A Runaway Competitive Fringe:

How File-Sharing is Disrupting the Music Industry

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Abstract

In recent years, new technologies have allowed music to be digitized and for people across the globe, facilitated largely by the development of the internet, to more easily copy and share such products without compensating copyright holders. This paper considers this transition in the recorded-music industry – from analogue formats for the distribution of music to digital – borrowing from the existing literature on the behaviors of dominant firms facing competitive fringes. Empirically, we find that sales and revenue data are consistent with theoretical predictions, insofar as the transition from of the music industry's pre-digital structure to the present seems consistent with what one might expect over a decline in dominance-induced superprofits brought about by the emergence of low-marginal-cost competitors. We also consider the future of the industry in light of our analysis.

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Professor Glen R. Waddell Date

1. Introduction

The recorded music industry is currently in crisis: sales are down nearly 30 percent since 1999, and fell seven percent last year alone, after a century of nearly unstoppable growth.[1] According to statistics collected by the Recording Industry Association of America (RIAA), 939.9 million albums were sold in 1999, and only 441.6, including digital album sales, in 2008. Revenue on total units sold fell in the same period from $14.5 billion to $8.4 billion. For all of these problems, the record companies are placing the blame almost exclusively on the online file-sharing of digital music files, which began in earnest in 1999 with the rise of the file-sharing software Napster. Since that time, the music industry, headed by the RIAA, their industry trade group, has taken a very public and active stance against Napster and similar file-sharing services which they claim are destroying the industry. The International Federation of the Phonographic Industry (IFPI) reports that in 2005, 20 billion songs were illegally downloaded globally; another study reported that, in the US in 2006, 300 million files were traded each month, a number which was 50 percent higher than 2005 (Oberholzer-Gee and Strumpf 2007).

In the last six years, the RIAA has taken action to try to combat the spread of peer-to-peer (P2P) file-sharing, the primary technology used to share digital music files over the internet. According to the Electronic Frontier Foundation (EFF), "the recording industry has now filed, settled, or threatened legal actions against well over 28,000 individuals."[2] Furthermore, the RIAA spent slightly over two million dollars in the year 2007 lobbying the government for stiffer copyright protection laws, including one which could potentially "outsource the thousands of copyright infringement lawsuits filed each year to the Department of Justice," and Warner

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[1] New York Times, "Music Industry Imitates Digital Pirates to Turn a Profit," <http://www.nytimes.com/2009/01/19/business/worldbusiness/19digital.html?scp=20&sq=music%20piracy&st=cse> (1 May 2009)

[2] Electronic Frontier Foundation, "RIAA vs. The People," <http://www.eff.org/riaa-v-people> (26 April 2009).

Music, one of the "big four" music labels, recently began a project intended to investigate "blanket licensing" for music by adding a surcharge to the monthly access fees already paid to internet service providers (ISPs) by anyone who connects to the internet.[3]

If it is true that the recorded music industry is in significant decline, it could have more serious consequences than lost profits. The size of the industry and its position in the forefront of the rise of digital media mean that the way it handles this transition period – whether the government steps in to enforce industry copyrights or the industry convinces ISPs to add a "music tax" to broadband internet access – will likely have wide ranging effects, from determining the future supply and price of music to providing a template for other industries making a similar transition. The book industry in particular is potentially at the brink of such a transition, given the introduction of devices for reading electronic books like Amazon's Kindle.

What little empirical economic research there is on this topic is divided. Some studies have found that online file-sharing has a negative effect on music sales (Stevans and Sessions 2005; Liebowitz 2006; Zentner 2006), while others have found neutral or even positive effects (Oberholzer-Gee and Strumpf 2007). The situation is also unclear theoretically, because the relationship between downloading and purchasing music is ambiguous. On one hand, downloads may represent lost sales since they are near-perfect substitutes. On the other, people may find they like an artist based upon songs they downloaded – but would not have purchased – and purchase some of the artist's music based upon the "taste" that file-sharing made possible.

Rather than examining the relationship between downloading and purchasing directly – which has seen relatively more attention in the small literature in this area – we will model this

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[3]Ars Technica, "RIAA spent $2 million lobbying for tougher IP laws in 2007," 21 April 2008, <http://arstechnica.com/tech-policy/news/2008/04/riaa-spent-2-million-lobbying-for-tougher-ip-laws-in-2007.ars> (26 April 2009).

transition in the recorded-music industry – from analogue formats for the distribution of music to digital – by borrowing from the existing literature on the behaviors of dominant firms facing competitive fringes.

This paper is organized as follows. Section 2 describes the background, structure, and mechanics of both the recorded music industry and piracy, and Section 3 considers existing literature on the effect of online file-sharing. Section 4 describes the theoretical model and its application to the industry, and Section 5 concludes and discusses further implications.

2. Background

A. Music Industry Background

History

The recorded music industry has its roots in the late nineteenth century, when new technology was introduced that could facilitate the playback of sound which had been transcribed by a stylus into indentations on a malleable surface, such as tin foil or wax. This new technology was called the phonograph, and was patented by Thomas Edison in 1878. By 1890, there was a method for making a limited number of reproductions of the recorded sound and even a basic machine that functioned as a jukebox. Improvements in technology were fairly regular throughout the twentieth century, and helped to drive the growth of the music industry. By 1948, the LP, or "long play" record had replaced the original phonograph, and during the following 25 years the music industry experienced an average of 20 percent growth per year. In the late 1960s, the cassette tape was introduced, largely replacing the LP. Once again, the industry grew, and sales "rose from less than $2 billion at the beginning of [the 1970s] to over $4 billion in 1978." Finally, the introduction of the compact disc, or CD, which was released in the

mid 1980s spurred considerable growth in the industry, doubling its total shipments of products from $6.25 billion in 1988 to $13.7 billion in 1998 (Krasilovsky, Shemel, and Gross 2003).

These technological changes were all incremental improvements to the medium; they gained more clarity, durability, and lower per-unit costs, but for this analysis they can be considered to be similar. In particular, they were physical objects, and as such could only be possessed by a single person at a time.[4] This is importantly not the case with digital music files, commonly known as MP3s, which were introduced in the late 1980s. In 1988, a group called the Motion Picture Experts Group (MPEG) came together to work on creating a format for making digital files out of recorded sound. Because digital music files are quite large in their usual format, the goal was to create a format which compressed the music enough to be practical for commercial applications. They succeeded, and one of the formats they created, MPEG-1 Layer 3, or MP3, became the *de facto* standard for digital music files. Crucially, no copy protection was built into it, and this fact set the stage for the current situation in that it made digital media files essentially non-excludable, and reduced marginal costs of production to nearly zero.

Following the creation of the MP3 format, and the popularization of tools for copying music from CDs to personal computers, or "ripping," people began to be able to copy music to their computers using, by then standard, CD-ROM drives. The first major ramifications of this came in 1999 when Shawn Fanning started a company called Napster, which produced software allowing users to search for and download digital music files from the internet. Prior to this it had been possible to download music from the internet, but it was not widespread because searching for and finding the music had been difficult; search engines were not advanced and

[4] Copying of cassettes and CDs was possible, however, and will be addressed in the next section.

one had to know where to look. Napster, however, made it trivial to download music for one's own use and, just as important, upload music for other people to download.

Although Napster was the first of the group of software known as peer-to-peer (P2P), meaning that the users' computers connected directly to each other to facilitate the exchange of files, Napster's software required a central server to index the filenames to allow users to search. Many current day P2P applications do not rely on central servers, and therefore are more robust than Napster was. After being sued by the RIAA in 1999 it was finally shut down in 2001. Following Napster's removal, numerous similar P2P applications sprang up in its place, including Grokster, KaZaa, Morpheus, Limewire, and others. The most recent and popular incarnation of P2P software is based upon the BitTorrent protocol, first released in 2001, which improves upon previous implementations of file-sharing. These more recent applications, in particular BitTorrent, rely on *ad hoc* networks of computers, meaning that even if the producer of the software could be legally shut down, the networks of computer users based on that software would continue as long as users themselves maintained them.

Along with these illegal online file-sharing methods are a handful of legal online retailers for digital music files. After shutting down in 2001, Napster itself was purchased and remade as a subscription based online music service. iTunes Music Store, an extremely popular service run by Apple Inc., is an online retailer which began in April 2003 and sells music most often used in combination with their popular MP3 player the iPod. AmazonMP3 is another popular online retailer of music which was launched in early 2008.

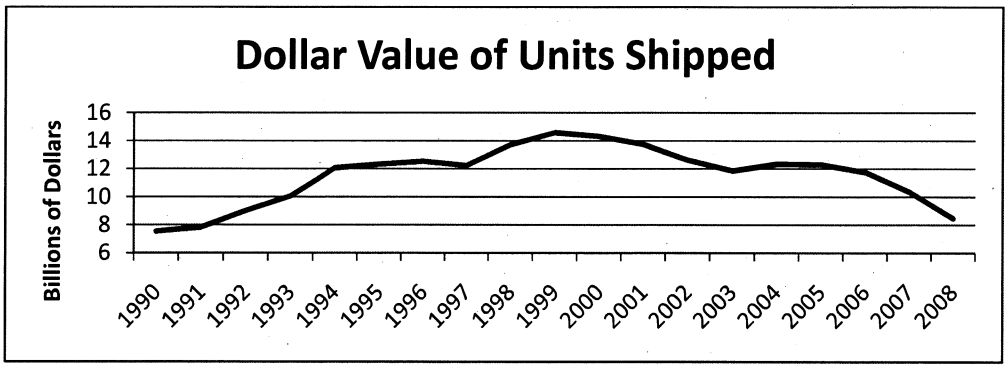
Although the MP3 format originally had no copy protection, both Napster and iTunes have employed Digital Rights Management (DRM) software schemes, which attempt to return control of digital music to the recording industry by removing the ability of users to make copies

of them. The DRM schemes have not caught on, however, because they are cumbersome, often malfunctioning and causing music to be unplayable, and none of the DRM schemes were compatible with the others. AmazonMP3 does not employ any content protection at all, selling downloads of MP3 files, and iTunes, although it does not sell music in MP3 format, was set to have removed all DRM from its music files by April 2009.[5]

Decline in Sales

One of the most obvious features of the history of the music industry was the strong growth in sales and revenue they experienced throughout most of the twentieth century, growth that was highly correlated with the introduction of new technologies. The introduction of digital music files have not, as of yet, had a similar effect on the industry, however, and according to Recording Industry Association of America data, revenue has been in steep decline since 1999, corresponding to the beginning of online file-sharing. The following graph (Figure 1) shows the trajectory of the dollar value of the units shipped.

Figure 1: Industry Revenue



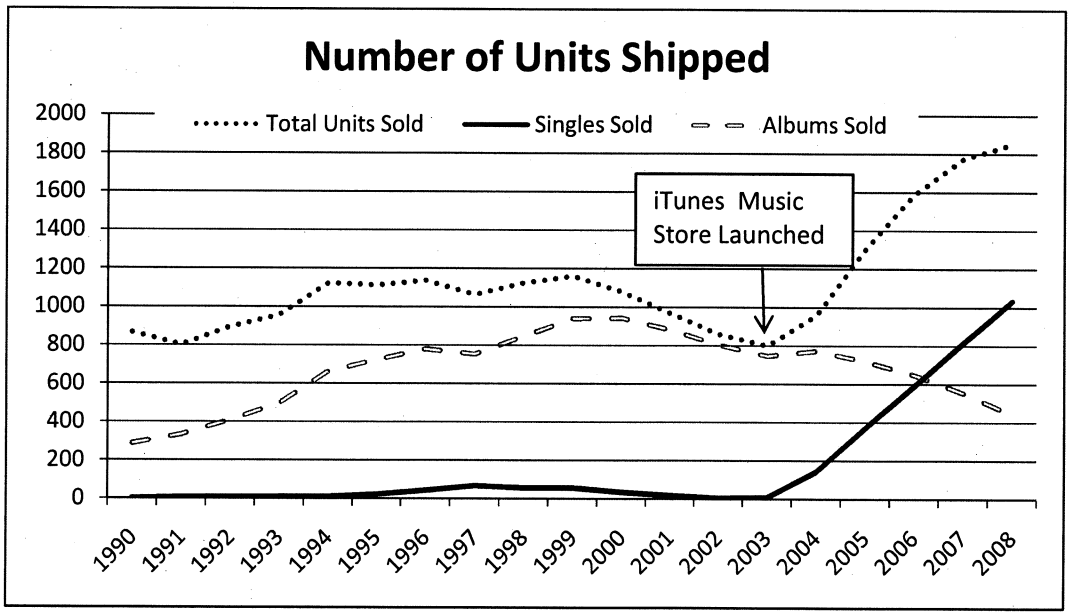
Source: Recording Industry Association of America[6]

[5] Ars Technica, "Getting naked with DRM-free iTunes upgrades: the details," 7 January 2009, <http://arstechnica.com/apple/news/2009/01/getting-naked-with-drm-free-itunes-upgrades-the-details.ars> (April 26, 2009)

[6] Recording Industry Association of America, "Facts and Figures," 1990-99 and 2008 U.S. Manufacturers' Unit Shipments and Value Chart, < http://www.riaa.com/keystatistics.php> (April 29, 2009)

It is clear that there has been a significant decline in revenue for the music industry since 1999, and in the following sections we will investigate the existence of a causal link between the rise of online file-sharing and this decline. It is important to note, however, that although the dollar value of units shipped declined sharply, the total number of units shipped, including digital music sales, rose, as can be seen below in Figure 2. The singles category is composed of both CD and digital singles, and the albums category is composed of both CDs and digital albums.

Figure 2: Industry Unit Sales



Source: Recording Industry Association of America[7]

Although there was a decline in total sales beginning in 1999, the launch of iTunes Store, the first major online retailer for digital music, created a significant increase in singles sales, which oughtweighed the decline in album sales. The higher price of a CD compared to that of a single digital music download explains the decline in revenue seen in Figure 1.

[7] *Ibid.*

B. Piracy Background

The unauthorized copying of music has been termed "piracy" in popular culture. It is distinct from bootlegging, which is the unauthorized copying or transmission of *unreleased* works, and counterfeiting, which is the unauthorized copying and *sale* of music. All three forms of illegal activity are pervasive in the music industry, and have been for some time. A study by the IFPI showed that as much as 37 percent of CDs purchased across the globe in 2005 were counterfeit.[8] However, a careful analysis of bootlegging and counterfeiting, both potentially harmful activities to the recorded music industry, is not within the scope of this paper, although it is worth noting that in many ways, online file-sharing likely encompasses bootlegging since unreleased works can also be distributed via the internet at low cost. This will have some importance, since there are examples of music that has been leaked onto file-sharing networks *before* the general release.

For the purposes of this paper, bootlegging and piracy insofar as they represent non-commercial copying and dissemination of music will be considered together, distinct from all commercial forms of copying. We will use the labels commercial and non-commercial piracy to denote these composite segments. In discussing the extent of non-commercial piracy, there will be two important subsets to consider: home taping, which is the illegal copying of one physical media to another such as copying a cassette or CD, and online file-sharing, which is the illegal copying and distribution of digital music files over the internet.

Home Taping

The first media which allowed people to easily make home copies was cassette tapes, and there are some strong similarities unauthorized copying of cassette tapes and online file-sharing.

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[8] International Federation of the Phonographic Industry, "The Recording Industry 2006 Piracy Report," <http://www.ifpi.com/content/library/piracy-report2006.pdf> (1 May 2009)

In 1989, the Office of Technology Assessment (OTA) released an extensive survey of home taping, finding that 40 percent of Americans had made at least one copy of recorded music in 1987. Interestingly, the report also found that a significant part of home taping was done to "format shift," which means to move music from one type of media to another, to facilitate playback with different types of music players; for example, 20 percent suggested that they made the recording so as to be able to listen to the music in their car.

The report also found that the majority of people who were engaged in home taping were making copies of music they already owned for themselves. Only 20 percent said they were making copies for a friend or family member. Finally, the report found that while people who were making copies for themselves would be willing to purchase the music if they could not make the tape, only a minority were willing to do the same if they were making a copy of the tape for a friend, suggesting that "taping for other people is a marginal activity for most tapers" (U.S. Congress, Office of Technology Assessment 1989). One proposed solution involved methods to prevent tapes and CDs from being copied. Another was a tax on recording devices and recording media, and such a royalty tax was enacted as part of the Audio Home Recording Act (AHRA) in 1992.

Online File-sharing

At its peak, Napster had 38 million users on its system. Today, more than 20 billion songs are estimated to be illegally downloaded each year across the world each year, with at least four billion in the US alone, and online file-sharing is still on the rise, due especially to increased broadband internet penetration and better P2P software programs. The increased broadband penetration means that fewer downloads are interrupted, and many more songs can be downloaded in the same amount of time. Better and more efficient P2P programs also account

for fewer interrupted or corrupted downloads, and they also have improved delivery mechanisms to improve the speed and availability of content.[9] Searches have also improved, both inside P2P software and out. Software built on the BitTorrent protocol does not yet have built in searching, but many extremely popular websites, including the infamous "Pirate Bay," exist that provide that service. Surveys similar to the OTA survey on home taping have also been done on online file-sharing, but the results are inconclusive, suggesting that "file sharers generally acknowledge both sales displacement and learning effects, and it is unclear if either effect dominates" (Oberholzer-Gee and Strumpf 2007).

C. Institutional Background

Industry Structure

The recorded music industry is dominated by the "big four," the four largest record labels that together account for around 80 percent of market share: Universal Music Group (UMG), Sony Music Entertainment, Warner Music Group, and EMI Group. The remaining market share is split between a large number of independent record labels none of which individually control significant market share. In 2005 UMG held 31 percent, Sony Music 26 percent, Warner Music 15 percent, and EMI ten percent, for a combined market share of 82 percent, according to Nielson SoundScan.[10] The "big four" replaced the "big five" in 2004 when Sony Music Entertainment merged with BMG to create Sony BMG.[11] That is not the first notable consolidation of market power; the "big five" itself was created from the "big six" in 1999 when Polygram merged with UMG.

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[9] P2P programs are so efficient, in fact, that some software companies, like Activision Blizzard, use them to help defray bandwidth costs for large downloads.

[10] Another study, by the International Federation of the Phonographic Industry (IFPI), found that these four firms accounted for 72 percent of market share, with the distribution between them being roughly similar to that from the Nielson study.

[11] The name was later changed again, back to Sony Music Entertainment.

This industry is economically interesting in several ways. First, contracts with artists are long-term and exclusive, creating a confined labor market. Many artists sign with a record label and spend their entire musical careers in the same contract. George Michael, a popular artist in the 1980s, filed suit against Sony in 1993, with whom he was under contract, in an attempt to break out of a "eight album, fifteen year deal" (Burnett 1996). That he lost the lawsuit, and did not appeal, demonstrates the pervasive nature of these contracts.

Second, there are relatively high start-up costs. There are considerable costs associated with acquiring capital resources to begin physical production of music, and there is an extremely complex intellectual property rights structure which companies must navigate, wherein often four or more parties own different aspects of a given song. For example, the individual or group singing a given song retain rights to the sound as it is recorded, but the record labels retain those to the masters. Songwriters, if applicable, also have some rights. Leyshon, Webb, French, Thrift, and Crewe (2005) discuss one anonymous on-line start-up company which ran a legitimate music e-commerce business that had also considered becoming an on-line record company, meaning that it would sign and produce artists of its own rather than just acting as an online reseller. It found it could not do so because of these high "know how" start-up costs; Leyshon *et al.* write, "like other companies before it, it quickly discovered that [setting up a new record company] was 'not a good business to be in' … one reason for this is that the people running the putative company … were not schooled in [the music industry's] complexities".

Finally, in addition to the fixed start-up costs, the industry's structure is such that "it is estimated that no more than ten percent of records sold actually recoup the money the record company invests in its production," meaning that creating a new record company would likely require signing and producing significant number of artists to hedge against the probability that

most of them would not be hits (Leyshon *et al.* 2005). That, combined with the fact that "the transnational music industry has found that its average investment in a recording by a new and non-established artist … can approach half a million dollars," means starting a viable music label would be a very expensive proposition (Burnett 1996).

Music as an Information Good

Recorded music is often classified as an information good (Shapiro and Varian 1998; Wu and Chen 2008; Yeh-ning Chen and Png 2003), meaning that its value is not the physical material but rather the information contained on it. This is even more clearly seen in the case of a digital music file, where the actual physical media is flexible and almost irrelevant to the utility of the good. We will follow Shapiro and Varian in defining information goods as "goods capable of being distributed in digital form" (Shapiro and Varian 1998).

Although this definition encompasses all music relevant to this paper, since songs on any CD can be converted into digital form and then distributed, it importantly did not apply to music before the rise of online file-sharing, because although the music existed on the CD in the same way, there was no way to distribute it separate from that media. For simplicity, we will assume that the launch of Napster was the point at which music made the shift towards being more purely an information good.[12]

Information goods are associated with high fixed costs of production along with low marginal costs of reproduction. This is consistent with the production of music (both before and after it became an information good), since there are high costs associated with writing, recording, and marketing music. Following these expenditures, however, the cost to manufacture an additional CD or upload an additional digital music file unit is very close to zero, especially in

[12] Although it is true that online file-sharing existed prior to Napster, its effect was negligible, so we can safely simplify in this way.

the latter case. This low marginal cost is an important feature that will be considered more closely later when we discuss the incentives faced by those involved non-commercial file-sharing.

Absent any form of software control, like the DRM schemes mentioned above, or filtering the internet at the ISP level, a practice which has already been rejected by the FCC, the music industry has no way to control the spread of music. Given that AmazonMP3 and iTunes will have no DRM in place, at the same time that moved toward becoming more purely an information good, it also became non-excludable.[13] We will follow Gaustad in calling goods such as this, that are non-rival due to the nature of digital files as well as non-excludable, non-marketable public goods (Gaustad 2002).

3. Literature Review

A. The Effect of Piracy on Music Sales

Although several empirical studies have been done attempting to determine the effects of online file-sharing, the results have been mixed. One prominent paper found no statistically significant effect of music downloads on sales, concluding that they "reject a null that P2P displaced more than 6.6 million CD sales or less than 10 percent of the 2002 decline," and that "while downloads occur on a vast scale, most users are likely individuals who in the absence of file sharing would not have bought the music they downloaded" (Oberholzer-Gee and Strumpf 2007).

Several other papers have found the opposite results, including one which found that University of Pennsylvania students "reduce[d] their per capita expenditure (on hit albums

[13] Ars Technica, "Hammer drops at last: FCC opposes Comcast P2P Throttling," <http://arstechnica.com/old/content/2008/07/hammer-drops-at-last-fcc-opposes-comcast-p2p-throttling.ars> (1 May 2009)

released 1999-2003) from $126 to $100" (Rob and Waldfogel 2004), another which argues that "music downloading could have caused a 20% reduction in music sales worldwide between 1998 and 2002" (Peitz and Waelbroeck 2004), and a handful of others with similar arguments (Zentner 2006; Liebowitz 2006).

Before embarking on a brief summary of this debate, it is interesting to note that of all of these papers, only the Oberholzer-Gee and Strumpf paper had access to actual data gathered from a file-sharing network. Furthermore, the reduction in sales due to file-sharing shown by the other papers, if accurate, is still inconclusive regarding the overall and long term effects of file-sharing, since the time periods studied are *prior* to the existence iTunes Music Store. Recall that its introduction corresponded to a huge increase in sales of singles, raising the total units sold above prior levels. This means that even if consumers were not disposed to use file-sharing over legitimate purchases *in general*, they may have used it *at that point* because no online legal alternatives existed.

In laying out both sides of this empirical debate, we will focus on two representative viewpoints. Felix Oberholzer-Gee and Koleman Strumpf, mentioned above, published the most substantial econometric analysis of the situation with actual file-sharing data. Stan Liebowitz, who has written several papers on the effects of file-sharing, directly responded with a paper titled "How Reliable is the Oberholzer-Gee and Strumpf Paper on File-Sharing" (Liebowitz 2007).

Oberholzer-Gee and Strumpf versus Liebowitz

Oberholzer-Gee and Strumpf obtained file-sharing data spanning the time period from September 7 to December 31, 2002 from the log files of two OpenNap servers, observing 1.75 million downloads, which they suggest represents 0.01 percent of all downloads in the world

during that time. They use this data in combination with weekly sales data, from Nielson SoundScan, for a sample of albums sold in the US during that time, as panel data used to estimate a fixed-effects model. Recognizing that the popularity of albums affects both album sales and downloads, they use a number of variables as instruments. Most notably, they use the "number of German secondary school kids who are on vacation in a given week," as an instrument for the number of downloads, suggesting that while they correlate with the number of files shared, they are not related to music demand (Oberholzer-Gee and Strumpf 2007).

Although Liebowitz criticizes a number of elements in the article, the fact that Oberholzer-Gee and Strumpf did not release their data due to confidentiality agreements meant that he was severely hampered in attempting to reproduce their results. He analyzes a number of secondary claims from their article in an attempt to debunk their results, but his primary econometric critique of the Oberholzer-Gee and Strumpf paper is based upon their choice of instrumental variables. For an instrumental variable, both exogeneity and relevancy are important factors in how powerful the results based on it will be; Liebowitz attacks the German-school-children instrument on the grounds of relevancy, writing "how important are the files of German school children to American downloaders? We really do not know."[14] For instance, he argues that the time difference between America and Germany (around seven hours) suggests that, unless German kids leave their computer on all night long, there would be little overlap between Americans attempting to download and Germans making music available. Furthermore, he suggests that the supply of MP3s on the internet from outside Germany is so great that German kids' positive or negative effect on overall supply must be quite small.

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[14] Stan Liebowitz's home page, <http://www.utdallas.edu/~liebowit/> (1 May 2009)

Both of these Liebowitz's concerns are addressed in the Oberholzer-Gee and Strumpf paper. They suggest that, rather than leaving their computers on while they sleep, German school children stay up later during the breaks, so that they are online during peak times for downloading in the US. Furthermore, they find that "the number of German kids on vacation is a significant predictor of the number of files uploaded from Germany to the United States."

Although it is beyond the scope of this paper to fully analyze the sufficiency of German school kids as an instrument for downloading, there are some remarks on this debate that are relevant. In particular, if Liebowitz is correct and the instrument used is a weak instrument, or worse is irrelevant, Oberholzer-Gee and Strumpf's underlying regression will have little predictive power, or simply be incorrect. However, even if this were the case, the lack of actual file-sharing data in all other empirical analyses means that the debate cannot be settled on the basis of existing studies.

B. Other Explanations

Aside from online file-sharing, there are a handful of alternative theories for the decline of the music industry. Oberholzer-Gee and Strumpf (2007) suggest a few in passing. One which has particular relevance to this paper is that the observed decline was a result of a reorganization of the way the music industry distributed music to retailers in the late 1990s, shifting from smaller record stores to large stores like Wal-Mart. Since Wal-Mart and similar large stores may be more efficient at selling the music, they suggest that this reorganization might be accompanied by a corresponding reduction in inventory levels, since there would be fewer small record stores with consistently high inventory levels. This would be *highly* significant, since most of the data showing the decline is based upon *units shipped to suppliers*, rather than units sold (the data used in this paper above uses this method). Therefore, if inventories were

decreasing, it would be natural for the number of units shipped to be significantly less, causing a perceived decrease in sales revenue.

Another paper suggests that the rise of online file-sharing was only the tipping point for an industry already in trouble due to "broader cultural forces that have changed the role of music within society, and relegated its immediacy and importance among many of its consumers" (Leyshon *et al.* 2005). This idea, that the music industry's profits have not reflected their true value for some time, is also to be found as one of the alternate explanations in the Oberholzer-Gee and Strumpf paper. They, along with Leyshon *et al.*, suggest that industry profits were unnaturally high in the 1990s due to the introduction of the CD which created artificially high demand because consumers were purchasing CDs of music they already owned, although in a different format. The OTA survey of 1989 lends some credibility to this theory as well, suggesting that many people made copies of their own music in order to "format shift," and if they could not make copies for themselves, they would be likely purchase the new format. In this case, there was no practical way to make a copy from a cassette tape, which is an analog format, to a CD, which is a digital format.

4. Model

This paper will model the market structure of the music industry using by borrowing from the existing literature on the behaviors of dominant firms facing competitive fringes in order to address the specific relationship of the music industry to online file-sharing. In particular, this model will be useful in providing a framework to address whether file-sharing is responsible for the music industry's decline and, if so, to explore what solutions the music industry might consider to mitigate the situation, or, if not, to explore what the true cause for the decline of the music industry might be.

In brief, the model of a dominant firm facing a competitive fringe suggests that the dominant firm will use its market power to realize some monopolist rents. Over time, the positive economic profit associated with the industry will encourage increased entry by fringe firms, drawing away the market share of the dominant firm. The rate of this entry depends on the cost advantage enjoyed by the dominant firm, and the elasticity of supply of the competitive fringe. We will suggest that the non-commercial piracy, from the home taping of cassettes to online file-sharing, is the competitive fringe that is of interest, and that the rise of online file-sharing created a significant decrease in the cost function that competitive fringe faced, eliminating any cost advantages the dominant firm had enjoyed, and changed the fundamental supply function of the fringe.

In our analysis, we will set aside the competition that exists between legal firms in the music industry. Although this would be an important component of a more general analysis of the industry, in considering the implications associated with the advent of online file-sharing alternatives there is support for considering them as a single economic agent. We will therefore abstract away from the competition between the largest four firms and model the interplay between them and the many smaller actors in the industry as a dominant firm facing the pressures of a competitive fringe. In so doing, we acknowledge the limitations while believing that this abstraction captures the essence of what is important to the question being addressed. This simplification is consistent with contemporary economic research regarding the music industry (McLeod 2005; Leyshon *et al.* 2005; McCourt and Burkart 2003).

A. Goodness of Fit

Before constructing the details of the theory, we will show why this model is a good fit for the observed market structure of the music industry and those engaged in online file-sharing.

Dominant Firm(s)

The concentration of the recorded music industry around only four firms, which together account for the vast majority of market share in the United States, suggests that some form of dominance exists in the marketplace. Even more suggestive is the fact that, although no single firm controls a majority of market share, there is evidence that the "big four", under their trade group the RIAA, have strong ties to each other. Legal challenges alleging collusion and price fixing have been brought. For example,

> In May 2000, the US Federal Trade Commission (FTC) ruled that the five major record companies illegally discouraged discount pricing of compact discs by retail stores. By withholding cash payments intended for cooperative advertising from retailers that advertised CDs below the suggested 'minimum advertised price', the Big Five artificially inflated CD prices.2 On 8 August 2000, a coalition of 30 states and US territories also filed suit against the record industry for price fixing (Peers, 2000b: B7). The big five settled this suit in 2002 (McCourt and Burkart 2003).

It is not surprising that firms are concentrated in this way. A small labor market, almost entirely devoid of proven talent, high start-up costs, the variable costs associated with recording and marketing new artists, which can approach half a million dollars per artist, and the high risk of failure mean that there are significant barriers to entry. In addition to these entry barriers, there are also significant gains to be realized by large firms due to the existence of economies of scale. Once a record company has established a given artist, that artist has a significant advantage over other competing artists who have not been similarly established because they have had the opportunity to acquire fans who will seek out new releases of their work.

Each record company can also exploit economies of scale in terms of equipment infrastructure, relationships with distributors, and brand recognition. Each of these are necessary for a music label regardless of the number of artists they represent, but large firms will have more artists, which will lower the average costs. In particular the improvements to brand

recognition and relationships with distributors which result from increased size of the company also serve to improve sales of all of that company's product lines.

Competitive Fringe

Although there are several types of fringe firms in the music industry, the important one for this paper's analysis is that composed of the non-commercial illegal firms. These firms have been around for as long as technology has existed to make home copies of sound recordings, largely starting with cassettes, expanding with the introduction of CDs, and finally exploding along with the internet. Traditionally, this fringe has faced substantial, if hard to measure, costs, including the fixed costs of equipment to make copies along with variable costs of the copy media. They also face intangible costs in terms of potential danger of legal action by the recorded music industry, the difficulty in making copies due to quality deterioration, and at least some positive transaction costs in terms of coordinating exchange.

More recently the introduction of CD burners, digital music files, and peer-to-peer (P2P) technologies has significantly reduced these costs associated with sharing music. It is the set of fringe firms associated with online file-sharing which will be the primary focus of this paper, since it represents, as will be explored, a significant and important departure from the pre-internet fringe structure. The rise of the online file-sharing non-commercial fringe is importantly associated with the introduction of digital music files and, as detailed above, with the transition of music towards a more pure information good.

B. Basic Theoretic Model

Because of the substantial shift which occurred in the nature of the competitive fringe in 1999, significantly reducing switching costs, transaction costs, and greatly expanding the number of supplying firms in the competitive fringe, as will be discussed below, it will be most useful to

take a before and after approach. In both periods the dominant firm is the same and the underlying production structure of music does not change, and so this analysis is appropriate for examining the effect of online file-sharing. In analyzing the basic static model, we will make the simplifying assumption that products supplied by the dominant firm and the competitive fringe are identical. Although this is a good starting point, we find this assumption to be unrealistic, and relaxing it will be an important part of the section devoted to extending the basic model.[15]

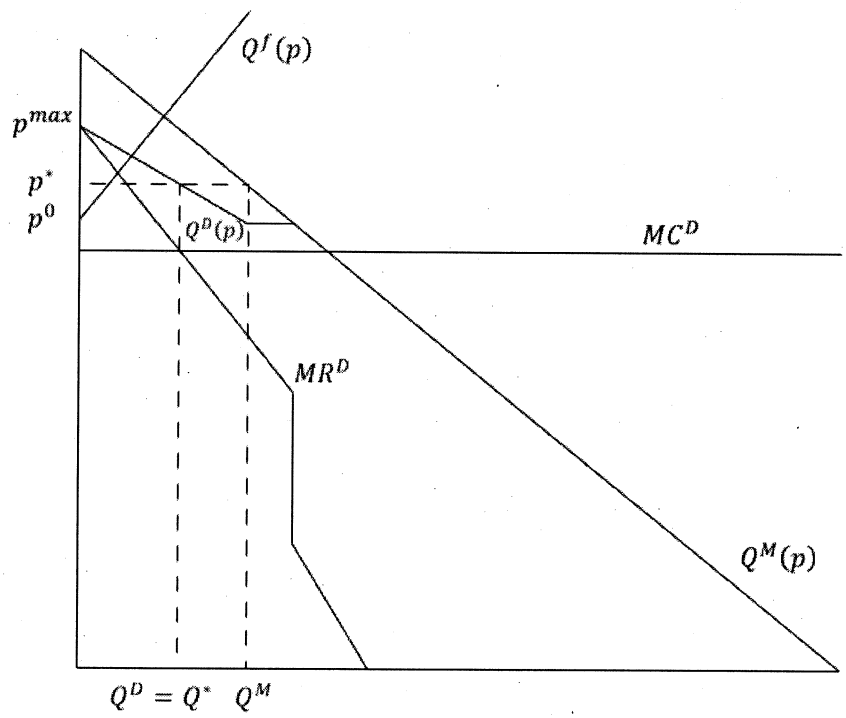
In the standard static model, a dominant firm faces a competitive fringe which cannot influence price, and therefore makes supply decisions based upon the price set by the dominant firm. The total supply curve of the fringe is a horizontal summation of the marginal cost curves of the individual firms. Furthermore, the model suggests that the dominant firm is aware of the fringe, and of their potential supply response, and is able to use that information when it sets its price, in order to maximize profit based on the share of demand that it expects. Letting $Q^f = Q^f(p)$ be the fringe's total supply function, which depends on the dominant firm's price, since each fringe firm is a price taker, and $Q^M = Q^M(p)$ be the total market demand, we can construct the residual demand function for the dominant firm as follows: $Q^D = Q^M(p) - Q^f(p)$. Using standard first order conditions, the dominant firm will set the price to maximize its profit function: $\pi^D = p * Q^D(p) - C(Q^D(p))$.

A simple version of the model is provided in Figure 3, below. The profit-maximizing price for the dominant firms is at p^*, where $MR^D = MC^D$. The other two important price levels, p^{max} and p^0 respectively represent the highest price at which the firm will produce any output,

[15] In particular, there is a significant observed difference between demand for legal versus illegal music; in fact, differentiating products this way has been a central theme of the reason for the litigation campaign pursued by the RIAA.

and the lowest price at which the fringe will produce any output. These two prices will play an important role in our analysis of the music industry.

Figure 3: The Static Model



As usual, raising price will decrease quantity demanded in the market, but our assumption that the firm has considerable market power means that it may be able to price above marginal costs in order to extract some monopoly rents (in this case, of course, each firm in the composite dominant firm is extracting a share of those monopoly rents). Given the definition of the residual demand faced by the dominant firm, however, a rise in price will reduce its demand for a second reason as well, since the competitive fringe will try to expand output to maximize their profits under the higher price.

Although the dominant firm has substantial market power, however, it does not have as much market power as a monopolist, since the presence of the competitive fringe increases the

elasticity of the dominant firm's demand curve. The competitive fringe provides a way for consumers to substitute away from the dominant firm. The market power of the dominant firm is therefore determined by three factors: 1. the elasticity of market demand; 2. the elasticity of supply of the fringe; and 3. the nature of the cost advantage the dominant firm has over the fringe firms. These three factors will form the basis of analysis in the before and after periods.

Before

Prior to the rise of the internet, the competitive fringe was limited in important ways. There were high transaction costs associated with finding and coordinating an exchange of music, since a physical object, either a cassette tape or a CD, had to be manually copied and delivered. Furthermore, the equipment and materials to make copies was relatively expensive, and in the case of cassettes quality deterioration accompanied each copy, so that a person who had purchased the cassette might be able to make copies for their friends, but anyone who had a copy would encounter significantly reduced quality on attempting to make a "second generation" copy. Taken together, this indicates that there were significant positive fixed and marginal costs faced by fringe firms, and in many cases the number of firms available to supply the market was limited due to quality degradation. These elements speak to the second and third factors mentioned above that determine the market power of the dominant firm, which will now be explored in relation to the before period, and also suggests where p^0 and p^{max} would appear on a graph of this situation.

The fringe firms have a low elasticity of supply since their cost structure suggests that increasing production would be unprofitable. Since, by assumption, there were no monetary profits for fringe firms in this market, there were only "social" profits to be gained by producing (recall that this is the non-commercial fringe, consisting of friends making copies for one

another, or some similar situation). This limited production significantly, since individuals could not spend all their time producing copies given the need to find paying work to support themselves. This means that as the dominant firm increased price, the demand faced by the competitive fringe would also increase, but the nature of the firms suggest that the supply would be relatively inelastic, so the number of firms would not increase in a one-to-one ratio with the price.

Furthermore, the limited nature of the firms, i.e. that they operate in "spare time" and are not sources of monetary profit, indicates that the dominant firm faced lower, although quite different, marginal costs, since the nature of information goods is that they have high fixed costs of production, but very low marginal costs. Both of these factors indicate that the fringe would have a relatively insignificant effect on the dominant firm. The fringe would only supply to those with an extremely low willingness to pay (in terms of monetary currency) and to niche markets like that for custom mix tapes. This suggests that p^{max} during this time period would be relatively high, and so the firm would have a greater ability to raise prices. Furthermore, p^0 would be relatively high as well, suggesting that the dominant firm would have more ability to shut out the fringe if it chose to do so. This high p^0 is consistent with the results from the OTA survey, which found that most customers would be willing to purchase music if they could not tape it themselves.

After

The introduction of the new technology, which digitized music and provided an infrastructure (P2P software) to distribute music outside of the control of the music labels, significantly reduced the costs of the external fringe. In particular, the equipment needed to make copies of music, computers, was widely available already, the quality of music no longer

deteriorated as copies were made, and distribution of copies was made almost completely painless with P2P software programs. This meant that fixed costs of production as well as marginal costs fell dramatically. Not only that, however, but also the potential number of suppliers in the external fringe was radically increased. While it had previously been confined to those willing to buy and use expensive recording equipment, anyone with a computer and an internet connection could become (perhaps even unwittingly) a fringe supplier of music. [16]

This reformed competitive fringe, existing as a series of P2P networks of hundreds or thousands of personal computers, not only had marginal costs that were close to zero, they also priced their goods at zero, for obvious reasons. First, the technology that allowed the files to be shared easily, P2P software, did not allow the supplier to charge for their files. They only had the option to supply or not to supply the music at a price of zero. Secondly, since these suppliers were exclusively suppliers, in that they did not produce any new products. This meant that the competition between fringe firms for a given song can be analyzed with Bertrand model with a large number of identical firms; each firm competes on price, which therefore falls to marginal cost. In this case, since marginal costs are near zero, the price must also be near zero. Anyone who attempted to price their good above zero would simply get shut out of the market. Finally, these suppliers were still a part, as discussed above, of the illegal fringe, and attempting to charge a non-zero price would attract the attentions of the legal firms wishing to stamp out piracy.

This significantly changed the relationship of the dominant firm and the competitive fringe. Whereas in the before period there was a relatively high elasticity of supply, the fringe in

[16] In order to increase the number of files shared on their networks, the creators of P2P software often made sharing files the default behavior of the program; less technically savvy people might not even realize they were uploading files to others.

the after period is characterized with an elasticity of supply that is essentially horizontal at price $p^0 = 0$, since the nature of the fringe suggests it would be able to supply any practical amount of demand. [17] The model would suggest that p^{max} would dramatically fall, as well, because it means that the dominant firm no longer had any efficiency advantages, since the competitive fringe faced marginal and fixed costs of almost zero. Even though the dominant firms could also supply via the internet, their need to coordinate payments and have a hardware infrastructure for distributing files via the internet means that they must face higher marginal costs than the fringe (even though their marginal costs would still be small, relative to the fixed costs of production). The model therefore suggests that this change in the nature of the fringe alone would serve to substantially reduce the dominant firms' market share and, over time, eliminate it completely.

C. Extensions to the Basic Model

The conclusions drawn from the basic model are not borne out by empirical data. It has been almost ten years since Napster was released and, although the music industry is highly concerned, there is no indication that they are hemorrhaging market share. As our initial data suggested, their total unit sales are significantly higher than ever, even though average revenue has declined. Furthermore, although the discussion of the empirical data included studies that demonstrated a negative correlation between online file-sharing and music sales, even the most pessimistic result suggested only a twenty to thirty percent drop in sales, and the existence of alternate studies showing no relationship between file-sharing and the loss of sales even more strongly suggests that the basic theoretic model above is not a good predictor. We will now undertake a survey of extensions to the model which could explain the discrepancy between it and the observed market conditions.

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[17] Note: this is only true in a "given" period, since the fringe can't supply until after the dominant firm has already introduced the first unit of supply.

Product Differentiation

One of the assumptions made in construction the basic model was that the dominant firm and the competitive fringe had identical products. This is not the case, however. At the very least, there is a distinction between music obtained legally and music obtained illegally which exists in the minds of consumers. The RIAA suggests that its highly publicized legal campaign was meant to cultivate the understanding that online file-sharing is illegal, and that it has had a significant amount of success, raising the percentage of people who agree with that statement from 35 to 72 percent.[18] Not only that, the RIAA emphasizes the idea that file-sharing is inherently unfair to the artist, attempting to make a moral distinction as well as a legal one. This non-price competition is crucial to understanding the situation, because, as noted above, the competitive fringe faces marginal costs close to zero, making it impossible for the dominant firm to compete on price alone.

This is also consistent with theory that differential pricing in the form of quality differentiation, or "versioning" can be an effective way to deal with the non-excludability of information goods. If one assumes that the music market can be segregated into two groups, one with a high willingness to pay and one with a low willingness to pay, then the music industry must set a price to maximize profits given the reservation price of each group (Varian and Kahin 2000). Those in the low willingness to pay group would be supplied by the fringe, but because their reservation price is by definition lower than the profit-maximizing price set by the dominant firm, they would not have purchased music in any case. This sort of reasoning is also present in Oberholzer-Gee and Strumpf's (2007) explanation of their findings that file-sharing does not have a significant effect on music sales.

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[18] Recording Industry Association of America, "For Students Doing Reports," <http://www.riaa.com/faq.php> (1 May 2009).

Reducing Monopoly Power

Another facet of the situation not well addressed in the basic model involves the nature of the dominant firm. As a dominant firm with nearly 80 percent market share, it holds considerable market power to realize monopoly rents by reducing supply and raising prices. This is not the only tool that firms with market power possess to extract additional surplus from the market, however. Another such tactic is bundling, or tying, which occurs when monopolists only sell a desirable good bundled along with many less desirable goods.

The data suggests that one of the most important changes to the industry as a result of online file-sharing was the dramatic increase in the number of singles sold, due to online sales of singles, despite the availability of full length albums online. This evidence gives credibility to the idea that the dominant firm used its market power to bundle music in albums, artificially increasing prices and profits. By producing a few hit songs that could only be purchased on an album along with eight to ten other tracks, they industry had incentives to reduce the availability of less profitable singles.[19] The decline in revenues, then, is likely to be the result of the rising competitive fringe reducing the market power of the dominant firm, and forcing it to abandon its profitable bundling scheme.

This compliments the theory that profits were artificially high in the 1990s as a result of the change from cassettes to CDs, as both theories suggest that the dominant firm was leveraging market power to increase the sale of undesirable products. McCourt and Burkart (2003) go even further, arguing that the industry foresaw anti-trust concerns on the horizon, and used file-sharing as an excuse to distract people from its anti-competitive practices. They write "the timing

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[19] New York Times, "Spinning into Oblivion," <http://www.nytimes.com/2007/04/05/opinion/05sachsnunziato.html?_r=2&scp=10&sq=RIAA&st=cse> (1 May 2009)

of the Napster case is critical, as it was initiated at the same time as lawsuits against the Big Five for price fixing by US federal and state agencies."

5. Conclusion

The theoretic model in this paper and its extensions support the empirical evidence suggesting that file-sharing does not significantly impact music sales. While the music industry has described a situation in which file-sharing, if left unchecked, would increasingly sap sales (this is the situation which appears in the naïve model above), there is no evidence that an acceleration of file-sharing is occurring: the data suggests that more music is being purchased. Rather, the structure of the dominant firms and their observed behavior of maintaining high prices along with practicing bundling suggest that the rise of file-sharing merely reduced the market power enjoyed by these dominant firms. The data cited by the music industry, suggesting declining revenues, is perfectly consistent with the above model, which suggests that these lost revenues are the revenues the dominant firms extracted as a result of their market power.

The Recording Industry Association of America (RIAA) and its constituents no doubt have incentives to try to maintain the high profits of the 1990s, but there should be little concern that depriving them of those profit levels will destroy the industry. Rather than saving an industry from a chronic free riding problem, the lobbying efforts of the RIAA in support of laws requiring the government to prosecute those involved in file-sharing should be understood as an attempt to return the high levels of exploitable market power to the dominant firms of the music industry.

Similarly, the proposed implementation of a surcharge for all internet access, ostensibly to aid the ailing industry by "blanket licensing" all music and thereby lessening the losses from online file-sharing, can be seen as an attempt by the music industry to continue to maintain the

superprofits it has enjoyed. In fact, although this plan would succeed in taxing those engaged in online file-sharing, because it would necessarily be a tax on all internet use – technical limitations prevent the possibility of distinguishing those who share music files from those who do not – it would allow the music industry to extract additional rents from those who have never used file-sharing software, and essentially double rents from those who purchase music legally. Moreover, the model suggests that inherent product differentiation, particularly that between legal and illegal goods, may be sufficient to provide normal profit levels to the industry even in the face of online file-sharing, and the rising number of units sold in the last few years bears that theory out.

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