

## Napster and its Effects on the Music Industry: An Empirical Analysis

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**Abstract: Problem statement:** In the mid to late 1990s the rise of the internet has led to the development of Peer-to-Peer networks (P2P), which allows for increased and rapid connectivity between individuals and has made the transfer of information and files as simple as clicking a button. **Approach:** The ability to connect so easily has had its share of positive and negative effects on the music industry. **Results:** One potentially negative effect in particular has been the charge made by the Recording Industry Association of America (RIAA), a trade group representing the music industry, that P2P networks have enabled individuals to effectively steal and share music, which is concomitant with decreasing CD sales. Still others claim that the availability of free music on applications such as Napster and Kazaa, among others, has actually helped the music industry by exposing individuals to artists they might not have otherwise become aware of. This study attempts to empirically identify and measure the effects of illegal downloading on CD sales and the music industry as a whole, using semi-annual time series data for the years 1990 through 2007. **Conclusion/Recommendations:** Our regression results showed that we cannot establish illegal downloading as the main culprit for decline in CD sales. There appears to be a number of factors driving down the sale of CDs, the largest of which is the sale of vinyl singles. The rise of legal online downloading since 2002 will also be accounted for the online electronic transfer and its effect on CD sales.

**Key words:** Peer-to-Peer (P2P) networks, illegal downloading, Napster, vinyl, regression

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### INTRODUCTION

The global economic climate has experienced dramatic changes over the last two decades as a result of the personal computer and increased Internet connectivity. This rapid advancement of technology has created new business opportunities and allowed for vast improvements in communication. Despite the multitude of positive effects being reaped from the internet, there also exist issues that have upset many people. In the mid to late 1990s the rise of the internet has led to the development of Peer-to-Peer networks (P2P), which allows for increased and rapid connectivity between individuals and has made the transfer of information and files as simple as clicking a button. The ability to connect so easily with masses of individuals has had its share of positive and negative effects. One potentially negative effect, in particular, has led to much controversies in our society: the Recording Industry Association of America (RIAA, 2009), a trade group representing the music industry, has charged that P2P networks have enabled individuals to effectively steal and share music, leading to a significant reduction of CD sales and illegally appropriate the profits of

recording artists individually and the music industry as a whole. It has also led to disputes over copyright infringement upon the rights of music artists. Proponents of these types P2P networks (that facilitate music file sharing) claim that the ability to download music for free has had an innocuous effect on CD and paid electronic sales. Still others claim that the availability of free music on applications such as Napster and Kazaa, among others, has actually helped the music industry by exposing individuals to artists they might not have otherwise become aware of, or has allowed sampling of music prior to purchase. The purpose of our research project is to identify the extent to which these P2P networks have contributed to the overall decline in CD sales and, also, to identify the effects of enacted legislature against illegal file sharing and the increase in access to legal digital downloads have helped curb this issue. The study is organized as follows: firstly this study briefly explains the nature of the recorded music industry and its history, the nature and function of P2P networks and legislation imposed to protect intellectual property. Secondly this study briefly reviews the literature. In fourth part, this study details the hypotheses to be tested and discusses the

data and econometric methodology. In fifth part, this study discusses empirical results and implications. Finally conclusion is given.

**A brief history of the recorded music industry:** The recorded music industry consists of several groups who are involved in the creation, recording and distribution of music. In the nineteenth century, the music industry was dominated by live music or the sale of sheet music. The creation of the phonograph marked the establishment of a new market: recorded music, which currently dominates the industry in this day and age. The industry saw many changes over time, generally, as a result of technological innovation. Some of the groups involved in this industry include musicians, producers, A & R agents, publishers, labels and retail music stores. However, for most of the later part of the 20th and into the 21st century, the music industry consisted primarily (on the supply side) of two major groups. These groups are major record labels which are dominated by the “big four” record groups (Sony, BMG, EMI, Universal and Warner). The other group is comprised of smaller independent labels producing and distributing music on a much smaller scale. These two groups spent a long period of time at odds with one another, but each played an integral role in the industry’s development and expansion. Independent labels boasted the ability to serve artists’ interests and not be part of the corporate “sell out” of major labels. They were able to spend time break in new artists and genres creating and feeding expanding demand for music. Major labels were able to amass large quantities of capital that allowed them to finance the recording process and expand to have global distribution chains that served to feed global demand for recorded music. Furthermore, labels are supposed to protect the intellectual property of their clients, preventing piracy and unlicensed distribution. The 1980s led to most independent labels using major labels for their distribution and, therefore, independent labels came to serve the interests of major labels (Throsby, 2002).

P2P file sharing did not mark the first threat to the rights and profits of the music industry and the artists they represent. The ability to copy tapes, burn CDs, or purchase pirated music from street vendors has long plagued the music industry. However, the burning of CDs and copying of tapes took place on a relatively small scale in comparison to the online sharing. The online climate of sharing allowed people all over the world to access a person’s music library, where burning a CD would require one to know an individual who has the music they want and who is generally in a very close geographical proximity (Harrower, 2005).

The digital revolution of the musical world appeared to happen very quickly. However, the music industry’s infrastructure and institutional legislation protecting the rights of the artists lagged far behind the innovative changes taking place. Before the record companies could begin putting into place online marketplaces, others were already creating their own P2P software to share music free of charge. This created the problematic issue of the P2P networks. Although the development of P2P networks has changed the climate of the internet and has led to some excellent innovations, however, these P2P networks have also enabled online communities to connect and illegally share copyrighted music without any payment to the artists. In order to understand the effects these P2P networks can potentially have on the music industry, it is important to first develop an understanding of how they function.

P2P networks are online communities that are able to connect to one another’s computers to search, share and download files. These P2P networks capabilities can easily be extended to movies, pictures and computer programs. A distinct characteristic separating P2P networks from other more traditional networks is the lack of a central server or client servers, but rather shared peer nodes which provide the bandwidth. Most online business networks derive from a central server where a client would initiate a download and the server would react to satisfy the request. In most P2P networks the individual computers initiate downloads directly from one another usually through host software. Thus, as more users begin to use these P2P networks, their system capacity increases along with the number of files available for sharing.

P2P networks, despite the fact that they pose a threat to some industries, have been used to break new ground in innovation and assisted in the distribution of information. For example, many computer programmers will make their programs and program codes available on P2P networks for other individuals to test, adjust and improve the programs. Furthermore, many colleges have become a part of online academic P2P networks that allow colleges and higher education institutions to legally share files. The largest of these academic P2P networks is the Penn State’s LionShare. LionShare allows secure and legal file sharing of academic content. Another attractive feature of LionShare is its commitment to disclosure of the identity of sharing peers and movement away from anonymous sharing. It is clear therefore why it is important to understand how P2P networks function and facilitate illegal file sharing (Felix and Strumpf, 2004).

**Brief literature review:** A number of studies have attempted to analyze and assess the effects of illegal downloads on the sales of the music industry. Many of these studies have estimated econometric models to support multiple arguments, while others have used less quantitative reasoning to explain the decreasing CD sales. Our study will follow them to help build and construct an effective model to assess effects of digital pirating on the music industry. Liebowitz (2002) attempted to test “annihilation hypothesis” in the context of illegal downloads on the music industry. He used 30 years of music sales data to identify external influences on the sale of music in order to discover a link between MP3 downloads and music sales. He identified the factors that he believed might influence the sale of records. These factors include the changes in income of potential users, changes in the prices of complements and substitutes, changes in musical tastes and changes in recording formats. He concluded that the price of CDs and consumer income are not statistically significant in determining CD sales, which is quite contrary to typical consumer demand theory. He suggests that this may have happened as a result of no major changes in prices during the period of study. He also attempts a qualitative analysis to link declining CD sales to illegal downloading, but does not provide any empirical evidence to support his propositions. He examines four other major decreases in sales over the last 30 years and infers that this current decline in sales appears to be different in nature from previous declines because of the major technological changes that have taken place during the study period (other than MP3s); namely, vinyl, cassettes and compact discs.

In another study, Waelbroeck and Peitz (2004) conducted a survey of individuals in 16 countries with the largest markets for recorded music, where downloading of music took place in the past. They analyze the data from the years 2000 and 2001 when illegal downloading was becoming popular. This study uses a cross-sectional analysis to control for differences in the countries and still attempts to tie downloading to the number of CD units sold. In this study, the independent variables are GDP, the percentage of households with broadband connections, the number of cassette units sold divided by CD sales and the number of CD players per household. Their regression analysis reveals that all of the tested variables were statistically significant with the exception of CD players. The study attributes 11% of current CD sale declines to illegal downloading.

Felix and Strumpf (2004) tracked actual illegal downloading on a P2P server and attempted to link the downloaded songs and albums to the sales of the same

songs and albums over 17 weeks. The study observed 1.75 million file-downloads, or approximately ten downloads per minute. Their original model involved sales as the dependent variable with downloads and specific album characteristics as independent variables. However, since downloads are likely to be correlated to immeasurable characteristics, such as a band’s popularity, Felix and Strumpf (2004) used the fixed effects model to control for such changes. The study reveals that downloading is heavily concentrated on a limited number of songs. Songs at the top of the Billboard Charts during the study were, in general, the most downloaded. However, their results find that downloads have no statistically significant effect on the purchases of the average album in the sample and could not possibly explain the drastic decreases in sales in the music industry (Felix and Strumpf, 2004).

Hong (2004) used the US Bureau of Labor Statistics (2008) Consumer Expenditure Survey (CEX) to link together expenditures on music and computer ownership. This study attempts to see if the access to the internet has significantly decreased expenditure on music which could imply that Napster has, in fact, illegally encroached upon the profits of record companies and artists. Hong attributes a \$3 decrease in music expenditure per household as a result of Napster’s illegal downloading platform. Furthermore, he finds that this downloading could be responsible for as much as 33% of decrease in sales. In another study, Michel (2006) also performed an analysis attempting to capture the effects of illegal downloading on individual music consumption using the CEX. Michel took the survey and divided individuals into two groups: people who owned computers in 2000 and those who did not, thus effectively created a control group for spending on music, individuals without computers and a test group of those with computers. This approach provides extremely clean data by avoiding self-selection problem and false or incorrect statistical conclusion thereof. This research study finds a significant negative relationship for the interaction variable between computer ownership and year, which indicates that the relationship between computer ownership and CD expenditures weakened from 1998-2003. He concludes that illegal file-sharing may have reduced CD sales by as much as 13% (Michel, 2006).

## **MATERIALS AND METHODS**

**Econometric methodology and data:** In this study we describe the method we have used for identifying causes of decreasing CD sales, using semi-annual time series data for the years 1990 through 2007. The model

we estimate is based on the following linear regression equation:

$$y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \beta_3 X_{3t} + \beta_4 X_{4t} + \beta_5 X_{5t} + \varepsilon_t \quad (1)$$

Where:

$y_t$  = A measurement of CD sales

$X_{it}$  = The vector of the corresponding explanatory variables as discussed below (other media format, median income, consumer prices, substitution variables)

$\varepsilon_t$  = The random white noise error term

t = For t-th time period

A number of variables are chosen initially as potential predictors of CD sales, based on preexisting research. These variables are listed below (as follow) along with an explanation for their inclusion in the sample.

**Other media formats:** Other audio media format sales are included in the regression model in order to account for substitution of one format for another. These formats include cassettes and vinyl albums. It seems that most individuals purchase predominantly one format of music for the sake of consistency and to reduce the cost of different types of media players. For this reason different media formats should have a negative impact on CD sales. Furthermore, once legal downloads became available in 2004, their unit sales were included as an additional independent variable. The effects of legal downloading on CD sales will be especially interesting because arguments can be made for whether people will substitute away from CDs when purchasing online, or if legal downloading allows consumers to sample music from home before purchasing the entire album in CD format.

**Median income:** Music consumption generally falls into the category of discretionary recreational spending coming from one's disposable income. We expect income to have a positive effect on the sale of CDs. For this reason inflation adjusted median income has been included in the study to account for increased spending on music resulting from increased income.

**Consumer price index of recorded music:** Though the price elasticity of recorded music is a relatively unexplored topic, it is safe to assume that drastic changes in the price of recorded music will have some effect on the demand and, consequently, the consumption of this good.

**Consumer price index of DVDs and video games:** When considering what may be influencing the sale of

music, it is important to consider what substitutes are available. One substitute that quickly comes to mind is DVDs, videos and video games, which certainly compete with music sales. For this reason the CPI of DVDs and similar products have been included in the study.

**Substitution variable:** It is believed that some of the CD sales in the 1990s were the result of individuals updating their music libraries from cassette format. In order to account for such behavior a variable has been introduced, which divides cassette unit sales by CD sales. This variable is expected to be positive.

Once the data were collected, all of the variables were run through a stepwise regression (detailed below) to eliminate the insignificant variables.

## RESULTS AND DISCUSSION

**Analysis of the empirical results:** We have used a stepwise regression methodology at first to identify independent variables that have a significant effect on the sale of CDs to eliminate unnecessary variables (which may skew the results of subsequent models). After the regression model was selected, we used the Chow test procedures to identify the possibility of structural breaks during the time period that illegal downloading became statistically significant. Next, we run regressions to compare differences in the estimated coefficients of independent variables for the years 1990 through the middle of 2002 and 2003 through 2007, to identify the effect of the legal download. The final regression analysis involves estimating a simple regression model for each individual independent variable. The results of these regressions are presented in the Tables 2-4.

In Table 1, we have presented the traditional descriptive summary statistics of the sample observations. Simple regression model results and the multiple regression model results are presented in the Table 2. In the rows 1-4 of the Table 2, the simple regression model results are presented. Estimates of the multiple regression Eq. 1 is presented in the last row of Table 2. Initial examination reveals that this is a good model as indicated by the traditional goodness of fit statistics such as  $R^2$ , F-statistic and t-statistic.

Table 1: Summary statistics

	CD sales	Vinyl	DL	MedInc	Subs
n	36.00	36.0	8.00	36.000	36.00
Mean	348.70	4.5	365.50	47652.000	152.70
St. Dev.	110.50	3.8	212.70	2363.000	350.00
Max	568.80	13.8	629.70	50641.000	1284.00
Min	143.80	0.3	58.60	44034.000	0.94
Skewness	-0.26	1.2	0.45	-0.041	2.60

Table 2: Regression analysis: Dependent variable CD sales

Intercept	Vinyl model	Substitution	Median income	Time	R <sup>2</sup>	DW stat	F-stat
438.799* (<0.0001)	-20.144* (<0.0001)				0.4718		30.38 (<0.0001)*
395.898* (<0.0001)		-178.617* (0.001)			0.2736		12.81(0.001)*
-920.527* (0.0060)			0.02663* (0.0003)		0.3247		16.36 (0.0003)*
265.674* (<0.0001)				4.48530* (0.0092)	0.1830		7.62 (0.0092)*
71.5414 (0.8347)	-49.6446 ** (<0.0001)	-88.5464* (0.0737)	0.0176** (0.0177)	-17.0073* (<0.0001)	0.8186	2.228	34.973 (0.001)*

Note: p-values are in parentheses; \*: Significant at 1% level; \*\*: Significant at 5% level

Table 3: Chow test for structural change

Chow statistic	Break point	p-value
2.15	17	0.0915
2.55	18	0.0523
2.36	19	0.0678
4.18	20	0.0064

Table 4: Regression results: Before and after the introduction of legal downloading

	1990-2002	2003-2007
Intercept	85.51041 (0.74270)	16331.0000 (0.0519)
Vinyl model	-38.40150* (<.00010)	-231.1653**** (0.1359)
Substitution	-54.45172 (0.1356) ****	10742**** (0.1294)
Median Income	0.01321** (0.03420)	-0.32429** (0.07420)
Time	-8.36368 ** (0.02450)	5.27826
DL		0.13875 (0.62560)
R <sup>2</sup>	0.92980	0.92060 0.90010
F-stat	69.54000* (<.0001)	6.96*** (0.0706)
Sample obs.	26.0000	10.0000

Note: p values are in parentheses; \*: Significant at 1% level; \*\*: Significant at 5% level

This model reveals a good relationship between CD sales and the explanatory variables. Examination of the Durbin Watson statistic also indicates the absence of the serial autocorrelation among the random error terms. The signs of the regression coefficients are very close to what was anticipated before. To examine the presence of multicollinearity, we have also looked at the traditional VIF (variance-inflating factor) statistic, which confirms the presence of very mild multicollinearity.

In order to mitigate the effect of the multicollinearity and to estimate the actual effect of each explanatory variable on the sale of CD units without interaction with other variables, we have also run simple regression based on only one independent variable at a time. The results are presented in the first four rows of Table 2. Again, examining the global F-statistics for each model proved the models' overall fitness in predicting CD unit sales. The results provide a much clearer picture of the effects of the independent

variables on CD sales. Vinyl singles had a very significant negative impact on the sale of CDs. This, again, is explained by the movement away from CDs to vinyl formatted media. The substitution variable resulted in a significantly negative effect on CD sales. This is contrary to our expectations that the updating of libraries from cassette format would increase the sale of CDs. Median income was found to have a small significantly positive effect on sale of CDs, which is congruent with our belief that spending on music will increase proportionally to one's income increases. Finally, the variable of time was found to have a significantly positive effect on CD sales. This can be explained by the fact that as the 1990s progressed, CD use became more and more widespread.

Since the data involved in the study is time series in nature, we have performed a series of Chow test to capture the point of structural changes in the model. The empirical results are presented in Table 3. The breakpoints used in the analysis included the first and second halves of 1998 and 1999, around the time Napster was introduced and when it began to be widely used by music listeners. Hypotheses tests of all these breakpoints reveal that there were, in fact, structural changes taking place during the course of all of these four periods. The actual breakpoint was at the end of 1999, or the twentieth data line. We can attribute the change to the increase in Napster downloading. Though Napster and other illegal downloading existed prior to the later part of 1999, it does take time for awareness of such new technologies to be disseminated to the general public. The test reveals that the effects of the independent variables are not stable and may be changing over the course of these years as a result of a rise in the prevalence of downloading. This result is to be expected because the introduction of P2P networks for downloading music illegally, almost certainly changed the climate of the music industry as a whole and for the years following its introduction, as more and more people began to utilize these networks. Furthermore, the attempts by record companies and law makers to curb this illegal downloading trend only serves to make the industry more volatile and the effects of these different independent variables become more unpredictable over the course of several years.

Another set of statistical inference was then used to assess whether or not the coefficients of independent variables varied significantly after the introduction of legal downloading when compared to years leading up to the introduction of illegal downloads. The first model included the semi-annual data for the years 1990 through 2002. The estimated results would coincide with intuitive conclusions about the independent variables' effects on the dependent variable. Median Income had a small positive effect on the sales of CDs. It makes sense that as a person's income rises, they would generally increase their expenditures on discretionary goods based on their individual interests, which, for many, includes music. A hypothesis test of this variable proved the effects of income to have a significant impact on CD sales during this time period. The sale of vinyl singles, which became more popular in the late nineties with the rise of DJ culture, had major significant negative effects on the sale of CDs. As the grass roots movement towards more traditional vinyl formats increases there is a substitution effect away from the purchase of CDs. The substitution variable for the updating of cassette media libraries to CD libraries had negative impact on CDs sales, contrary to our expectation. Finally, the time variable had a significantly negative effect on the sale of CDs, which indicates some sort of movement away from the CD media format that is not accounted for in our study. In the second time period, which includes the years after the introduction of legal downloading after 2002, the regression model was estimated. This new empirical estimation yielded some unexpected results and may have some underlying issues that need to be looked at for further adjustments to the model. First, median income was found to have a significant negative effect on CD sales, which is certainly contrary to intuitive analysis and our results from other models. CDs are not an inferior good and, thus, its consumption should increase with income. The only possible explanation is that as a nation's median income increases, the availability of internet becomes more widespread. As more individuals are able to access the internet, they will also have increased access to illegal downloading platforms. Similarly, legal downloads appear to have no significant effect on the sale of CDs. This can be explained by the purchase of a single song via the internet resulting in increased interest in a music group which may lead an individual to go out and purchase a copy of the CD while others chose to substitute away from CDs altogether for the new electronic media format. Vinyl singles continue to have a significantly negative impact on CD sales, but the effects of these vinyl purchases have a greater negative impact on CDs

during the later time interval than in the earlier time interval. This may be a result of the fact that DJs and individual movement back to vinyl became more prevalent in the first decade of the twenty-first century compared to the late 1990s (Mearin, 2009). Substitution variable seems to have a significantly positive effect on CD sales for the later time interval which is consistent with our original hypothesis. The time variable was also found to be statistically insignificant for this model. An assessment of variance inflation factors revealed the likelihood of multicollinearity. Furthermore, the fact that legal downloading has been around for only a few years, (given our extremely small sample size), makes the results far less reliable than that from a large sample.

### **CONCLUSION**

Testing for illegal down-loading's actual effects on CD sales is a near impossibility due to the fact that data about what has been downloaded is largely unavailable. This black market activity has been blamed for much of the decline in CD sales. The results of our study, however, indicate that illegal downloading is not the only culprit. There appears to be a number of factors driving down the sale of CDs, the largest of which is the sale of vinyl singles. Vinyl singles act, essentially, as a substitute for CD formats and tend to drive down the sale of CDs as more and more vinyl units are purchased in a given year. Additionally, the significance of the substitution variable indicates that CD sales may, in fact, have been inflated in the early 1990s as a result of widespread updating of individual's multimedia formats. However, it appears that there are forces driving down the sale of CDs in the music industry that are not accounted for in the study. This could potentially be explained by a lack of interest in the music that is available or other qualitative factors. The other side of this argument is that there is more music than ever available and the communication age we live in makes it extremely easy to search for and find a plethora of different types of music. The obvious fact that there is something missing from the model that is contributing to the decrease in CD sales makes illegal downloading a very likely suspect. Furthermore, the existence of structural changes in the music around the time of Napster's height of popularity makes an even stronger case for the RIAA's belief that illegal downloading has been swallowing up profits from the industry.

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