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Copyright Protection, Technological Change, and the Quality of New Products: Evidence from Recorded Music since Napster

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Abstract

While some recent technological changes reduced revenue for digital products, other changes reduced the costs of bringing creative works to market. Therefore, we do not know whether copyright protection now provides weaker incentives to bring forth new products. This paper assesses the quality of new recorded music since Napster was established in 1999. First, I create an index of high-quality music from critics' retrospective lists. Next, I rely on music sales and airplay data, using the idea that if one vintage's music is better than another's, its superior quality should generate higher sales or greater airplay through time, after accounting for depreciation. I find no evidence of a reduction in the quality of music released since 1999, and the two usage-based indices suggest an increase since then. Researchers and policy makers thinking about the strength of copyright protection should supplement their attention to producer surplus with concern for consumer surplus.

1. Introduction

Creative products, such as movies, music, and books, have high fixed costs and low marginal costs. Private firms have traditionally been able to bring them profitably to market because these products are excludable, through a combination of technology and the complementary legal framework provided by copyright law. Physical media products are sufficiently difficult to copy that purchasing them has been the easiest means of their acquisition. Moreover, copyright grants legal monopoly rights to creators, assisting them in appropriating returns from

I am also a Research Associate of the National Bureau of Economic Research. I am grateful for the comments of seminar participants at the Federal Trade Commission, University of Toronto's Rotman School of Management, Indiana University, the National Bureau of Economic Research digitization conference, the University of Minnesota's Carlson School of Management, HEC Montreal, and the Workshop on Information Systems and Economics in St. Louis (December 2010).

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their works. While this arrangement gives rise to monopoly's usual harm to consumers, this harm is thought to be offset by copyright's incentive effects on the creation of new works (see Boldrin and Levine [2008] for a discussion of the net benefits of intellectual property rules).

Recent technological changes may have altered the balance between technology and copyright law. First, file sharing reduces the revenue available for any particular digital product, with recorded music as a leading example. On its own, this would tend to reduce the flow of new products, particularly if creators are motivated by economic factors. Organizations representing the recorded music industry have voiced concern that weakened effective copyright protection will undermine the flow of new recorded music products. The International Federation of the Phonographic Industry (IFPI 2012, p. 9) describes music as "an investment-intensive business" and worries that "piracy makes it more difficult for the whole industry to sustain that regular investment in breaking talent" (IFPI 2010, p. 29). The Recording Industry Association of America (RIAA) explains that its antipiracy efforts seek "to protect the ability of the recording industry to invest in new bands and new music" and that "this theft has hurt the music community, with thousands of layoffs, songwriters out of work and new artists having a harder time getting signed and breaking into the business."¹

Although file sharing has weakened effective copyright protection, other technological changes have reduced many of the costs of bringing digital creative works to market. Production, promotion, and distribution of music have all been made less expensive by new computing and information technologies. As a result, the revenue needed to cover the costs of maintaining the traditional flow of products may have declined. It is possible that despite being weakened by Napster, the effective copyright protection still available may be sufficiently strong to facilitate a continued flow of valuable new recorded music products. Making this determination requires an assessment of whether consumers continue to face a steady stream of valuable new products in the face of the compound experiment of weakened copyright protection and new technologies for bringing products to market in the post-Napster era. This paper seeks to address that question by, first, creating indices of the quality of recorded music over time and, second, asking how these indices have fared since Napster was established.

While reductions in revenue are comparatively easy to document, quantitative assessment of the volume of consequential new music products is more challenging. It is natural to point, for example, to the number of products released each year, but the distribution of consumption is skewed, and most products are rarely, if ever, purchased.² Thus, most products contribute little to consumer and producer surplus, and the number of products, while interesting, is not

¹ Recording Industry Association of America, *Why We Do What We Do* (http://www.riaa.com/physicalpiracy.php?content_selector=piracy-online-why-we-do-what-we-do).

² See Handke (2006, 2012) and Oberholzer-Gee and Strumpf (2010) for discussions of the increased volume of music released in recent years.

particularly informative about the welfare generated by products. A second impulse is to quantify the number of products whose sales pass some threshold, such as 5,000 copies. But in an era of increasing theft, 5,000 copies is an increasingly difficult target to measure. A work of equal quality appearing in, say, 1998 and 2008 would sell fewer copies in 2008, so this method will not work.

Against the backdrop of this challenge, this paper presents three independent approaches to quantifying the evolution of music quality over time. First, I develop an index of the quantity of high-quality music based on critics' retrospective lists of the best works of multiyear time periods. In particular, I assemble data on album quality from 88 Anglophone sources, chiefly from retrospective lists (for example, *Rolling Stone's* 500 best albums, Pitchfork Media's 200 best albums of the 1990s, and so forth). Each ranking allows me to create an index of the number of albums released each year meeting the criterion. I combine the indices statistically to create an overall index of the volume of high-quality music since 1960.

My second and third approaches to quantifying the evolution of music quality are more tightly linked to the service flow of recorded music by vintage, making use of the following insight: if one vintage's music is better than another's, its superior quality should generate higher sales or greater airplay through time, after accounting for the time elapsed since release. Using data on the airplay and sales of recorded music by calendar time and vintage, I am able to construct two separate indices of the mean utility, or quality, of music from different vintages. After accounting for their age, the approach evaluates vintages by the extent to which recorded music from the time period continues to be played—or continues to sell—at above-normal rates. I create these usage-based indices of the quality of recorded music by vintage (vintage quality) for the period since 1960. I can then ask whether these indices track the critic-based index, as well as whether they track each other. Moreover, I can ask how all three of the indices evolve, absolutely or relative to preexisting trends, as major technological changes—including Napster—have unfolded. Each approach has different shortcomings, but together they paint a consistent picture.

The paper proceeds as follows. Section 2 lays out a simple theoretical framework that illustrates the importance of the long-run supply question. Section 3 describes the critics' data and the resulting index. Section 4 describes my sales and airplay data in detail, along with my empirical approach for extracting vintage quality from data on sales or airplay by time and vintage. Section 5 presents statistical results on the changes in these indices since Napster was established in 1999. My indices are consistent with each other and with other historical accounts of recorded music quality, and I find no evidence of a reduction in the quality of music released since Napster was established. Indeed, the two usage-based indices suggest that the quality of music has increased fairly substantially since 1999. Section 6 presents a discussion, and a brief conclusion follows.

2. Theory

Like any product, music generates surplus for two parties, buyers and sellers. While recorded music is durable in some senses—the recordings can last forever and can be reproduced digitally without degradation in quality—it is subject to taste depreciation. Obviously, there are exceptions. Many people still listen to classical music that is hundreds of years old. But for the most part, consumers prefer new music, and we see this in the data below: while roughly one-seventh of music on the radio in a particular year was released in the same year, less than 10 percent was originally released 5 years earlier, and less than 2 percent was originally released 10 years previously.

The fact that music depreciates is important for a welfare analysis of supply disruptions. If it did not, then the consumer losses from a slowdown in new-product introductions would be of only minor importance. If the amount of music available increased a few percent in a normal year, then even a complete cessation of new production would still leave consumers with nearly as much variety as they would have faced if new products had continued to arrive. But because most music does seem to depreciate for most users, disruptions to supply are potentially important for the welfare that this product delivers.

The welfare analysis of sharing zero-marginal-cost digital products has both static and dynamic components. Putting aside all of the usual problems with theft—such as costs incurred for deterrence and protection—it is easy to see that sharing files for music that already exists increases welfare on balance. Producers lose, but their losses—when consumers obtain without payment things for which they used to pay—are all transfers to consumers, who now enjoy greater surplus (the price they had formerly paid plus the former consumer surplus). In addition to the transfers from producers to consumers, file sharing also turns deadweight loss—circumstances in which consumers valued music above zero but below its price and therefore do not consume it—into consumer surplus. In a purely static analysis—again, ignoring problems associated with theft—eliminating intellectual property rights benefits consumers more than it costs producers and is therefore beneficial for society.

Of course, the static analysis above is valid only for works that already exist. The dynamic analysis is different. If developing products requires investments of time or money, then producers may only make these investments in the hopes of obtaining returns. If the returns are eliminated, then producers may stop investing, as the above statements from the industry associations suggest. If music fully depreciates in one period, then no valuable products are available in the second period, and there is no surplus for either party. In contrast to the welfare-improving static effects of file sharing on welfare, the dynamic impact is potentially devastating. This focuses attention on the paper's goal, a quantification of the flow of high-quality new recorded music in the past decade.

3. A Critic-Based Quality Index

The basic data for constructing the critic-based index are professional critics' retrospective rankings of songs and albums from multiple years, such as best-of-the-decade lists (see Waldfoegel [2011] for more extensive discussion). For these lists, the staff of a magazine or Web site produce a list of the best albums (or songs) of the past decade or quarter century or all time. That is, experts evaluate music from different years, subjecting all of it to a time-constant quality threshold for list inclusion. I have been able to assemble data from 88 different rankings (and ratings), 64 covering albums and the remainder covering songs. All of the rankings are from Anglophone countries (the United States, England, Canada, and Ireland).³

Each of these rankings allows ready creation of an index showing the volume of works released in each year that pass some threshold. Because thresholds differ across lists, I employ only within-list variation in the construction of an overall index. Figure 1 displays the sources and their chronological coverage periods.

Prominent examples include *Rolling Stone's* 2004 list of the 500 best albums and Pitchfork Media's list of the best 200 albums of the 2000s. Entries on the *Rolling Stone's* list "were chosen by 273 of the world's preeminent musicians and critics ranging from Fats Domino to Moby" (Levy and editors of *Rolling Stone* 2005). Figure 2 depicts the index derived from *Rolling Stone's* list, and a few things are immediately evident. First, perhaps because *Rolling Stone* was founded in 1967, its editors are very fond of 1960s music. Second, the index trails off toward the year that the list appeared (2004).

Indeed, the process of producing long-term retrospective lists appears biased against recent works. For example, Pitchfork Media produced a list of the top 100 albums of the 1990s in October 1999 and then released another list covering the same period in November 2003. The latter list was introduced with a statement contrasting it with the 1999 ranking: "looking back at that list a lot has changed: our perceptions of the decade are different now, our personal tastes have expanded, our knowledge of the music has deepened" (Pitchfork Media 2003). And, indeed, the later ranking has a greater emphasis on the last years of the decade. Ten percent of the albums on the 2003 list were released in the last 2 years of the decade, compared with only 7 percent for the 1999 list. Hence, I can use the retrospective rankings but exclude the year the ranking appeared as well as the previous year to avoid a bias against recent works. Together, the 64 album lists cover the period 1960–2007 and include 15,158 entries. The 24 song lists also cover 1960–2007 and include 1,806 entries.

While critic-based data are unconventional, I can provide a few pieces of evidence of their legitimacy. First, they track well-known historical trends in music. For example, historians of contemporary popular music believe that the

³ I discovered rankings in a variety of places. The Acclaimed Music Web site (<http://www.acclaimedmusic.net>) lists many of these, including the majority of the lists I use for the period since 1999. See, in particular, the lists of the top albums and songs of the 2000s.

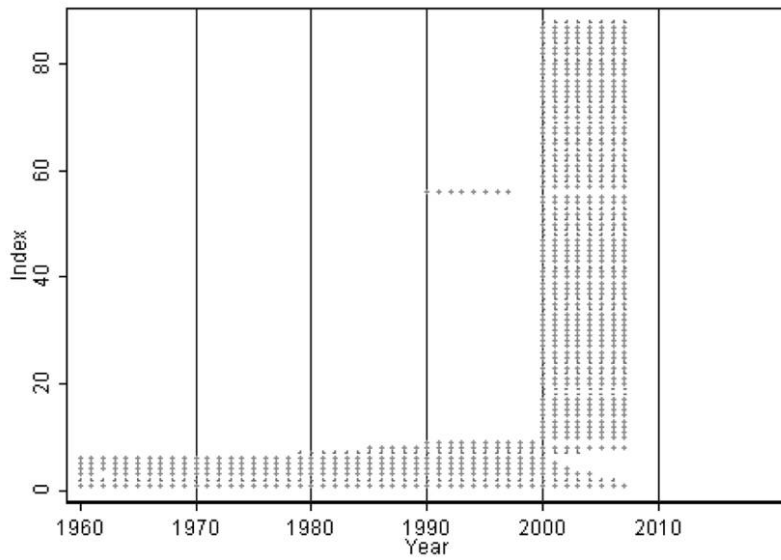


Figure 1. Critic-based quality index sources and their coverage periods

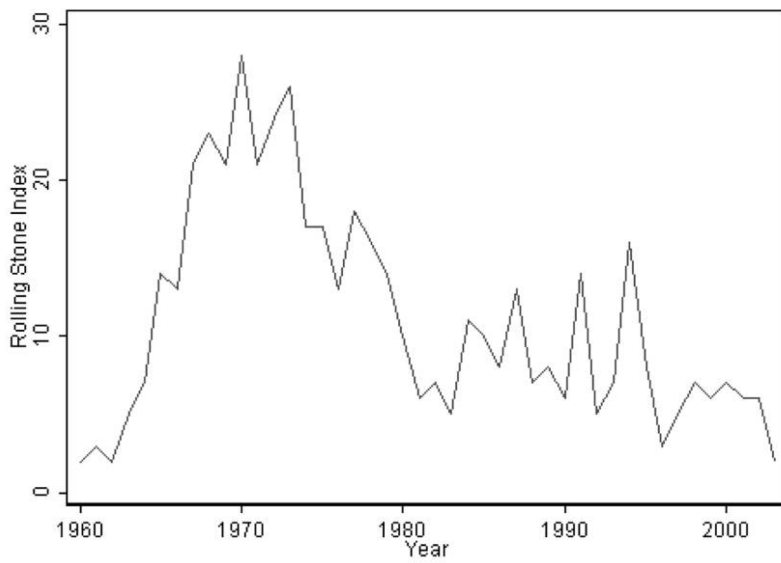


Figure 2. Index derived from *Rolling Stone's* 2004 list of the 500 best albums

late 1960s was a period of unparalleled creative output in recorded music.⁴ And the indices—such as the one shown in Figure 2, based on *Rolling Stone's* 2004 list—reflect that. Second, the various indices are highly correlated with each other. Of the five indices that extend back to the 1960s, all but one of their pairwise correlations exceed .7.

Because the period following 1999 is crucial to this study, it is important to provide evidence of the reasonableness of the rankings and resulting indices for the post-1999 period. I have 56 professional critics' album lists—and 22 professionals' song lists—covering this period (beginning in 2000). To determine whether these lists contain a common signal rather than simply noise, I examine overlap across lists. There is a great deal of concordance across these lists: Two albums—*Funeral* by Arcade Fire and *Kid A* by Radiohead—appear on 47 of the 56 lists covering the 2000s. *Is This It?* by the Strokes and *Stankonia* by Outkast appear on 45 and 37 lists, respectively. One hundred albums account for 40 percent of the entries on decade-best lists, 250 albums account for more than 60 percent, and 500 albums account for more than three-quarters of the 4,202 entries on 56 publications' best-of-the-2000s lists. At least 300,000 albums were released during the decade. Yet 500 albums—less than .2 percent of the decade's new releases—account for three-quarters of the entries on 56 critics' best-of-the-2000s lists.

The relationship between critical acclaim and sales provides another source of validation for the critic-based data. If the designation of being an acclaimed album is relevant to whether the album's existence and consumption generated extra satisfaction for consumers, then critically acclaimed albums should sell more. And, indeed, critical acclaim and sales are linked. Of the 50 most acclaimed albums of the 2000–2009 decade, half sold at least half a million copies in the United States. This is highly atypical: less than 1 percent of albums sell more than half a million copies.

If I define y_{it} as the number of works on list i that were originally released in year t , then I can describe the time pattern of the supply of new works with a regression of the log indices on index dummies and flexible time dummies: $\ln(y_{it}) = \mu_i + \theta_t + \varepsilon_{it}$, where μ_i is an index fixed effect, θ_t is a time effect common across indices for year t , and ε_{it} is an idiosyncratic error. Two points bear emphasis. First, by including index fixed effects, I make use of only within-index time variation. Second, the change in the index between any 2 successive years is determined only by the indices covering both of those years. I have six indices covering the years 1960–78, seven for 1979–85, eight for 1986–89, 10 for 1990–99, and roughly 40 for the years since 2000. Figure 3 shows the critic-based index as time series plots of the annual values of θ_t and has a vertical line in 1999. Because the regression-dependent variable is in logs, the index is in percentages. The dashed lines show the 95 percent confidence intervals.

The index rises from 1960 to 1970 and then declines until about 1980. The

⁴ For example, Larkin (2007, p. 24) writes, "The 60s will remain, probably forever, the single most important decade for popular music."

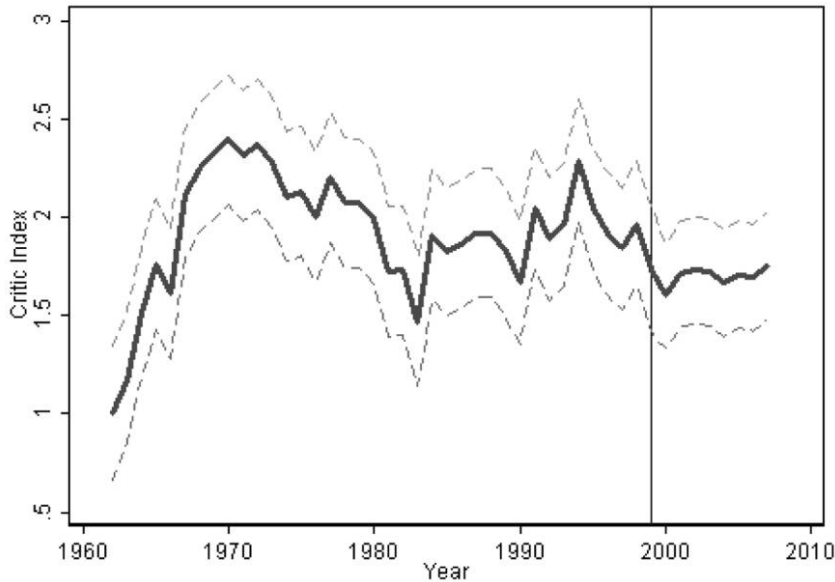


Figure 3. Critic-based quality index

index then rises in the mid-1990s and declines until 1999. Following 1999, the index is stable. Although more formal statistical characterizations follow in Section 5, in this first glimpse of results a few things are evident. First, while the index had been declining prior to Napster's appearance in 1999, the decline did not continue past 2000. Second, this approach gives no indication of a reduction in the quantity of high-quality music following Napster's creation.⁵

4. Usage-Based Approaches

While interesting, the critic-based index has some weaknesses. First, despite their apparent relationship with sales, the critic-based data are not themselves

⁵ Demographics raise a possible concern for the critic-based indices. If people most like the music of their formative years, and if the critics constructing the underlying lists are baby boomers, then the 1970 peak shown in Figure 3 may arise because 1970 coincides with baby boomers' formative years. Most of our lists covering the period since 1960 were constructed in the early 2000s, when baby boomers (born between 1946 and 1964) were 36–54 years old. Some of these lists are likely to include baby boomers' involvement. For example, *Rolling Stone* was founded in 1967. But the lists identifying the index variation for the post-1999 period were assembled in 2009 and 2010, when baby boomers were 46–64. Moreover, the latter lists appear in publications and Web sources (such as Pitchfork Media) founded since 1995 that are less likely to reflect baby boomers' influence. Hence, baby boomers' preferences cannot easily explain the failure of the critic-based index to decline following 1999. Perhaps more important, my other indices are not vulnerable to this concern, as I discuss below.

reflective of consumer behavior. Second, critics' best-of lists may include only a handful of albums from each year whose subsequent critical acclaim does not faithfully reflect the service flow of music from that year generally. Concerns of this sort lead me to alternative indices based more directly on the service flow from the music of each vintage. Implementing the usage-based approach requires data on the use of recorded music by time and vintage. Before turning to the details of implementation, I describe the sales and airplay data.

4.1. *Airplay Data*

For the 5 years 2004–8, I observe the share of songs aired on radio that were originally released in each prior year. The airplay data are from Music Monitor. The firm monitors the songs played on 2,000 radio stations and maintains data on, among other things, the original release date of each song.⁶ Each year's data are based on observing more than a million "spins," so the vintage shares, even for vintages as early as 1960, are estimated with precision.⁷

The distribution of a year's airplay across vintages clearly demonstrates depreciation: recent songs make up the largest share of what's played, and older songs are played steadily less. As Figure 4 shows, about 13 percent of songs on the air in 2008 were released in 2008, and about 16 percent of the songs aired in 2008 were released in 2007. Going further back, the share then declines almost monotonically by vintage: 12 percent for 2006, 9 percent for 2005, 7 percent for 2004, and so on. The decay pattern includes some curious deviations from smooth decline—for example, the share for 1995 appears to be above the pattern defined by the other vintages—and this is suggestive about vintage effects. I observe an analogous vintage distribution based on airplay in 2007, 2006, 2005, and 2004. Figure 5 highlights the share of songs aired in 2008 originally released in the years 1960–90. Even for older vintages, the decay pattern is smooth.

4.2. *Certification-Based Sales Data*

Ideally, I would observe sales of recorded music by time and vintage of recorded music products. That is, I would like to observe the sales of 1975 music in 1990, and so on. Moreover, I would like to observe actual sales so that I can accurately characterize the entire sales distribution by vintage. My sales data, from the RIAA's Gold and Platinum Certification database, approximate this ideal. The RIAA announces when each single's or album's sales pass .5 million (gold) and 1 million (platinum), as well as multiples of 1 million.⁸ The timing of these successive certifications allows me to create a rough measure of each album's

⁶ I am grateful to Rachel Soloveichik of the Bureau of Economic Analysis for sharing the airplay data she employed in Soloveichik (2011).

⁷ For example, of the songs aired in 2005, suppose that 1 percent were originally released in some year. Given that the proportion is calculated with more than a million spins, the 95 percent confidence interval surrounding that year's proportion would be no larger than .04 percent.

⁸ Prior to 1989, a single was certified gold only when its sales reached 1 million. Since then, singles have received gold certifications with .5 million sales.

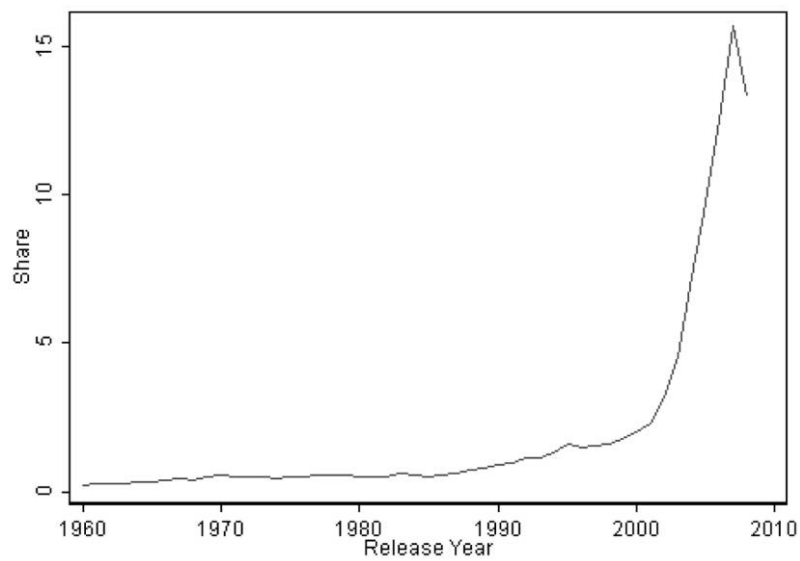


Figure 4. Share of songs aired on the radio in 2008 that were originally released 1960–2008

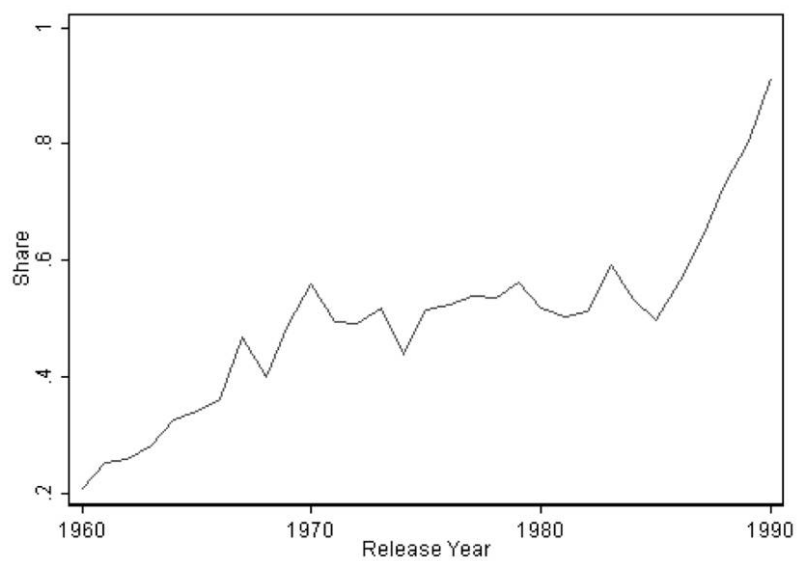


Figure 5. Share of songs aired on the radio in 2008 that were originally released 1960–90

sales over time. The measure is crude in that I observe only whether an album's sales pass each of these thresholds and, if so, when. Still, because I am not interested in particular albums but rather in the total sales of music from each vintage in each calendar year, some of the measurement error may average out.

I obtained all of the certifications awarded between 1958 and 2010 for a total of 17,935 album certifications, 4,428 single certifications, and 2,341 certifications for other products. Each certification includes the work's original release date and certification date (month, date, and year), the artist, the album title, the label, the type of certification (such as gold), and whether the artist is a soloist, part of a duo, or part of a group. Prior to 1987, many certifications are missing release dates. Excluding those observations leaves me with 15,866 album and 3,556 single certifications with complete data. I am interested in determining the sales of music originally released in particular years. Greatest-hits albums present a problem since their release date is not the original release date for the included songs. Hence, I exclude all albums whose title contains "best of," "hits," or "collection." If an observation is a gold certification, I code it as .5 million in sales. I code a platinum certification as an additional .5 million in sales. Finally, I code a multiplatinum certification as an additional 1 million in sales. Certifications can occur multiple years after release or previous certification, while sales occur continuously. I allocate certifications evenly across years since either release or previous certification. Hence, if an album was certified gold in 1995 and was certified platinum in 2000, I allocate the half-million additional sales associated with the platinum certification evenly across the 5 years 1996–2000.

While the certification data cover only a small fraction of albums released, they cover a relatively large fraction of music sales. That is, sales are heavily concentrated in a small number of high-selling albums. For example, the RIAA (2010) report CD shipments of 292.9 million units in 2009. Sales calculated from certifications awarded in 2009 total 155.5 million, which is roughly half of the total reported shipments of physical albums. While sales data derived from certifications are imperfect, they appear nevertheless to cover a large share of total sales. Moreover, the sales implied by certifications reflect time patterns known to hold for music sales in the aggregate. For example, certification-based sales rise to a peak around 2000, then decline.

Although the certification database reports release dates and certification dates by day, the data are sufficiently sparse that I aggregate by year. The resulting database is organized by certification year and release year. That is, for each year I can calculate the total certification-based sales of albums released in any year since, say, 1960.

Figure 6 shows the album sales distribution by vintage, averaged over all years in the data, and a few patterns are evident. First, sales tend to be concentrated around the time of release. Second, there is relatively steady decay in sales over time. Roughly 45 percent of certification-implied sales occur in the same year as the release. Another fifth of sales occur in the year following the release, while

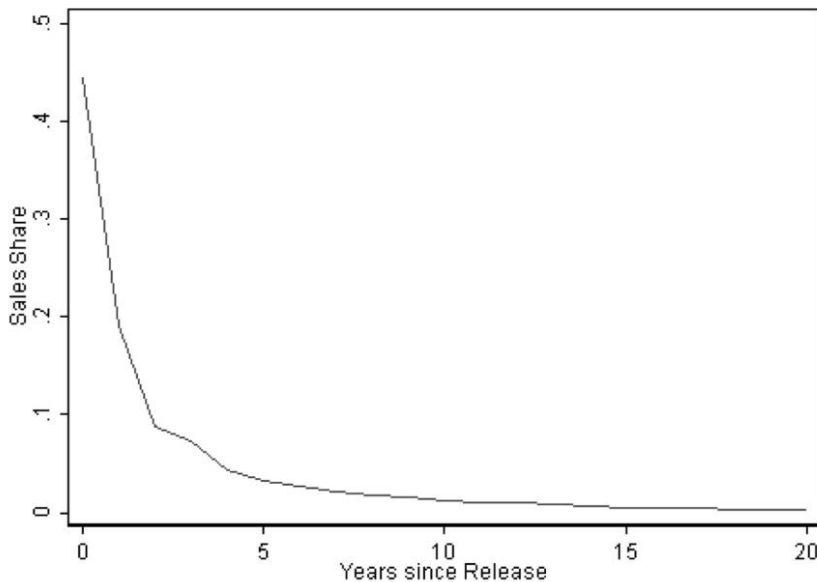


Figure 6. Distribution of certification-based album sales by time since release

about 8, 7, and 5 percent occur 2, 3, and 4 years after the release, respectively. Figure 6 shows smooth decline, in part, because of averaging. But even when data for only a particular year are used, sales decline smoothly with age.

4.3. Empirical Approach for Usage Data

Given the usage data, I can derive an index of the importance of the music from each vintage. To this end, I define $s_{t,v}$ as the share (s) of vintage (v) music in the sales or airplay of music in period t . Suppose that we observe this share for V vintages and T years. For a given year t , s varies across vintages for two reasons. First, music sells less, and is played less, as it is older, thereby reflecting depreciation. Second—and this is the effect of interest—vintages are used differently because they differ in quality. My goal is to control for depreciation and to ascertain an index reflecting the quality of each vintage.

I implement this via a regression of the log share on age with vintage dummies. That is, $\ln(s_{t,v}) = f(t - v) + \mu_v + \varepsilon_{t,v}$, where $f(t - v)$ is a flexible function of the elapsed time between the release date of the music and the calendar year t , μ_v is a vintage effect, and $\varepsilon_{t,v}$ is an error term. In particular, if I define $t - v$ as the age of music in integer years (a), then given that I have multiple years of sales data, I can operationalize $f()$ nonparametrically as a full set of age dummies. The index of vintage quality is then the sequence of vintage effects (μ_v). With

the inclusion of a full set of age dummies, the approach identifies the evolution of vintage quality from variation in the log share of $s_{t,v}$ among observations of equal age.

4.4. Structural Interpretation

In addition to its intuitive interpretation, my approach also has a structural random utility interpretation, although my context differs in some respects from the standard product choice model. Normally, one models a consumer choosing among imperfect substitutes—such as related varieties within some product category—and an outside good. In this context, the inside goods are different vintages of music. The difference here is that because of piracy, I do not observe the total size of the market for inside goods. Although sales of recorded music are falling, I do not believe this is happening because recorded music is declining in utility relative to alternatives. Instead, sales are falling because of increased stealing. Because the data on overall music sales are not informative about the value of music relative to its alternatives, I employ the normalizing assumption that the overall appeal of music relative to the outside good is constant over time. In the case of airplay, this normalizing assumption has the behavioral justification that music stations fill an essentially fixed amount of time with music. My regression of $\ln(s_{t,v})$ on the age of music with vintage dummies then recovers the evolution of mean utility with vintage. This is my rationale for describing my vintage dummies as an index of quality.

5. Results

This section presents two groups of results. First, I present my estimates of vintage quality indices, based on both airplay and certification data, which I compare with the critic-based index. I then use all three of the indices to evaluate whether quality has changed since Napster was established in 1999. It is quite difficult to know how vintage quality would have evolved following 1999 in the absence of both Napster and the other technological changes, so I cannot estimate the effect of Napster per se. However, I can quantify the post-Napster experience relative to various counterfactuals. These include that experience relative to levels defined by 5, 10, or N years prior to Napster's creation and the trends implied by the 5, 10, or N years prior to Napster's creation.

5.1. Airplay Data Results

Table 1 reports results of regressions of $\log(s_{t,v})$ by the age of music and with a full set of vintage dummies. Figure 7 reports the age coefficients from a regression with a spanning set of age dummies, along with confidence intervals calculated by clustering standard errors on vintage. The coefficients give rise to a smooth and monotonic depreciation pattern. After 10 years, songs receive

Table 1
Regression Estimates of Depreciation

	Airplay ($N = 235$)		Certifications ($N = 868$)	
	(1)	(2)	(3)	(4)
Age	-.1897** (.0311)	-.1557* (.0616)	-.2515** (.0119)	-.4049** (.0224)
Age ²	.0020** (.0006)	-.0001 (.0026)	.0036** (.0004)	.0140** (.0017)
Age ³		.0000 (.0000)		-.0002** (.0000)
Constant	2.6590** (.5323)	2.6493** (.5381)	-3.3120** (.5955)	1.5280 (1.1789)
N	235	235	868	868
R^2	.99	.99	.77	.80

Note. The dependent variable is the log vintage share in a year. All regressions include vintage fixed effects (coefficients not shown). Robust standard errors are in parentheses.

* $p = .05$.

** $p = .01$.

roughly a quarter as much ($.25 \approx e^{-1.5}$) airplay as during the year they were released.

Figure 8 shows the vintage indices derived from the coefficients on the vintage dummies in the regression specification allowing for a flexible depreciation pattern. The figure also reports the 95 percent confidence intervals based on standard errors clustered on vintage. Quality rises from 1960 to 1970, then falls through at least 1985. The vintage quality index then rises substantially after 2000.

A shortcoming of the airplay data is that they may reflect influences apart from listeners' preferences. In particular, they may reflect either the preferences of program directors or promotional concerns. If, as is plausible, record labels promote only recent music on the radio, then I can avoid this potential bias by excluding observations with recently released music. To this end, I reestimate the models including only observations for which age is greater than 0, 1, or 2. The general pattern of results is the same; in particular, I continue to see the upturn in quality following 2000.

5.2. Certification Data

Table 1 also focuses on album certification data and reports results of regressions of $\log(s_{i,v})$ by age along with full vintage effects dummies, and Figure 9 shows the flexibly estimated age effects. As expected—given the sparse nature of the certification data—the album certification depreciation pattern is slightly less smooth than the airplay pattern. Because of data sparseness, I include all formats (albums, singles, and other media) to increase precision.⁹ Figure 10 shows the resulting vintage quality indices for 1960–2010 based on the flexible

⁹ Results using only album certifications are nearly identical.

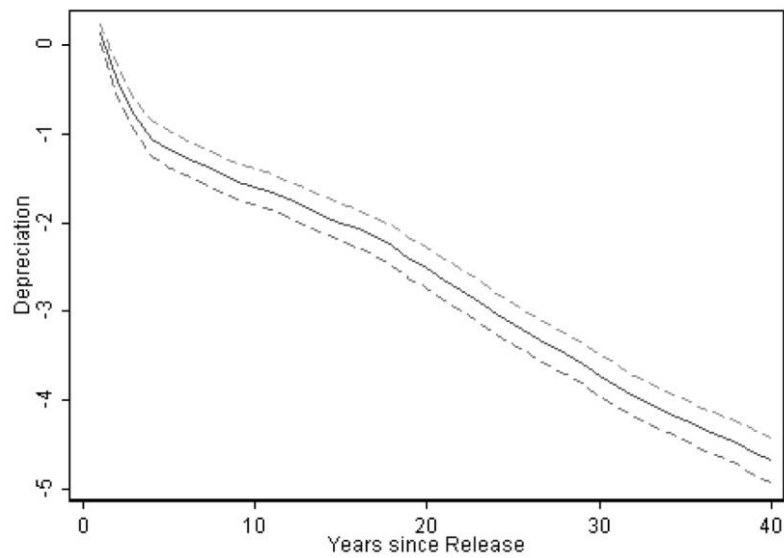


Figure 7. Coefficients on music age from airplay data, with 95 percent confidence intervals

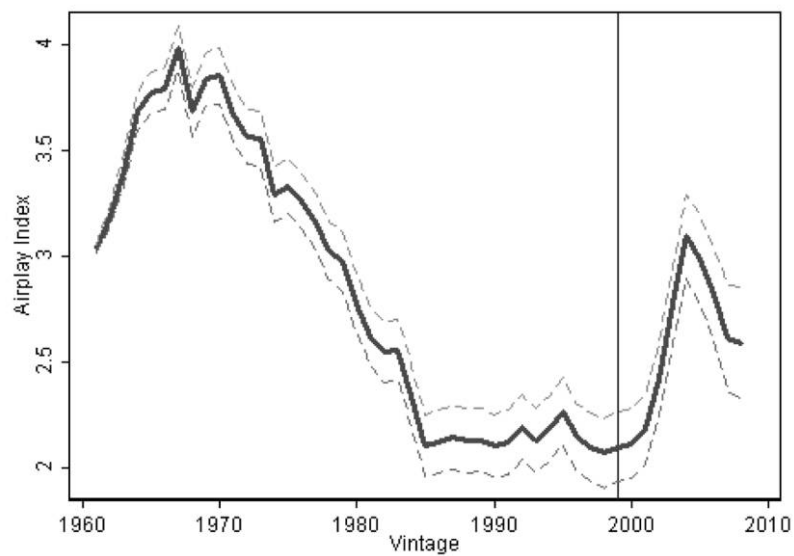


Figure 8. Airplay-based vintage quality index, with 95 percent confidence intervals

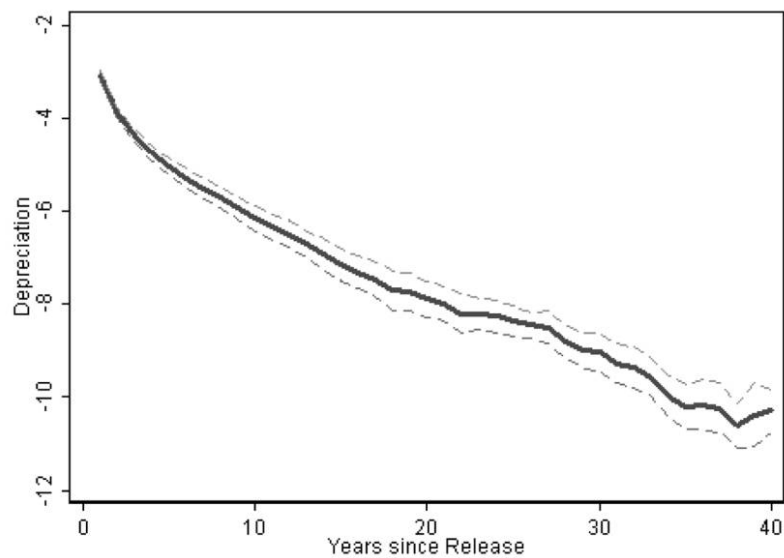


Figure 9. Coefficients on music age from certification data, with 95 percent confidence intervals

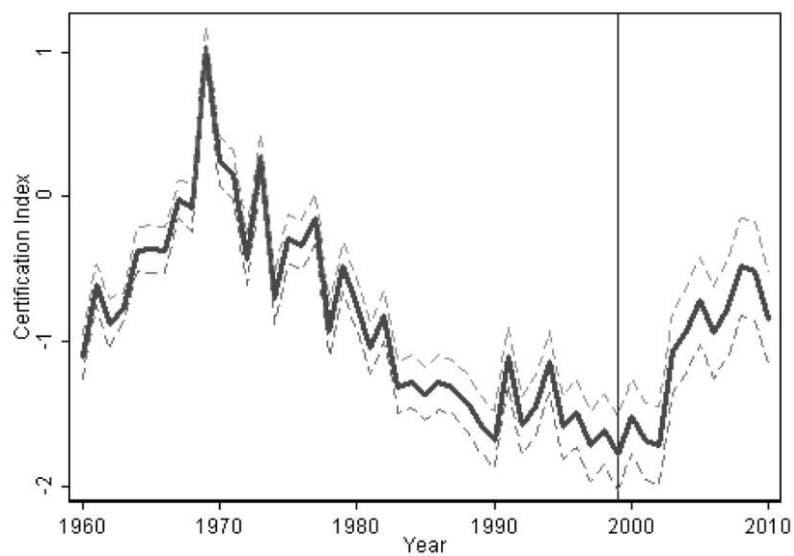


Figure 10. Certification-based vintage quality index, with 95 percent confidence intervals

specification. The resulting index rises from 1960 to 1970, falls until about 2001, then rises thereafter until about 2008.

One might be concerned that the drop in overall recorded music sales after 2000 changes the composition of sales by vintage. To explore this, I reestimate the certification-based sales model using two measures of sales that are less affected by the downturn in overall album sales after 2000. First, I exclude multiplatinum certifications, which become less common after 2000. Second, I examine only singles, whose sales peaked in 2000, decreased through 2003, then increased beyond their previous level. The quality indices resulting from both alternative approaches mimic the baseline result, peaking in 1970, declining through roughly 2000, then rising. Hence, it does not appear that the changed level of sales since Napster's appearance explains the time pattern of the quality index.

5.3. *Post-Napster Changes*

In order to ascertain the effect of the changes in technology surrounding Napster on the volume of high-quality music brought forth by the industry, I would ideally compare the world experiencing the changes to an otherwise similar environment not experiencing the same shocks to demand and supply. Unfortunately, I lack such a control for comparison with my experiment. I can still pursue the more modest goal of asking whether the volume of high-quality music has changed since the advent of Napster using a few different benchmarks.

First, I can ask whether the level of the index changed following Napster's appearance. This comparison is, of course, sensitive to the amount of pre-Napster time included in the calculation, so I perform the calculation with various starting times. Second, I ask whether the time trend following Napster's introduction deviates from the time trend defined prior to it. This approach, too, depends on the number of pre-Napster years used for defining the preexisting time trend. Tables 2, 3, and 4 report the results of these regressions for critic-, airplay-, and certification-based indices, respectively. In each table, the first set of columns shows data for the post-Napster level of an index and its level for various durations prior to Napster's establishment (1995–99, 1990–99, and so forth). The second set of columns shows data for the post-Napster trend and the time trend defined for various pre-Napster periods. Not surprising, in light of the figures already presented, the critic-based index gives a somewhat different result from the usage-based indices.

As Table 2 indicates, relative to the entire pre-Napster period, the post-Napster level of the critic-based index is 23 percent lower, and this difference is statistically significant. The post-Napster critic-based index is below all pre-Napster periods, although the difference is statistically significant only for comparisons with pre-Napster periods beginning in 1970 or earlier. The deviations between the post-Napster trend and the pre-Napster trends (defined with various starting points) are all statistically insignificant. While the post-Napster critic-based index is lower

Table 2
The Post-Napster Critic-Based Album Quality Index Relative to Pre-Napster Levels and Trends

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Post-Napster level	-.2295* (.1099)	-.2026 (.1628)	-.2380 (.1355)	-.1790 (.1177)	-.2849* (.1064)				
Level 1995-99		-.0310 (.1370)							
Level 1990-99		.0116 (.1052)							
Level 1980-99				-.1064 (.0914)					
Level 1970-99					.2631* (.1064)				
Post-Napster trend						.0450 (.0697)	-.0130 (.0430)	-.0196 (.0315)	-.0248 (.0283)
Trend 1995-99						-.0498 (.0406)			
Trend 1990-99							-.0101 (.0160)		
Trend 1980-99								-.0050 (.0067)	
Trend 1980-99									-.0029 (.0045)
Constant	1.9271** (.0458)	1.9312** (.0497)	1.9240** (.0540)	1.9831** (.0663)	1.7194** (.0945)	1.9365** (.0484)	1.9308** (.0518)	1.9434** (.0593)	1.9510** (.0718)
R ²	.09	.09	.09	.12	.20	.09	.07	.07	.07

Note. The dependent variable is the critic-based quality index. Standard errors are in parentheses. $N = 46$.

* $p = .05$.

** $p = .01$.

Table 3
The Post-Napster Airplay-Based Sales Index Relative to Pre-Napster Levels and Trends

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Post-Napster level	-.2231 (.2340)	.4875 (.3277)	.4822* (.2346)	.3790** (.1126)	.0032 (.1944)				
Level 1995-99		-.8151** (.2814)							
Level 1990-99			-.9484** (.1873)						
Level 1980-99				-1.2359** (.0899)					
Level 1970-99					-.9806** (.1944)				
Post-Napster trend						.3223* (.1350)	.2391** (.0747)	.2239** (.0393)	.2032** (.0241)
Trend 1995-99						-.2165* (.0827)			
Trend 1990-99							-.1170** (.0301)		
Trend 1980-99								-.0767** (.0094)	
Trend 1970-99									-.0595** (.0043)
Constant	2.8434** (.1013)	2.9479** (.1007)	3.0866** (.0948)	3.4772** (.0644)	3.5977** (.1705)	2.9097** (.1005)	2.9942** (.0985)	3.2408** (.0822)	3.5293** (.0680)
R ²	.02	.17	.38	.81	.37	.13	.25	.60	.81

Note. The dependent variable is the airplay-based vintage quality index. Standard errors are in parentheses. $N = 48$.

* $p = .05$.

** $p = .01$.

Table 4
The Post-Napster Certification-Based Sales Index Relative to Pre-Napster Levels and Trends: All Recorded Music Products

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Post-Napster level	-.1806 (.2140)	.6206* (.3084)	.4969* (.2295)	.3490* (.1546)	-.0186 (.2049)				
Level 1995-99		-.9157** (.2734)							
Level 1990-99			-.9033** (.1918)						
Level 1980-99				-1.0590** (.1303)					
Level 1970-99					-.6479** (.2122)				
Post-Napster trend						.3955** (.1112)	.2626** (.0595)	.2139** (.0324)	.1818** (.0247)
Trend 1995-99						-.2657** (.0737)			
Trend 1990-99							-.1297** (.0272)		
Trend 1980-99								-.0751** (.0092)	
Trend 1970-99									-.0540** (.0054)
Constant	-.8371** (.0994)	-.7226** (.0966)	-.6112** (.0959)	-.3076** (.0921)	-.3512 (.1838)	-.7627** (.0935)	-.6818** (.0915)	-.4685** (.0815)	-.2424** (.0846)
R ²	.01	.20	.33	.59	.17	.21	.32	.58	.68

Note. The dependent variable is the certification-based vintage quality index. Standard errors are in parentheses. N = 51.

* p = .05.

** p = .01.

than the level prior to Napster, this is largely attributed to the peak that occurred in 1970. Relative to various pre-Napster trends, there is no evidence of a decline in quality in the period since Napster.

Table 3 shows results for the airplay-based index. While the post-Napster level is below the average for the entire pre-Napster period (1960–99), the post-Napster airplay index is statistically significantly above the averages for the decade immediately prior to Napster's appearance. Relative to all pre-Napster trends, the airplay-based quality index has a positive and statistically significant time trend.

Finally, Table 4 reports results for the certification-based index. Relative to the various pre-Napster periods, the post-Napster level of the certification-based index is generally above its pre-Napster level, and the difference is statistically significant relative to all pre-Napster periods (except the periods beginning in 1960 and 1970). Relative to all pre-Napster time trends, the post-Napster trend deviates positively and significantly.

6. Discussion

The lack of decline in music quality following the introduction of Napster is somewhat puzzling against the backdrop of the sharp decline in revenue. It is costly to bring new music to market, and one might share the recording industry's expectation that a sharp reduction in revenue would reduce the amount of new music brought to market. A possible resolution to the puzzle is the observation that while some new technologies have reduced revenue, other new technologies have reduced the cost of bringing new music to market.

Bringing new music to market has three major activities: creation, promotion, and distribution. New technologies have sharply reduced the cost of each of these. Creation entails both composition activity as well as recording, mixing, engineering, and manufacturing. Many aspects of creation were traditionally expensive, but new technologies—including some in use prior to Napster's establishment—have changed this. As Kalmar (2002, p. 73) notes, with the development of digital audio tape in 1987, "a label can set up their own recording studio for about five grand." Costs have continued to decline in the last decade: software such as Pro Tools, which sells for roughly \$100, turns an inexpensive personal computer into a home recording studio (Bell 2010).

Music is an experience good, and consumers need to become aware of music to be interested in purchasing it. Record companies have traditionally made consumers aware of their products by promoting their new releases on radio. Even prior to the availability of the Internet, the labels produced more music than radio stations could air, so the labels paid the stations to promote their music. While the literal practice of payola was outlawed in 1960, labels continued to pay for airplay through independent promoters, and payments for their services were substantial: in 1985 the record labels collectively paid \$65 million for

airplay when the industry's pretax profit was \$200 million. The cost of promoting a hit single was about \$150,000 (Caves 2000, p. 292).

In the past decade, the way in which consumers learn about new music has changed substantially. Where radio used to be the main means for discovering new music, consumers now learn about new music from a variety of Web sources, including Pandora, MySpace, and YouTube. Over half of young consumers (ages 12–34) use the Internet for learning about new music, while only 32 percent use radio, according to the 2010 Infinite Dial study conducted by Edison Research and Arbitron. Just over a quarter (27 percent) of the population 12 and older had used Internet radio in the previous month, and Pandora was the most recognized Internet radio site. Among those who had ever listened to Internet radio, 28 percent named Pandora, followed by Yahoo Music (9 percent), AOL Radio (6 percent), and Last.fm (4 percent) (Edison Research and Arbitron 2010). The Internet appears to have undermined terrestrial radio stations as music promotion channels.

The Internet has also substantially changed music distribution. Many factors, including the need to get a large quantity of physical product into many stores before popularity waned, favored large-scale enterprises prior to the availability of the Internet. Music can now be distributed electronically, thereby eliminating inventory and transportation costs. Using TuneCore's service, for example, an artist can make a song available on iTunes for as little as \$9.99 a year.¹⁰

Some observers have argued that these reductions in costs have made it possible for more smaller scale organizations to bring music to market. Even if major recording labels are now less able to recoup returns from their investments, independent labels may now play a larger role in bringing music to market.

Do the data support the contention that independent labels are bringing forth more of the supply following the advent of Napster? Pitchfork Media's ranking of the top albums of the 1980s, 1990s, and 2000s includes each album's issuing label or, more commonly, a less recognized entity that may be either an independent label or a sublabel of one of the major ones. Using mostly Wikipedia entries, I have been able to code each of the labels on the top 100 albums of each decade as either a major or an independent. This is not a trivial task, as the major owners produce records under a long list of label imprints. The data provide support for the idea that independent labels are playing an increasing role (see Figure 11). While the share of the top 100 on independent labels was 50 percent or less in both the 1980s and the 1990s, it rose to 60 percent in the period since 1999.¹¹ This difference (between the 2000s and the previous 2

¹⁰ In 2010, TuneCore's home page (<http://www.tunecore.com>) indicated that worldwide distribution costs as little as \$9.99 per single per year, \$9.99 per ringtone per year, and \$49.99 per album per year.

¹¹ Pitchfork Media critics' focus on artists they view as interesting likely explains the high share of independent label releases among their most highly rated albums. According to Leeds (2005), independent labels' collective share of recorded music revenue rose to 18 percent (27 percent including indie albums distributed by major labels) in 2005, its highest share in 5 years.

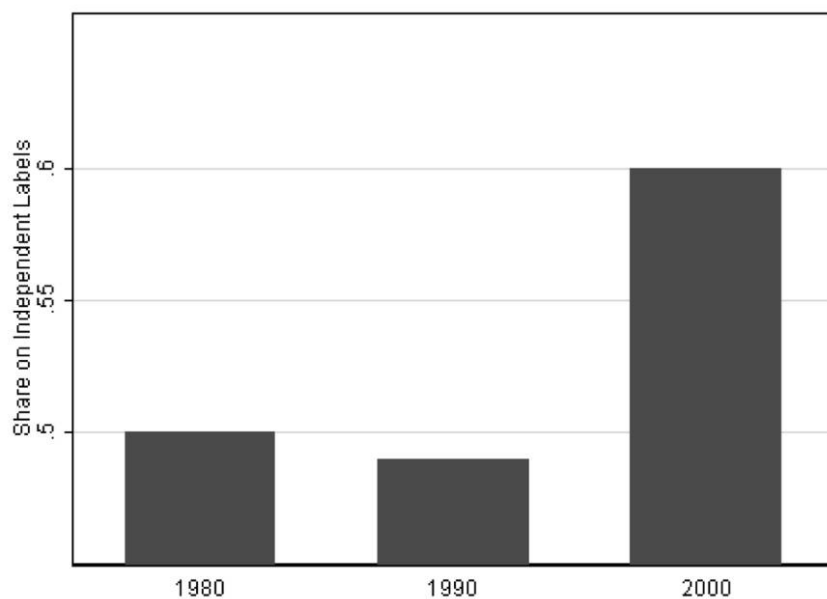


Figure 11. Independent label share among Pitchfork Media's top 100 albums by decade

decades) is significant at the 5 percent level in a one-sided test ($p = .04$). The ascension of independent labels has been noted elsewhere.

Pitchfork Media has disproportionately focused on independent, rather than mainstream, music. It would be useful to see how the independent share has evolved for music reaching larger and more mainstream audiences. To this end I calculate the independent share among the top-selling 200 U.S. albums on the year-end *Billboard* 200 for 2002–10 (see Figure 12). The share of albums on independent labels increased from 1.5 percent in 2002 to 7.5 percent in 2010.¹² The share among the top 100 has increased from 4 to 12 percent. It, thus, appears that independent labels are accounting for a growing share of successful albums, under various measures of success.

7. Conclusion

I have presented evidence, from three independent approaches, showing clearly that the quality of new recorded music has not fallen since the introduction of Napster. While it may well be true that the recording industry has experienced

¹² In addition to reporting year-end top-200 albums by sales, *Billboard* also reports separate lists of the top-selling albums from independent labels, which thereby makes it possible to calculate the share of top-selling albums from independent labels.

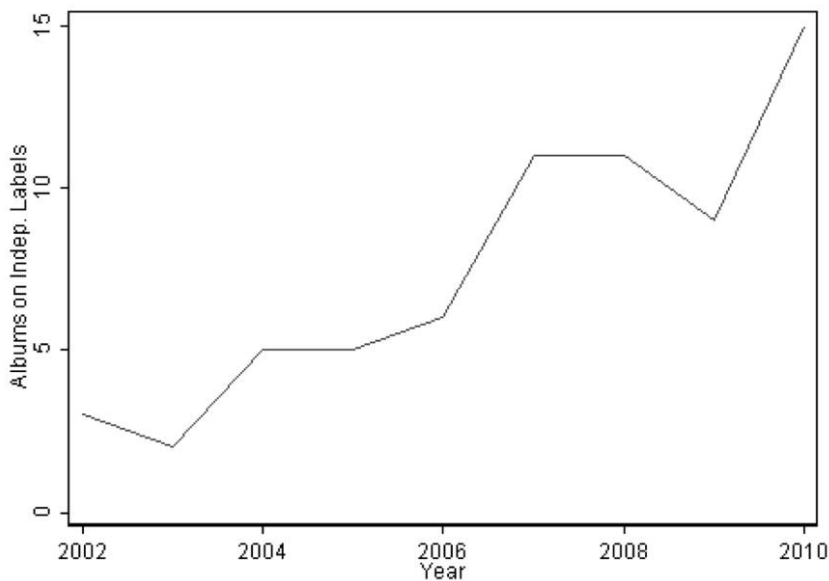


Figure 12. Independent label share among annual *Billboard* 200, 2002–10

substantial declines in its revenue and perhaps its profitability as well, there is no evidence that the quality of new recorded music has suffered from a withdrawal of creative effort.¹³ The flow of products appears to be as strong as before, if not stronger, and a reduction in the cost of bringing products to market may explain this result. Despite these emerging conclusions, two important caveats are in order. First, it is entirely possible that, absent the weakening of effective copyright protection, the other changes in technology might have ushered in an era of even greater creative output. It is impossible to say whether creative output is as high as it would have been without piracy. However, it is clear that creative output in recorded music is as high, or higher, than it was prior to Napster's arrival. While the period since Napster's establishment may be one of unusually low revenue for recorded music (relative to that throughout history), it is not a period of unusually low quantities of consequential output. A second important caveat is that while the supply of new music appears robust despite changes in technology, it is difficult to say whether this finding carries over to other contexts, such as motion pictures, in which bringing products to market is far more costly.

Much of the debate over appropriate copyright policy in the digital era has

¹³ Other explanations besides a reduction in the cost of bringing new music to market are possible. For example, artists facing the threat of piracy or unbundled song sales may have responded with better music.

focused on the effect of Napster on firms' ability to appropriate revenue. Revenue is, to be sure, important for financing the flow of new products, but revenue is a means toward the end of assuring continued production of new creative works. Emerging results on the continued availability of new recorded music products suggest that researchers and policy makers thinking about the strength of copyright protection should supplement their attention to producer surplus in creative industries with a concern for consumer surplus as well.

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