainly of shifting output from one musical composition to another or whether they have the impact of changing the overall size of the market. The question that is almost never addressed, but crucially needs to be is: do consumers need to be listening to the same exact music for the network effect to operate? We can refer to these as *specific* network effects. Specific network effects could

easily imply that any particular song might benefit from unauthorized copying since that song might become more valuable to purchasers of legitimate copies as the number of listeners of illegitimate versions increases. But specific network effects work to rearrange the sales of individual songs and do not necessarily have any impact on the overall sales of songs, or CDs. Specific network effects work mainly to allocate a consumer's utility from one CD to another depending on shifts in popularity, and they can have a neutral or negative impact on overall sales.

On the other hand, it is possible that the act of listening to music, any music, increases the value to others when they listen to music. This type of *general* network effect implies that purchasers of CDs have greater values for CDs the more other people there are listening to music in general. Since just about everyone listens to music, the factor that would affect the utility of users couldn't be the number of listeners but would need to be something like the total man-hours of music listening. Note that it isn't only the number of man-hours listening to prerecorded music. Radio should equally be able to impact this network effect. Note that, under these assumptions, any type of increase in overall music listening would increase the demand for CDs from those who do not engage in file-sharing.

Is there any reason to believe that such general network effects are at work? I am not aware of any direct evidence on this point, but it doesn't seem terribly likely that music listeners care very much about how much music everyone else listens to. Why should they? Specific network effects seem far more likely to occur.

ii. Would file-sharing even increase network effects?

Let us assume that there are such general network effects so that the utility of purchasing any particular CD increases as other individuals listen to more music. This general network effect is most consistent with the theoretical models mentioned above. Nevertheless, those models demonstrate, at most, that there are certain theoretical conditions under which general network effects might benefit the sellers of music.

A precondition for such a result is that file-sharing actually increases the man-hours spent listening to music since that is the mechanism that would lead to increased value for CDs. It seems unlikely that file-sharing will actually increase total time spent listening to music, however.

It is usually assumed that file-sharing must increase music listening since songs are made available for free that otherwise would require payment. It is a truism to economists that if the price is lowered the quantity consumed must increase. But in fact the alternative to file-sharing might not be the purchase of CDs, but instead might be the activity of listening to radio. Radio is another free method for music listening. Although file-sharing is likely to increase the time spent listening to non-broadcast music, it will not necessarily increase the time spent overall listening to music. It is true that file-sharing is likely to give consumers a better choice of music to listen to since consumers cannot control what is on the radio but can control the choice of downloaded music. But just because an hour of listening to downloaded files might provide greater utility to listeners than an hour listening to radio doesn't mean that file-sharing will increase the time spent listening to music. We are back, here, to the candy bar story.

Thus, in order for file-sharing to increase record sales due to network effects several rather long chains of possibilities all need to go the right way. First, network effects need to be general and not specific, which is questionable. Second, file-sharing needs to increase the general consumption of music, which is questionable. And finally, the network effects need to increase the demand by those who purchased CDs prior to file-sharing by more than the effect of a free substitute diminishes that demand. These are a set of conditions that seem highly unlikely to occur.

That is why network effects seem an unlikely factor to eliminate the negative impact of file-sharing of the sales of legitimate purchases.

C. Indirect Appropriability

The final impact of copying that might apply to file-sharing is indirect appropriability. This is a concept coined in Liebowitz (1985) and analyzed for the case of file sharing in Liebowitz (2002) which I summarize below. It has recently been brought up by Boldrin and Levine (2003) whose work was then critiqued by Klein and Murphy (2003). The basic idea is that originals from which copies are made might undergo an increase in demand as those making copies of originals incorporate the extra value derived by the users of unauthorized copies.

If, for example, everyone who purchased a CD made one cassette to play in their automobile, then the demand for the original CD would increase by the value of being able to make the tape, and the producer of CDs could capture some of this higher value by increasing the CD price, as would happen when demand increased. This value is captured indirectly since there is no direct payment made by the user of the copy.

In order for indirect appropriability to work, however, one of two conditions must hold. First, the variability in the number of copies made from each original must be small, as in the example above. Or else the seller needs to be able to charge higher prices for those originals from which the most copies are made as in the real world example of photocopies. The most heavily photocopied copyright materials are journals, and most photocopying of journals takes place in libraries. Thus publishers of journals were/are able to charge higher prices to libraries than they charge to individual subscribers to take account of photocopying and indirectly appropriate some of the value from copying. Support for this thesis came from empirical work revealing that the now common practice of libraries paying higher prices than individuals was practically unheard of prior to the advent of the photocopier, and the most heavily copied journals were also those with the greatest price differential.

Indirect appropriability will not work in the case of file-sharing. Because there is great variability in the copies made from each original, and sellers of originals cannot identify which originals are

going to be used on file-sharing systems, the mechanisms that allow indirect appropriability to function will not work.

III. The Basic Case against File-sharing

Data on the sales of recorded music tend to be available on a yearly basis from organizations of record producers, such as the Recording Industry Association of America (RIAA) and the International Federation of the Phonographic Industry (IFPI). The United States is by far the largest single market.

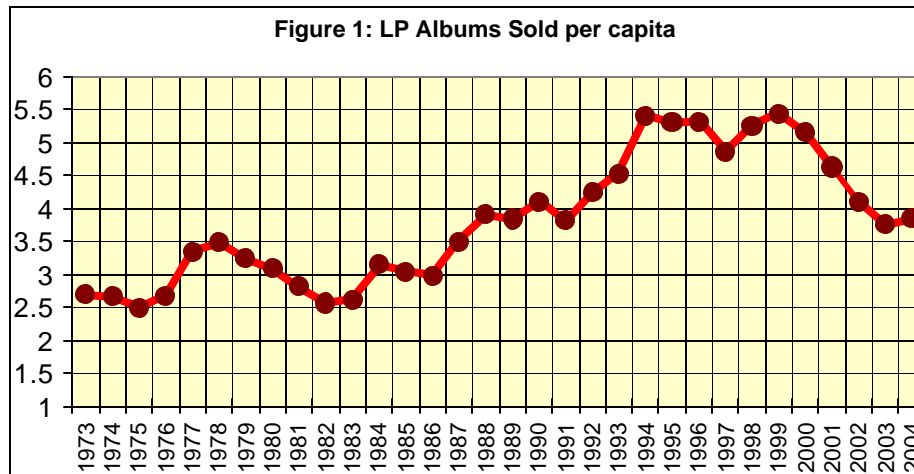
Figure 1 represents the per capita sale of full-length albums sold in the United States since 1972.¹³ The recent decline in sales is readily apparent. Clearly, there are yearly fluctuations in this series. I have stripped out the impact of ‘singles’ because their decline appears to be part of a much longer secular decline quite separate from file-sharing. Nevertheless, the current decline stands at thirty percent.

This recent decline is clearly the largest that has occurred in the last thirty years. In absolute terms (units per capita) it is more than twice as large as the next closest decline and in percentage terms it is nearly fifty percent larger than the next largest decline, which may also have been impacted by copying.¹⁴ Another way to gauge the size of the drop is to count how many years back one would need to go to equal the new lower sales level. In the case of the current drop, one needs to go back to 1987—17 years—before encountering a year with lower sales per capita.¹⁵ The second largest decline ended in 1982 and erased the (much smaller) gains of the prior 7 years.

¹³ Data on quantities were reported beginning in 1973. For prior years only the industry revenues were reported. The data on revenues tend to be estimates based on the list price of recordings. I use full-length albums to avoid measurement problems as, for example, with singles, as they have been in a twenty year secular decline.

¹⁴ The second largest decline occurred in 1978-82. Long playing vinyl records were in decline at that time, being replaced by prerecorded cassettes. This decline coincided with a fairly deep recession and the possibility that blank cassettes were being used to copy records. As I explain in Liebowitz (2004), cassettes ultimately allowed, for the first time, portability of prerecorded music, leading to a large increase in sales that overcame any negative impacts of copying.

¹⁵ 1991 is almost as low, but this still would be 13 years.



This recent decline is sufficiently striking that it would appear that something unusual has occurred in the last few years. Such a large change would be caused by either an unusually powerful but established factor, an unusual confluence of established factors, or some completely new factor.

Napster, which was the forerunner of modern file-sharing, came into existence in the second half of 1999, which also happens to be the peak year in sales. At the time, CD burners were still relatively expensive and did not yet have a large market penetration. Although Napster was closed down in 2001, file-sharers soon migrated to other file-sharing services.

The confluence of file-sharing's birth and the decline in record sales, the rapid growth to an immense size of file-sharing activities, and the unusually large decline in the sound recording market are all consistent with a claim that file-sharing is responsible for the decline in sales. Add to this the predictions of economic theory that file-sharing should lead to a decline in sales and we have what appears to be a very strong case that file-sharing is the cause of the decline.

In 2004 the sales slide ended, at least temporarily. This small increase was due to an increase in sales for the first half of 2004. Liebowitz (2004b) documents that this increase in the first half of 2004 occurred at the same time that file-sharing decreased (due to record industry lawsuits against individual file-sharers). This continued linkage between the size of file-sharing and the sales of sound recordings

provides additional support for the claim that file-sharing harms sales. Further evidence comes from the fact that three genres of music that are less susceptible to file-sharing—country music, jazz, and classical—each experienced an increase in sales even while sales of other genres fell.

IV. More Refined Analyses

Various analyses have been undertaken using different data and different approaches, and more are sure to come. Although measuring the impact of file-sharing on the sound recording industry provides important information, it is only part of the analysis that would be required to answer the question about file-sharing's impact on social welfare or even its impact on the industry's ability to appropriate value. Nonetheless, economists have limited themselves to the more prosaic question of whether or not file-sharing has decreased revenues to the sound recording industry.¹⁶ This is a useful first step, but we need to remember that it is only a first step.

A. Using Countries or Cities as the Unit of Analysis

There are several papers that take this approach. The idea is straightforward enough: compare changes in sales of sound recording in different geographic locations over time using some measure, such as the share of Internet users, to proxy for the impact of file-sharing across these regions.

Liebowitz (2005) examines the sales of CDs in 99 US cities by the number of individuals in various age groups within a city both with and without Internet access. Using Internet access as a proxy for file-sharing, he finds that large young populations with Internet access reduce record sales. The coefficients are of sufficient size to support a conclusion that file-sharing could explain the entire decline in sales. Peitz and Waelbroeck (2004) use data from 16 countries for the period 1998-2002. They find a 20% decline in the sales of music for the world. Zentner (2004) uses international cross

¹⁶ Rob and Waldfogel perform a sort of welfare analysis, but they do not claim to be able to measure any lost value from reduced creative activity which is the major cost normally associated with weaker copyright..

section data from a very large number of countries during the period 97-98 to 2001-2002. He finds a worldwide decline of 15% and a US decline of 30%.

Difficulties with the approach used by these authors include the fact that there are many factors that differ across geographic areas that cannot be accounted for by these regressions. In some instances these areas have different levels of organized piracy, speak different languages, and have very different levels of per capita income, CD sales, Internet use, and stereo equipment. This potential heterogeneity creates a lot of noise which the statistical technique would need to cut through. For example, CD writers make downloaded music much better substitutes for the purchase of a CD. In countries where there are fewer CD writers per computer, downloading will have a smaller impact on sales. Statistics on the number of CD writers are frequently difficult to come by, thus potentially clouding any analysis. Attitudes toward piracy are also likely to differ by geographic area, which is another variable that we do not have information about. Age distributions are also likely to differ by area. The size of the data sets are usually quite small because the number of geographic areas with data on file-sharing/Internet use is not large.

B. Using Records as the Unit of Analysis

There are two papers using this approach. A highly publicized paper by Oberholzer and Strumpf (O&S) and a dissertation by Blackburn.¹⁷ Oberholzer and Strumpf were allowed access to actual downloads logs on a server that was part of a file sharing system, whereas Blackburn used data provided by Big Champagne. Oberholzer and Strumpf have the advantage of having actual downloads but the disadvantage of have information from only a single small part of the file-sharing endeavor. Blackburn's data is based on the entire industry but doesn't directly measure downloads, instead having the number of files available on hard drives for individuals to download. Both papers assume

¹⁷ The Blackburn paper is available at <http://www.economics.harvard.edu/~dblackbu/papers.html> and the Oberholzer and Strumpf paper at http://www.unc.edu/~cigar/papers/FileSharing_March2004.pdf.

that their samples are representative of the entire market and provide some evidence to support this view. Both papers then matched their estimates of music downloads to the recordings where the songs appeared and then both papers used data from SoundScan to compare the downloads of CDs to the sales of CDs. Nevertheless, these two papers come to diametrically opposed conclusions.

Each paper finds that for the average CD, file-sharing has a negligible impact. Of course, it is incorrect to give each CD equal weight if the purpose of the analysis is to determine the overall impact of file-sharing on CD sales since a small number of popular CDs are responsible for the lion's share of industry sales. Blackburn interacts a measure of prior artist popularity with his measure of downloading and finds that file-sharing has a positive impact on relatively unknown artists, but more importantly, has a strong negative impact on CDs from more popular artists, leading him to conclude that file-sharing has a large negative impact on record sales. Oberholzer and Strumpf used two different techniques to determine how their measured impact differed by type of album. In the original version of their paper they divided their sample into quartiles based on how successful the album was in the market, and found that file-sharing had a small, insignificant negative impact on the less successful albums but a large positive impact that was on the border of significance for the more successful albums. This result is, in my opinion, so contrary to expectations that they most likely indicate a serious problem somewhere in their analysis. The newer version of this paper removes the tables providing details of the regression results by quartiles. Instead the authors use an interaction terms (based on prior popularity) similar to those of Blackburn and produce a result strikingly at odds with their prior analysis: now the more popular artists are negatively impacted by file-sharing, although, contrary to Blackburn's results, they are not significant. To my mind, current popularity is more important than past popularity, and breaking up the sample by the success of the actual album is the more natural way to test for these impacts, and both papers should report such results.

There are several potential problems with this methodology. First, it is unclear that an analysis using records as the units of observation can provide information about the impacts on the entire industry, as opposed to the impacts on individual recordings. There is a potential fallacy of composition problem here. Just as the impact of advertising on a firm's sales may be very different than the impact of advertising on industry sales, so too the impact of downloading on individual CDs may be very different from the impact of downloading on the entire recording industry.

Even ignoring this potential fallacy of composition problem, there are other difficulties in these analyses. There is a serious simultaneity problem in the data because popular songs are going to be both heavily purchased and heavily downloaded. Overcoming such a simultaneity problem is no easy task and the major thrust of both of these papers is in trying to overcome that simultaneity.

O&S and Blackburn use very different instruments to try to overcome the simultaneity. Blackburn uses the impact of RIAA lawsuits and O&S use variables such as the number of German schoolchildren on holiday, which appears to me to be a very problematic variable.¹⁸

The difficulty with choosing proper instruments is illustrated by comparing the O&S estimates for their pooled sample in the first and then in their revised paper. In their first version of the paper they use several instruments and yet the coefficient on downloads (which is biased upward due to the aforementioned simultaneity) actually increases, although the diagnostic tests performed by O&S do not indicate any problems. Perhaps in response to criticisms, O&S add an additional instrument into the later paper (misspelled song titles) and the coefficient in this version declines to a less outrageous level. Since their diagnostics did not indicate any problems in their original paper, why should we believe that the now seemingly more reasonable results are correct? Perhaps the addition of additional instruments will further change the coefficient?

¹⁸ I discussed some concerns about their instruments in more detail on my web page: <http://www.utdallas.edu/~liebowit/intprop/germankids.htm>.

C. Using Surveys

There are four papers based upon surveys. Both Hong (2004) and Michel (2004) use data from the Consumer Expenditure survey.¹⁹ Rob and Waldfogel (2004) use data based on a survey of college students and Zentner (2004) uses data based upon a survey of consumers in several European countries.²⁰

All of these studies conclude that file-sharing is harmful to record sales. Michel finds file-sharing causes a decline larger than the decline that occurred while Hong finds that file-sharing causes a decline less than half of the measured decline. Zentner find a decline in sales of 8% from what they would have been as of 2002, but his results are based on seven European countries and it is not clear whether this change is larger or smaller than the actual change that occurred. Rob and Waldfogel find that each downloaded album reduces legitimate sales by half an album, which is a large enough result that it could explain the entire decline in record sales. It is not clear, however, that college students are representative of all file-sharers, and thus their results might not generalize to the entire population.

As is true for all studies, there are potential problems. Surveys can be misleading because respondents may not know the answers to questions asking for detailed information about purchases, or because they are unwilling to answer questions honestly.²¹ Given the highly politicized nature of file-sharing, it wouldn't be surprising if respondents tried to minimize their reported reduction in CD purchases. If so, results based on such surveys would be biased to understate the true impact on sales.

Zentner and Rob & Waldfogel have direct information about MP3 downloading in their data, whereas Hong uses Internet access as a proxy and Michel uses computer ownership. Data used by

19 Hong's paper is part of his dissertation at Stanford and is currently available at:
<http://siepr.stanford.edu/papers/pdf/03-18.html>.

20 Rob and Waldfogel <http://ssrn.com/abstract=612076> Zentner (Chicago Dissertation)
<http://home.uchicago.edu/~alezentn/musicindustrynew.pdf>

²¹ In Rob and Waldfogel's survey, respondents reported that they would pay an average of from \$20,000 to \$50,000 to not have to give up favorite or popular albums. The median values are in the range of several hundred dollars. The higher average values clearly contain some outlandish responses.

Zentner, Michel, and Hong are no more recent than 2001 which precedes out much of the CD sales decline and might well understate the impact of file-sharing since CD burners were less prevalent then than they are now.

Further, the two studies with direct measures of downloading suffer from a simultaneity problem in that those individuals who are most interested in music tend to be heavy purchasers as well as heavy downloaders. Thus they each resort to instrumental variable techniques in an attempt to overcome the simultaneity. Since the key assumption of instrumental variables, that they are not correlated to the error term, cannot be tested, there is always a risk that the results might be untrustworthy.

D. Examining Alternative explanations

Another method to help determine whether the analysis above is correct is to examine, at a market level, whether there are other possible explanations for the decline in record sales. There are too few data points to run a regression, but that hardly seems necessary. One can examine the set of variables that might be used in a regression analyses. Given that there is a precipitous drop in sales that begins in 2000, it is merely necessary to know if other variables changed at about the same time. If these other variables did not have a fairly large deviation at about that time, a regression analysis using these variables would not have concluded that these variables were responsible for the decline.

Examination of other factors that might impact record sales is the approach taken in Liebowitz (2004). There are four main alternative factors to examine.

i. Price and Income changes

Although the claim is often made that price increases are responsible for the decline in CD sales the evidence does not support this view. Real list prices have been virtually constant for the last

decade, and the increasing share of the market generated by discount sellers has probably lowered the average transaction price.²² Prices, therefore, are ruled out as an explanation of the sales decline.

Regressing first differences in albums per capita on changes in real per capita disposable income and changes in penetration of portable devices over the period 1973-1999 gives the results found in Table 1.²³ The penetration of portable players has a positive but impact on album sales although the results are not statistically significant. The impact of disposable income on sales over the last thirty years is statistically significant, but a change in real per capita disposable income of \$1000 would alter per capita sales by only .5 units and the largest sustained decline in real per capita disposable income during the last thirty years was approximately \$715 in 1979-80. Although the US experienced a recession in 2001, it was far too mild, given the historical impact of income on sales, to be able to explain the decline in sales that occurred since per capita disposable income did not fall.

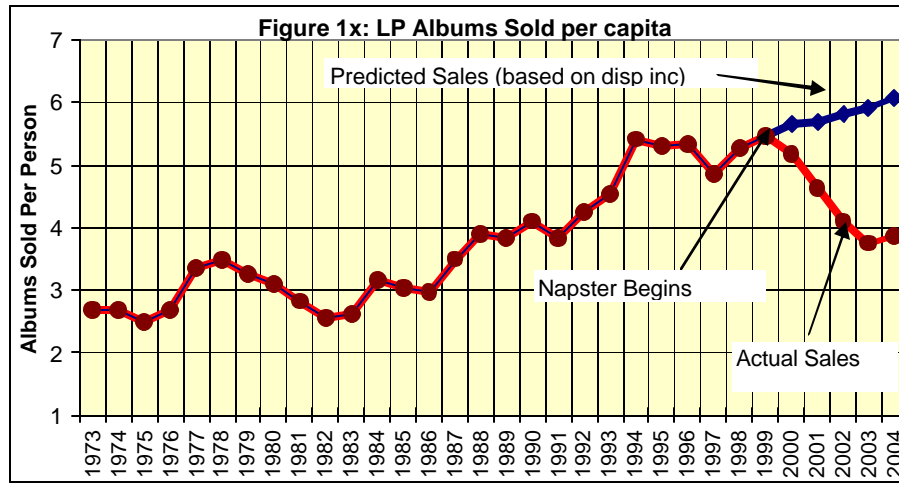
	Coef./ Robust Std. Err.	t	Beta	P>t
change in disposable income per capita	0.0005341	2.67	0.35035	0.014
change in portable penetration	1.862218	1.13	0.23302	0.27
constant	-0.050119	-0.63	.	0.535
R-squared	0.1948	# of obs	26	
Root MSE	0.32383			

In fact, from 1999 until 2003 real disposable income per capita has increased by \$1582, which, according to the regression, should have led to an increase in sales of 0.85 units per capita. The year-by-year sales figures after 1999, based on changes in income, are provided in Figure 1x as the line with

²² There was a very slight increase in real list price between 1999 and 2003 (3%) with a decline in price from 2002 to 2003. Transaction prices are likely to have risen less because of the shift to low markup vendors. With any feasible price elasticity of demand, only a trivial portion of the decline in sales that occurred could have been due to price changes.

²³ It is obviously inappropriate to use the post 1999 data in these regressions since file-sharing started in 1999 and we wish to determine the impact of income and portable penetration on record sales in order to judge whether the post 1999 sales were negatively affected by file-sharing. If file-sharing had an impact on sales, it could distort regression results ignoring file-sharing.

diamond markers. Of course, the variables in the regression are not capable of explaining all that much of the prior changes, so there are obviously other factors at work.



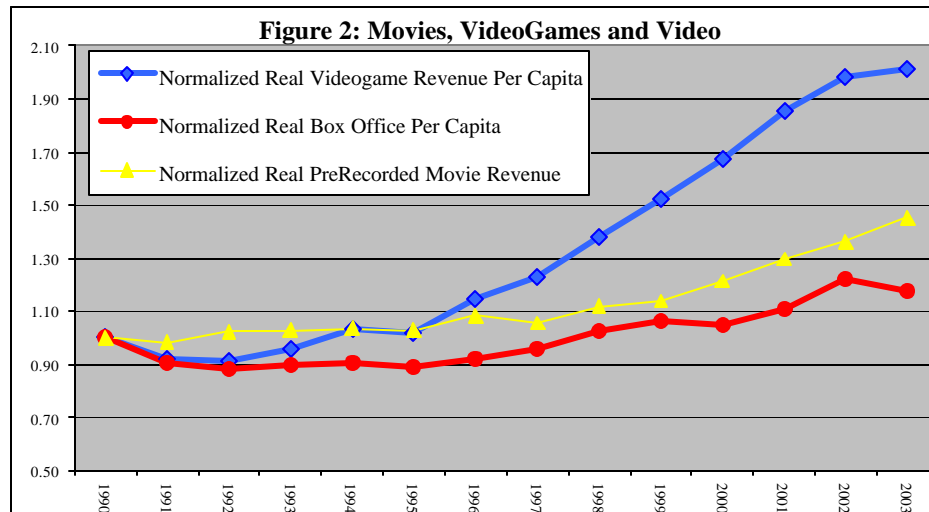
ii. The Impact of Substitutes, such as the DVD Market

One claim that is frequently encountered is the claim that record sales are down because alternatives, such as videogames, movie viewership, and DVDs are up.

Table 2 lists correlations between yearly changes in the sound recording industry and changes in these other industries. These forms of entertainment seem to be impacted by similar factors since yearly changes in each are positively related to one another. In some instances the number of observations is quite small, however, due to the relatively recent creation of these markets.

movie revenue per capita	0.199	1973-1999
videogame revenue per capita	0.265	1991-1999
units of prerecorded video per capita	0.177	1990-1999

More detailed information on whether changes in these markets can possibly explain the changes in record sales can be gained by examining Figure 2.



Here we compare the changes in these markets since 1990, with 1990 values normalized to equal 1. We know that record sales began their steep dive in 2000. None of the markets report here has any sort of abrupt shift at about that time, thus none are convenient candidates to explain the decline in record sales. Although not shown, there was an abrupt increase in *sales* of pre-recorded movies beginning in 2000, but the *rental* of movies fell during that period, with the total expenditure for pre-recorded movies shown in Figure 2. Some analysts (Strumpf) have mistakenly focused on just the sale of DVDs to claim that expenditures on DVD is a good candidate to explain the sale of records.

Which, naturally, brings us back to the question: why did these other media move generally in tandem with CD sales? One possibility is that interest in electronic gizmos, like other trends in consumer tastes, goes through cycles, and that music and video both tend to benefit from increased interest in home entertainment. Even under such circumstances, where both the video and sound recording markets are impacted by the same outside factor(s), the simple correlation that results between sales in these two markets still provides useful information. As long as that third factor continues to be the dominant impact in both markets, video and sound recordings would be expected to continue to move together. Again, the divergence of the fortunes in the CD markets indicates that something changed in the year 2000. The most viable candidate is file-sharing.

iii. Has the Music Changed?

When the record industry has a decline, critics of the industry will often claim that sales fell because the music was not interesting. Thus, it is not surprising that this has emerged as an answer to the question: “if MP3s are not hurting the industry, what is?”

I looked at two pieces of evidence related to the ‘quality’ of music. One was the financial success of concerts from 1990-2001. Although there are defects with this measure, the years 2000 and 2001 had the largest real increases in concert revenues—at the same time the record industry was experiencing unusually large decreases in revenues.

A second potential source of data is time spent listening to radio. If music is losing its luster, then radio listening should decline. Data from the last 5 years, shown in Table 3, do reveal a fairly serious decline in listening—9%. The decline, however, is across the board, not just for groups that listen to new music. It is implausible that those over the age of 65, for example, would find their attraction to radio diminished because contemporary musical compositions were not to their liking.

Group	Decline in Listening
Persons 12+	9.30%
Teens 12 - 17	11.67%
Persons 18-34	13.48%
Persons 35-64	4.27%
Persons 65+	5.75%

Further doubt about any claimed doldrums in current music composition comes from examining the listening shares of radio formats. If current music were inferior to past music, its share of listening should fall relative to old music and non-music categories. Yet the category of ‘News and Information’ is only up 1.8% over this period. The largest decline in radio listening (51.3%) is for the ‘Adult Standards’ category which consists of music from the pre-rock era, hardly a repository of new music. The categories of ‘Contemporary Hits’ and ‘Urban,’ both of which have a great deal of new music,

each increased their shares (5% and 23% respectively) and 'Alternative' (modern rock) was down only 2%.

The evidence on musical quality is far too weak and scant to provide a great deal of confidence. Nevertheless, there is no support in the data for a claim that a decline in music quality can explain the very large decrease in sales that has occurred.

iv. Changes in the Supply of Music

It has been claimed by some that the number of new titles has fallen in recent years and this decline in new titles is responsible for the decline in sales.²⁴ Of course, the number of new releases is not exogenous and we would expect the quantity of releases to fall if demand fell because of file-sharing. Unless we are willing to entertain the possibility that the supply of songwriters and musicians has suddenly dried up at the same time that file-sharing has started, we would expect that changes in demand are more likely to influence the number of new titles than would changes in underlying supply conditions.

Further, this discussion has suffered from an imprecision in the measured numbers of new releases.²⁵ One factor that is clear, however, is that the large majority of new releases, between 65% and 80%, are from independent record labels which account for merely 10-15% of industry sales. Looking at industry-wide new releases overweights independent albums at the expense of major labels and is like having the tail wag the dog. Thus the total number of new releases is a misleading statistic as regards the overall sales in the industry and really cannot be a useful barometer of supply even if it were exogenous. It would be like comparing the total footage of home movies shot year-by-year to

²⁴ See for example George Ziemann "RIAA's Statistics Don't Add Up to Piracy" available at <http://www.azoz.com/music/features/0008.html>. The analyses contained on these pages are probably best described as 'rants' but they have nevertheless been taken seriously by some. Understanding the differences between retail sales volume measured by SoundScan's barcode reading technology and wholesale shipment numbers reported by major labels would be a useful exercise, but instead the difference tends to be treated in these analyses as some sort of industry conspiracy.

²⁵ Apparently the RIAA was then taken by Ziemann and used in his analyses, although that was apparently an error. See <http://www.theinquirer.net/?article=9048>

explain the yearly economic performance of motion pictures. They are not really part of the same market.

E. Using Genres as the Unit of Analysis

I had high hopes for this methodology, although no one has formally attempted to use it to my knowledge. With data such as that created by Strumpf and Oberholzer, one could determine the variation in file-sharing proclivity by genre, measured as the number of files downloaded as a share of total sales. It is likely that certain groups of users (rock, hip hop?) would be far more likely to engage in file-sharing than other groups (classical).

If data on yearly sales by genres was normally reasonably stable, then we could look to see if those genres with the greatest incidence of file-sharing suffered relative to genres with the least incidence of file-sharing. As a control, we could use the share of radio listenership by genre.

I had high hopes for this methodology until I purchased data on genre sales from SoundScan. First, they had only seven genres plus a catchall genre called “current.” Second, and more important, sales by genre had extremely large changes over very short periods of time. The chart below, showing two genres, has a 170% increase in sales in the Metal genre in 1999 and a 100% increase in the R&B genre in 1997. Without more information that might help explain such sudden jumps, this data seem unlikely to prove reliable enough to use for any important empirical tests.

	Metal	R&B
1994	38,739	80,819
1995	31,101	80,718
1996	26,409	74,035
1997	28,983	141,613
1998	30,086	166,379
1999	82,698	175,339
2000	89,924	197,141
2001	88,158	195,498
2002	74,677	160,183
2003	74,629	149,972

Nevertheless, Oberholzer and Strumpf have claimed that the data on genres are inconsistent with the thesis that file-sharing is harmful to record sales. They state that “musical genres which are not heavily downloaded on file sharing networks experienced the same reduction in sales as other genres.”²⁶ More specifically, they claim that two categories of music (catalogue and country) are not heavily downloaded yet sales have fared poorly.

	classical	country	jazz/smooth jazz
1999	8.07416	5.821573	5.456752232
2000	6.979109	6.09621	5.269958006
2001	8.414178	6.361194	5.538243224
2002	8.590823	7.410973	5.495995581
2003	10.55179	6.795402	6.110928962

Table 5 presents evidence on three categories of music that are not heavily downloaded. Given the evidence on variability in sales by genre, we should be careful to make any strong statements. But the evidence here is contrary to the claims of Oberholzer and Strumpf. Sales of these three genres are up in absolute terms (not shown) as well as the more relevant comparison to radio listenership. This occurred in spite of the very large overall sales decline.

V. Conclusions

The analysis of file-sharing is a relatively new phenomenon. Economists are just getting started. Nevertheless, progress is being made.

The theory underlying the analysis of file-sharing has not received the attention that it deserves. It has always been clear that some possible aspects of file-sharing would harm copyright owners, such as the substitution of copies for the purchase of originals. What has not been understood is that the use of file-sharing to sample products is also likely to lead to harm to copyright owners. Although one can still construct theoretical conditions under which file-sharing might benefit copyright holders, these

²⁶ Page 12 of their Brief of Felix Oberholzer-Gee and Koleman Strumpf as Amici Curiae in support of Respondents, MGM v. Grokster, No. 04-480.

conditions seem quite far fetched. A broad analysis of the various theoretical factors at work supports a view that file-sharing is likely to cause serious damage to the owners of copyright materials that are so shared.

The last few years have provided economists a laboratory of sorts to analyze the impacts of file sharing. The basic evidence in the United States over the last few years—the birth of file-sharing and the subsequent decline in CD sales—makes for an extremely compelling and simple explanation in spite of the protestations to the contrary from a large and vocal group of individuals supportive of file-sharing.

Empirical examinations by economists must be undertaken against the backdrop of this simple explanation. That these basic facts fit nicely with the economic theory only adds support to this explanation. With such a strong prior, empirical studies need to meet a higher hurdle than normal before they might be considered to overturn this expectation.

All of the empirical works to date suffer from various imperfections. Nevertheless, all the studies except one find results supportive of the thesis that file-sharing is causing harm. As more evidence accumulates, both in the world at large and in the pages of academic publications we can expect to learn more about the impacts of file-sharing. The political arena is calling for an answer now, however, and is impatient to wait for academics to reach unanimity, which academics almost never do anyway. If an answer is needed, the answer that would appear to have the greatest likelihood of being correct given our current state of knowledge is that file-sharing hurts copyright owners and that it is responsible for most, if not all, of the recent decline in sales.

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