

Assessing The Academic Literature Regarding the Impact of Media Piracy on Sales

Professor Michael D. Smith and Professor Rahul Telang¹
Carnegie Mellon University, Pittsburgh, PA

August 2012

Introduction:

The goal of this paper is to provide a “non-technical” discussion of what the academic literatures in economics, marketing, and information systems can tell us about how piracy impacts sales of media products. Within these literatures, we have chosen to focus on empirical studies of the impact of piracy because, while there are a variety of analytic models proposing theories of how piracy might impact sales,² we believe that the true test of these theories starts with data.

Based on our review of the empirical literature we conclude that, while some papers in the literature find no evidence of harm, the vast majority of the literature (particularly the literature published in top peer reviewed journals) finds evidence that piracy harms media sales.

In the remainder of this document we first discuss our philosophy in evaluating the literature. We then present a high-level overview of the statistical challenges associated with measuring the impact of piracy, and three main methods used in the literature for

¹ We thank the Motion Picture Association of America (MPAA) for providing generous funding to support this study. We also note that while the MPAA funded this research, they have exerted no influence over our conclusions or presentation in this paper. As such, the conclusions stated in this paper are entirely our own.

² See Peitz and Waelbroeck (2003) for a review of the analytic/theoretical literature on the impact of piracy. Within this literature, Chellappa and Shivendu (2005) propose a model whereby consumers may pirate products as a “sampling” strategy — using the pirated content to learn more about the true value of the content and then using that information to decide whether to buy the content. Similarly, Conner and Rumelt (1991) and Takeyama (1994) propose a theory of network effects whereby the piracy of media products by a portion of the market might increase the value to other participants in the market. Finally, some have argued that indirect appropriability, a term coined by Liebowitz (1985), might mitigate the impact of media piracy by increasing the value of the initial purchase: i.e., if I can make a copy for my friend, I might be willing to pay more for the initial product. As noted by Liebowitz (2008a), without data serious questions can be raised regarding whether any of these theories hold in actual markets. This is why we have focused our analysis on what the data actually say.

addressing these challenges. Finally we discuss the specific findings of the major papers in the literature as they pertain to the impact of piracy on music sales, on motion picture sales, and on the sales of other creative products.

Epistemology and Social Science:

One of us (Mike) once heard a physics professor say that, outside of pure mathematics, there is no such thing as a “proof” in science. Instead, the physical sciences must deal with knowledge on the level of “what is the most reasonable explanation for the observed data.”

If this is true for the physical sciences, it is certainly true of the social sciences where the observed data are noisier, more incomplete, and subject to the vagaries of human behavior. As such, we believe that evaluations of the literature should start with the recognition that there is no such thing as a perfect or completely conclusive paper. Each paper has flaws, limitations, and areas that could be improved with better data or different methods. Because of this, we believe that when evaluating “what the literature says,” one should start by first analyzing what each individual paper finds, but then one should take a step back and draw overall conclusions based on what the totality of the literature says. We try to follow this approach in the discussion that follows.

Methodological Approaches:

A naive approach one might take to estimating the impact of piracy is to use data on sales of individual products, say movies, and measures of piracy levels for those movies. One could then run the following regression in an attempt to measure how piracy impacts sales:

$$S_{it} = X_{it}\delta + P_{it}\beta + \varepsilon_{it} \quad (1)$$

where S_{it} represents the sales of movie i at time t , X represents a matrix of variables, possibly including fixed effects for each movie and each time period or control variables, and where P_{it} represents piracy levels on movie i at time t . In this specification, the impact of piracy on sales would be given by the β coefficient.

The problem with this approach is that there exist variables that are not included in the regression but still affect variables on both the left- (independent) and right-hand (dependent) side of the regression. In this specific case, one might expect that the popularity of a movie (which is unobserved) would impact both the likelihood that it will be pirated and the likelihood that it will sell. In a situation like this, where missing variables affect both independent and dependent variables in a regression, the affected dependent variables are referred to as being “endogenous,” and it is well known that the resulting regression coefficients will be inaccurate (biased).

Indeed, in the specific case described above, if one regresses the sales of individual movies onto the piracy levels of those movies, one is very likely to see a *positive* coefficient on piracy. If the model were correct, the interpretation of this coefficient would be that increased piracy *helps* sales. However, as noted above, in this case one cannot make that interpretation because of the bias introduced by the unobserved variables.

Helberger, Huygen, and van Eijk (2009) represent a potential “real-world” example of this error. The authors survey 1,500 media customers and pirates in the Netherlands regarding their purchasing and piracy behavior. They find that media pirates purchase as many CDs as non-pirates do. In a section titled “downloading and buying as complementary activities” they conclude from this observation that “[d]ownloading need not be a threat to purchases of physical formats: it would seem that for Dutch consumers these go together” (p. 75). The problem with this conclusion is that it ignores a potential endogeneity problem: If there are unobserved characteristics of consumers (say their interest in music) that might influence both a consumer’s propensity to pirate and their propensity to purchase, then one cannot conclude anything about a survey that finds that pirates purchase as much as non-pirates do. Put another way: while pirates might purchase as much as non-pirates do, we have no way of knowing how much these pirates would have purchased if piracy weren’t available.³

³ Another concern with this paper is that the authors conclude that even though piracy reduces sales, increased piracy represents a net welfare gain to Dutch society. They reach this conclusion by viewing piracy as a welfare transfer from artists to consumers and noting that by reducing the cost of content to zero, piracy eliminates the dead weight loss from consumers whose utility for the music was below the market price. The problem with this conclusion is that it takes music production as a given. If piracy reduces rents available to

Below, we review the three major methodologies used in the academic literature to address this statistical problem either directly (in the case of product-level data using natural experiments and instrumental variables approaches) or indirectly (using country- or city-level data or survey data).

Product-Level Analysis Using Natural Experiments: Controlled experiments are the “gold standard” of social science research. For example, a controlled experiment to analyze the impact of piracy on sales might involve obtaining a random sample of 10,000 or so consumers, randomly assigning half of them to a treatment group that must stop using Internet piracy for a period of time, and then comparing the purchase behavior of the treatment group to the control group of customers who’s piracy behavior does not change. This approach would not suffer from the endogeneity problem described above because the decision about which consumers’ behavior is left unchanged (control group) and which are no longer allowed to pirate (treatment group) is unrelated to the dependent variable (media sales).

The problem with this approach, of course, is that it is very difficult both in terms of effort and money, and thus it is not surprising that there are no papers in the literature that we are aware of that use controlled experiments to study piracy.

However, an analogous approach involves using a “natural experiment” where a treatment is applied to one group of consumers and where one can find another group of similar consumers who are unaffected by this change to serve as the control group. We have used this approach in three of our papers. Danaher et al. (2010) use NBC’s decision to remove its content from iTunes as a natural experiment and compare piracy levels and sales for NBC content (the treatment group) to ABC, CBS, and FOX content (the control group). Similarly, Dhanasobhon, Smith, and Telang (2012) use ABC’s decision to add its content to Hulu as a natural experiment and compare piracy levels for ABC content (treatment group) to NBC, CBS, and FOX content (control group). Finally, Danaher et al. (2012) use the “HADOPI”

artists, and if artists were to produce less music (or lower quality music) as a result, then total social welfare could decline.

graduated law in France as a natural experiment and compare music sales by French customers (treatment group) to sales in a set of other European countries (control group).

The challenge with this approach is finding a suitable control group (one that has similar characteristics to the treatment group prior to the event), and finding an event that is both exogenous (i.e., is not driven by the dependent variable) and is sufficiently discrete that one can observe changes “before” and “after” it took effect.

Product-Level Analysis Using Instrumental Variables: The instrumental variables approach is similar to the “natural experiment” approach in that the researcher needs to find a variable that is correlated with the endogenous dependent variable (e.g., piracy) without being directly correlated with the independent variable. Oberholzer-Gee and Strumpf (2007) (a paper we discuss in more detail below) apply this approach by using the number of German secondary school students who are on vacation in a particular week as an instrument for the ease of piracy among U.S. citizens.

For this to work, German holidays must affect the ease of piracy in the U.S. (which the authors argue occurs because many music file sharers are German students and because German students are more likely to share files when they are in school), and German school holidays must be otherwise uncorrelated with U.S. music sales.

The main challenge of the Instrumental Variables approach is finding a variable that effectively meets both of these standards, and this represents the main critique of the Oberholzer-Gee and Strumpf paper as seen in the literature discussed below.

City- or Country-Level Data: The third main approach used in the empirical literature is to compare sales levels across different geographical markets (typically either countries or cities). The basic idea of this approach is that after controlling for differences in the demographic characteristics of each region, changes in the dependent variable (typically broadband Internet penetration) can be treated as an experiment, and the researcher can statistically compare the change in sales resulting from this experiment for a treatment group (those regions where broadband Internet penetration increased) to a control group (regions where there was no change in broadband Internet penetration).

Examples of this approach include Hui and Png (2003), Pietz and Waelbroeck (2004), Zentner (2009), Zentner (2012) for country-level data; and Liebowitz (2008b), Zentner (2006) and Smith and Telang (2010) for city-level data.

The main challenge of this approach is ensuring that the observed changes (for example changes in the propensity to adopt broadband Internet) are properly controlled for by the demographic characteristics of the region or by other control variables available to the researcher. For example, if there were unobserved characteristics of regions that were both driving Internet adoption and were driving media sales, and that weren't captured by observable demographic characteristics, then the resulting coefficients would have similar endogeneity bias to those described above. A related challenge is that while broadband Internet access can stimulate piracy, it can also influence users in many different ways (for example provide users with other entertainment options) that can affect media sales.

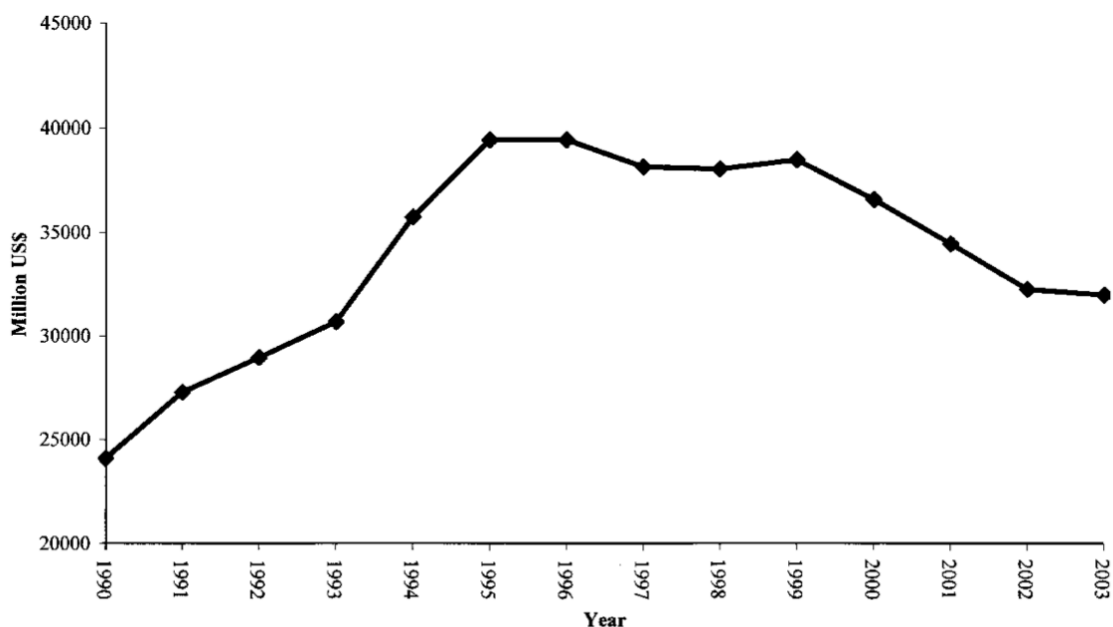
Individual-Level (Survey) Data: A final category of papers use surveys of small relatively homogeneous samples of consumers, for example, college students taking an economics class (Waldfogel (2009, 2010), Rob and Waldfogel (2006, 2007), Bai and Waldfogel (2009)). In this approach, the researchers use the homogeneity of the sample, along with observed demographic and psychographic characteristics to control for unobserved correlation with the dependent variable. The main interpretation challenges with this approach are (1) that the resulting conclusions are, of necessity, tied to the chosen sample and (2) that the stated behavior of individuals can be systematically affected by both inaccurate recall and by obfuscation. The first challenge means that, in the case of the Waldfogel papers cited above where the surveys are obtained from college students, it is difficult to generalize any results beyond college students. The second challenge may affect survey data to the extent that consumers systematically over- or under-estimate their actual purchase behavior, or intentionally obfuscate the impact of piracy on sales behavior.

The Impact of Piracy on Music Sales:

One piece of anecdotal evidence for why piracy may have harmed music sales revolves around the decline in sales in the music industry shortly after the introduction of Napster

in 1999 (Figure 1). Unfortunately, using this data alone can't tell what music sales levels would have been in the absence of Napster, or how much of the observed decline in sales can be explained by piracy versus other unrelated causes. To answer these questions, we need to apply some of the statistical techniques discussed above.

B Figure 1: Global Music Sales (1990-2003)



Source: Zentner (2006), p. 64

Below we review the major academic papers that have looked at the impact of piracy on music sales. While the vast majority of these studies have found some harm from piracy, one of the earliest and most prominent studies found no evidence of harm from piracy, and we start our discussion with that paper.

Oberholzer-Gee and Strumpf: The Oberholzer-Gee and Strumpf (2007) paper is not only one of the first papers in the economics literature to look at the impact of piracy on sales, it was also published as the “lead article” in the *Journal of Political Economy*, one of the most well respected journals in the economics literature. Because of this, it is one of the most cited papers on the impact of piracy on sales.

In the paper, the authors analyze data from the latter part of 2002. Their data include U.S. piracy downloads by album (collected from two large OpenNap servers) and U.S. album

sales. To address the endogeneity problem described above, Oberholzer-Gee and Strumpf use the number of German secondary school students who are on vacation in a particular week. The authors argue that German school vacations are an appropriate instrument for the ease of piracy in the U.S. because German users provide one out of every six files that are downloaded by U.S. users, and because during school vacations there are more files shared by German users (students have more time to spend online sharing files). After using this instrument, Oberholzer-Gee and Strumpf find that file sharing has a statistically insignificant impact on music purchases.

On one hand, we believe the authors deserve “full marks” for being the first to answer a very interesting question, for using a very creative combination of datasets to answer the question, for being the first to think carefully about how to measure piracy levels using data from pirate networks, and finally for developing a creative instrument to break the endogeneity problem in the data.

However, there have also been some significant concerns raised about their methods. The most forceful objections have been raised by Stan Liebowitz (e.g., Liebowitz 2007, Liebowitz 2010). Liebowitz’s main critique of the Oberholzer-Gee and Strumpf’s work revolves around the appropriateness of their chosen instrumental variable. Specifically, as noted above, for this instrument to do its job it must be correlated with the ease of file sharing in the U.S., and uncorrelated with U.S. sales. Liebowitz (2010) argues that it fails in both respects. Specifically, Liebowitz (2010, p. 3) argues that German school holidays are negatively correlated with U.S. sales, primarily through a correlation with the Christmas holiday season.

Liebowitz also argues that the Oberholzer-Gee and Strumpf data likely overstate the impact of German users on U.S.-based downloads. Specifically, Liebowitz observes that Oberholzer-Gee and Strumpf’s estimate indicate that a one standard deviation increase in German students on school vacation (an increase of 3.6 million students) would predict a 50% increase in American file sharing (an increase of about 2.2 million downloads). Liebowitz argues that this predicted increase is unreasonably large, so large that in any weeks where no German schools kids on vacation (which occurs in 7 out of 17 weeks in the

Oberholzer-Gee and Strumpf data), that all U.S. file sharing should fall to zero. Liebowitz (2010, p. 7) closes by saying “a power failure in a portion of Germany, or any event that caused German students to turn off their computers, would completely eliminate American file-sharing. How realistic is that?”

Liebowitz is certainly the most forceful, but is not the only academic to express reservations about Oberholzer-Gee and Strumpf’s work. Rob and Waldfogel (2006) also critique Oberholzer-Gee and Strumpf’s for relying on the contemporaneous relationship between piracy and sales (does piracy in a particular week reduce sales in that same week?) as opposed to focusing on the impact of piracy over a longer time horizon, and also expresses concern about the use of piracy and sales data whose correlation likely biases the results toward finding no effect.

In short, while we emphasize that Oberholzer-Gee and Strumpf deserve credit for writing the first major paper on this question and for doing so using an innovative dataset and innovative methods, their data and analysis should be evaluated relative to the quality of their data and relative to the findings of other papers in the literature — and this is particularly important given that most other papers in the literature have found a strong and significant impact of piracy on music sales. We review this literature below.

Other Papers: In addition to the Oberholzer-Gee and Strumpf paper, there are three other academic papers we are aware of that find no evidence that piracy harms sales. First, Boorstin (2004), in his undergraduate thesis at Princeton University, used census data on the number of individuals in each city with and without broadband Internet access in 1998, 2000, and 2002 and combined this data with CD sales data for the same metro areas. However, while Boorstin finds no negative effect of broadband Internet penetration on music sales, Liebowitz (2004) argues that after controlling for demographic characteristics at a city level (which might influence Internet adoption), and after adding year-level fixed effects, the results show that piracy harms sales.

Andersen and Frenz (2010) also find no evidence of harm from file sharing after analyzing the results of survey responses from Canadian file sharers taken in 2006. However, in a

recent paper, Barker and Maloney (2012) find the opposite result in this dataset after correcting for two “fundamental errors” in the econometric analysis in Andersen and Frenz’s. The first major change made by Barker and Maloney is restoring over 400 respondents to the analysis. Andersen and Frenz exclude over 400 individuals (about 20% of their sample) who did not purchase CDs in 2005 from their analysis, arguing that these consumers “may never have been active in CD purchasing.” Barker and Maloney note that since the survey data includes both CDs sales in 2005 and 2004, one can partially test this assumption (a test that Andersen and Frenz surprisingly did not conduct). And in fact that nearly a third of the excluded respondents had purchased CDs in 2004 even though they did not purchase in 2005. Barker and Maloney suggest that many of these consumers who stopped purchasing CDs may be exactly the sort of customers whose purchases were most affected by the availability of piracy. Second, Barker and Maloney specify a system of both CD and P2P demand, an econometric change that partially controls for potential endogeneity problems from unobservable consumer-level characteristics that may drive both CD and P2P demand. After controlling for these (and a few smaller statistical issues), Barker and Maloney find that the Canadian data actually reflects a strong and consistent negative impact of piracy on sales.

Hammond (2012) is the third paper we are aware of that finds no harm from file sharing on music sales. Hammond’s analysis occurs in the context of pre-release leaks of CDs, with data obtained from a private tracker site specializing in pre-release file sharing. Hammond finds that one month of pre-release file sharing causes a 60 unit increase in post-release sales, and also finds that pre-release file sharing disproportionately helps popular artists as opposed to niche or emerging artists. As with Oberholzer-Gee and Strumpf, Hammond’s use of a novel dataset is laudable, as is his novel focus on the impact of pre-release piracy. However, we also note that Hammond’s analysis relies on the idea that pre-release leaks are essentially random events — an assumption we believe requires further justification both econometrically and intuitively. In this regard, we believe that the finding that pre-release piracy disproportionately helps popular artists may actually point to an endogeneity problem in the econometric specification.

With the exception of these papers, all of the other papers we are aware of in the literature find that music piracy has harmed sales. We review these papers briefly below.

In the context of survey data, Zentner (2006) uses a sample of 15,000 people in 2001 and 2002 and finds that, after controlling for Internet sophistication and broadband speed, peer-to-peer usage reduces by about 30% the probability that an individual will purchase music, and overall that piracy reduced music sales by about 7.8% in 2002. Rob and Waldfogel (2006) survey the piracy and music purchasing behavior of 412 college students at 4 colleges in 2003 and find that each pirated download displaces about 0.2 album sales, and that overall piracy reduced per capita expenditures on music by about 20%. Waldfogel (2010) uses a survey of University of Pennsylvania undergraduates in January 2009 analyzing piracy and purchase behavior for music, and finds that each pirated download displaces between 0.15 and 0.3 album sales. Finally, in the context of Census data, Michel (2006) and Hong (2004) use purchase data from the Consumer Expenditure Survey combined with census data on broadband usage and find that file sharing causes a 5 to 7.6% reduction in sales.

In the context of country-level cross sectional data, Hui and Png (2003) use country-level data for 28 countries from 1994-1998 and find that physical piracy reduces sales by about 42%. Pietz and Waelbroeck (2004) use CD sales for 16 countries from 2000-2001 and find that piracy explains about 25% of the decline in music sales observed over that time frame. Finally, Zentner (2009) uses country-level music sales and broadband penetration for 49 countries from 1997-2008 and finds that file-sharing may explain up to 50% of the decline in music sales observed during that period.

As noted above, it is also possible to conduct similar analyses using city-level (MSA-level) data. This approach has been used by Zentner (2006) and Liebowitz (2008b) for broadband penetration and music sales major cities in the U.S. from 1998-2003, with both papers finding that piracy (via broadband availability) caused a significant portion of the observed decline in CD sales during this period.

Academics have also examined three questions closely related to the impact of piracy: the impact of anti-piracy enforcement on sales, and the impact of piracy on concert revenue for artists, and the impact of piracy on music production itself.

In the context of enforcement, Bhattacharjee et al. (2006) analyze how the RIAA's lawsuits against individuals in 2003 and 2004 impacted sales, finding that these lawsuits reduced the number of files individuals were sharing on P2P networks, and had a disproportionately large impact on large file sharers. Likewise, Danaher et al. (2012) analyze how the HADOPI law in France impacted French music sales by comparing music sales in France and a set of control group countries before and after the HADOPI legislation was passed. They find that the publicity surrounding the HADOPI law caused a 20-25% increase in French music sales relative to the control group countries. Finally Adermon and Liang (2010) find that enforcement of the European Union IPRED directive in 2009 caused a 27% increase in CD sales and a 48% increase in digital music sales in Sweden.

In the context of the impact of piracy on the distribution of revenue between CD sales and live performances, Mortimer, Nosko, and Sorensen (2010) find that while piracy displaces CD sales, it increases concert revenue for less well-known artists.

A final set of papers analyze how piracy impacts the composition of "best of" and bestselling lists of music, with Bhattacharjee et al. (2007) finding that piracy reduces the duration albums spend on bestselling charts, and with Waldfogel (2011) finding that file-sharing does not seem to impact the quality of music appearing on "best of" lists.

Returning to our initial statement that one should determine what the literature says by first looking at individual papers and then looking at the weight of the literature's finding, our review of the literature suggests that while it is fair to say that the results in the academic literature are mixed with respect to whether file-sharing negatively impacts music sales, we also believe it is fair to say that the vast majority of papers find evidence of harm. Specifically, restricting attention to papers published in peer-reviewed journals, two published papers in the literature find no evidence of harm and ten find evidence of harm. If one were to further restrict attention to "first or second tier" academic journals (Journal

of Political Economy, Journal of Law and Economics, Management Science, and Information Economics and Policy) the count would be one published paper finding no evidence of harm (Oberholzer-Gee and Strumpf) and seven published papers finding evidence of harm. Thus, we conclude that the extant literature suggests that file-sharing most probably causes some level of harm to music sales.

The Impact of Piracy on Motion Picture Sales:

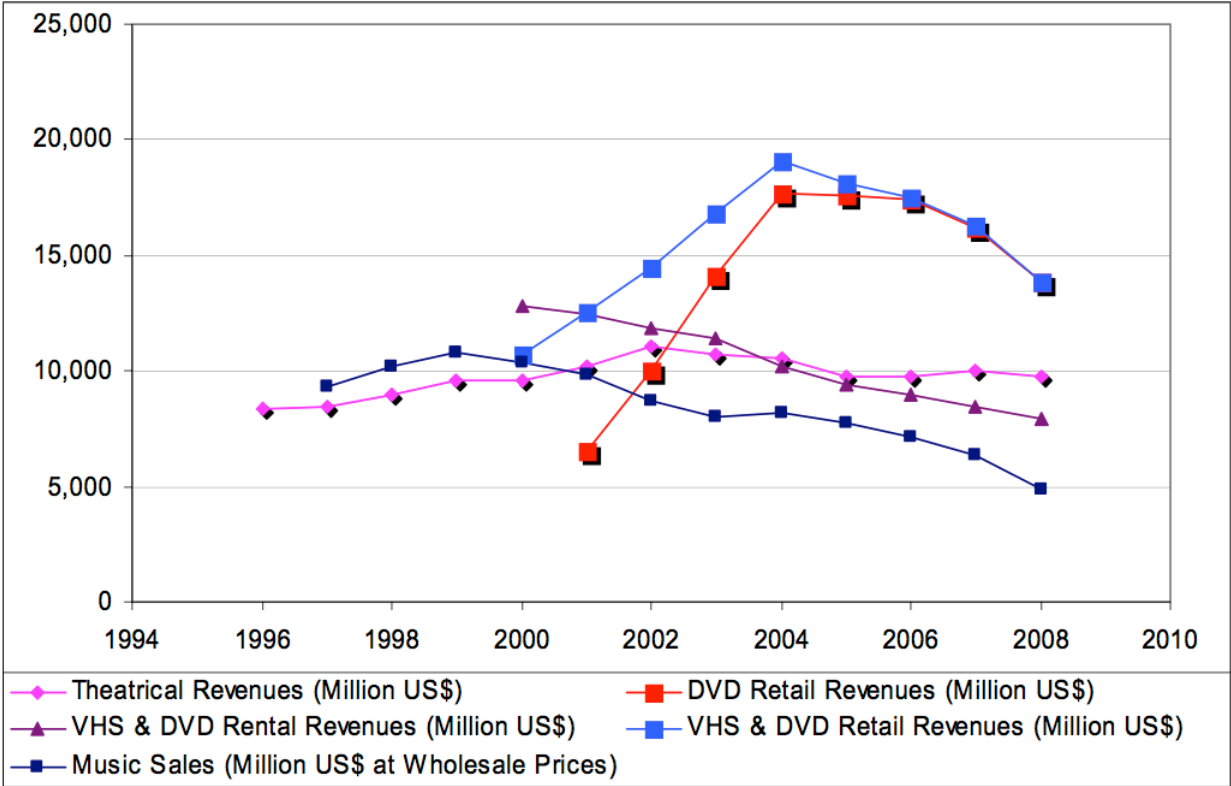
Given that the academic literature seems to show that piracy hurts music sales, what might we expect to be different about motion pictures? Two obvious differences between motion picture and music piracy are first that motion picture files are typically much larger than music files, and second that motion picture piracy developed into a significant phenomenon with the development of the BitTorrent protocol (in 2003), well after the mainstream development of music piracy (with Napster in 1999). Based on these differences, we might expect that the impact of motion picture piracy would be seen later than the impact of music piracy was, and that motion picture piracy might be more strongly tied to the presence of broadband Internet connections. And indeed, these two characteristics are consistent with what we see in the literature.

This effect can be seen quite clearly when analyzing the differences between three papers in the academic literature. First, Liebowitz (2008b), discussed above, used broadband Internet penetration and music sales at an MSA level for the 99 largest MSAs from 1998-2003 to show that increased broadband penetration led to a sharp decline in music sales during this timeframe. Note that this time period was after the introduction of Napster in 1999 and before the introduction of BitTorrent in 2003.

In contrast to these results, our 2010 paper (Smith and Telang 2010) uses essentially the same methods as Liebowitz used for music, but our data cover DVD sales data and broadband Internet penetration for 2000-2003. Our results also differ from Liebowitz's results: we find that increased broadband penetration caused about 9.3% of the \$14.1 billion *increase* in DVD sales from 2000-2003.

Our interpretation of the difference between our results those in Liebowitz (2008b) is that, while music piracy was prevalent from 2000-2003, movie piracy was much less developed during that period. As such increased broadband penetration from 2000-2003 may have exposed DVD consumers to the beneficial aspects of the Internet (increased information about movies, increased product selection through online retailers, and lower prices) without being exposed to the potentially harmful aspects of the Internet (increased availability of pirated content).

**Figure 2: U.S. Video Rental and Sales Revenue, 1994-2008
(Measured in Constant 2008 Dollars)**



Source: Zentner (2010), p. 2

Based on this we would expect that increased broadband Internet penetration would harm DVD sales after 2003. And indeed evidence from descriptive statistics on DVD sales seems to bear this out. Figure 2 is taken from Zentner (2010) and shows that DVD sales flattened in 2004 and that combined VHS and DVD sales dropped by 27% from 2004 to 2008 when measured in constant 2008 dollars.

Was this decline causally related to an increase in broadband-enabled Internet-based piracy from 2003-2008? Zentner (2010) finds that it was. Specifically, Zentner uses country-level panel data from 2001 through 2008 for 36 European countries, the U.S. and Japan documenting theatrical revenue, video rental, and video sales data for movies, along with broadband Internet penetration for the time period. The use of panel data allows Zentner to control for factors unrelated to broadband penetration in a way that is not possible if one were to only observe time series or cross sectional data. Zentner attempts to isolate the impact of broadband-enabled movie piracy by comparing the impact of increased broadband penetration before and after the widespread adoption of BitTorrent in 2003. Zentner finds that prior to the introduction of BitTorrent, increased broadband penetration had a positive impact on motion picture sales (consistent with Smith and Telang 2010), but after 2003, increased broadband penetration had a negative impact on sales.⁴

This result — that piracy harms motion picture sales — is consistent with all but two of the academic papers we are aware of that have looked at the impact of Internet piracy on movie sales, a set of papers that span a variety of datasets, settings, and statistical methodologies.

In the context of surveys, Bounie, Bourreau, and Waelbroeck (2006) use data on purchase and file sharing behavior for a sample of 620 French individuals in 2005, and find that, while file sharing has no statistical impact on theatrical attendance, file sharing leads to a large decline in both video sales and video rentals. Similarly, Rob and Waldfogel (2007) conducted a survey of 500 University of Pennsylvania undergraduates in the fall 2005 semester. These students were shown the top 50 movies from each of the 3 previous years (150 movies in all) and asked whether they saw the movie, and what channel (piracy, theater, television, rental, purchase) they used to view the movie. The authors used this data to find that unpaid consumption of movies reduces paid consumption on nearly a one-for-one basis. Likewise, Hennig-Thurau, Henning, and Sattler (2007) use a combination of customer's stated intentions and reported behavior to analyze the impact of file sharing on

⁴ Zentner also observes (p. 25) that legal online video sales and rentals were a very small part of the market (approximately 1% of DVD sales and rentals) even as late as 2008.

movie sales and find that file-sharing results in significant cannibalization of theater visits, DVD rentals, and DVD purchases. Finally, Bai and Waldfogel (2009) use a survey of college students in China and find that 75% of Chinese movie consumption is through pirate channels, and that each instance of unpaid consumption displaces about 0.14 paid sales.

In the context of “natural experiments,” Danaher et al. (2010) use data surrounding NBC’s decision to remove its television content from the iTunes store in September 2008. They find that piracy on NBC content increased by 11.4% relative to ABC, CBS, and FOX piracy, after NBC’s content was removed from iTunes. They also find that piracy levels on ABC, CBS, and FOX content increased during this timeframe as well, potentially suggesting that NBC’s decision to remove its content from iTunes caused an increase in both NBC and non-NBC piracy as users switched from iTunes to BitTorrent to obtain their television content.

In the context of product level data, Danaher and Waldfogel (2012) and Smith and Telang (2012) both examine the impact of longer international release windows on sales levels. Danaher and Waldfogel use box office data from July 2003 through July 2006 for the top 10 movies in each time period, and covering 17 countries and find that, after the widespread diffusion of BitTorrent, longer lags between the U.S. and the international release date cause about a 1.3% reduction in sales per week, or about a 7% reduction per movie. Smith and Telang (2012) use a similar dataset and method, but focus on DVD sales. Specifically, Smith and Telang use data from 2009 through 2011 for seven countries covering DVD sales for over 200 titles. They find that a 1-week longer release delay between the first DVD pirate source and the legitimate DVD release date is correlated with a 2% reduction in DVD sales per movie. Likewise, De Vany and Walls (2007) use piracy and revenue data for a major studio release and find that file-sharing caused the movie in question to lose \$40 million in box office revenue.

Finally, in the context of panel data, Zentner (2012) uses theatrical revenue and home video sales (VHS and DVD) for 36 countries from 1996-2008 to analyze whether Internet penetration reduces movie sales. He finds no statistical relationship between increased broadband Internet penetration and theatrical revenue, but a strong negative relationship between increased broadband penetration and DVD sales. Similarly, Liebowitz and Zentner

(2012) use panel data for major cities in the U.S., including Internet penetration, demographics, and television viewership to analyze whether increases in broadband Internet penetration reduces television viewership. While not a direct measure of the impact of piracy, they argue that broadband penetration may represent an indirect measure of piracy given the prevalence of pirated television content on the Internet. Their results are consistent with the results reported above in that they find a moderate reduction in television viewership among younger viewers caused by increased broadband Internet penetration.

Martikainen (2011) is one of the two academic papers we are aware of that find no evidence of harm from file sharing. Martikainen uses BitTorrent download data, collected from March to May 2009 and finds no evidence that increased levels of BitTorrent sharing reduce DVD sales. However, it is also important to note that this paper is only able to analyze DVD sales, not digital sales; and other work in the literature (e.g., Danaher et al. 2010) finds that during a similar time frame, digital sales and digital piracy were strongly related while there was no statistical relationship between digital content and physical content, which could explain why Martikainen finds no impact of digital piracy on physical sales.

The other academic paper we are aware of that finds no evidence of harm from piracy is our 2009 paper analyzing how movie broadcasts on advertising supported television stations impact demand for the movie through legal (DVD) and illegal (piracy channels) (Smith and Telang 2009). In this paper, we find that movie broadcasts stimulate demand in both legal and illegal channels. We then use the broadcast of movies on television as an exogenous shock to demand, and find that the availability of pirated copies of a particular movie at the time of broadcast has no impact on its subsequent increase in DVD sales. However, we also note in the paper that “our results do not speak to the impact of piracy in the earlier part of a movie’s lifecycle, where the availability of pirated content may have a negative impact on sales” (p. 336).

Thus, we believe that when taken together the results in the academic literature — particularly the published peer-reviewed literature focused on recently released titles — strongly suggest that digital piracy results in a decrease in sales of motion picture content.

Summary:

To summarize, while the academic literature is not uniform in finding harm, taken as a whole we see a very consistent story across the academic literature: With one exception, all of the papers we are aware of which have been published in major peer-reviewed academic journals find evidence of statistically significant harm to sales of recently released content as a result of illegal file sharing. These papers span a variety of methods, time periods, and contexts. Moreover, while the one dissenting paper should be lauded for innovative methods of data collection, and for being among the very first papers published addressing this question, there have been significant questions raised about the appropriateness of its instrumental variable, and as such we believe it is appropriate to weigh its finding that piracy does not harm sales relative to the large number of papers with opposite findings.

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