Statement before the Committee on the Judiciary Regarding HR 848, "The Performance Rights Act"

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I am an academic economist with an interest in the economic impact of new technologies, copying and the creation of intellectual products. I have been studying the economic effects of unauthorized copying since approximately 1980 when the Canadian government asked me to investigate the impact of photocopying on publishers. I have recently written several papers on the impacts of file-sharing and in that regard have compiled data on record sales which has then allowed me to conduct research on a subject that has played a role in the debate about a performing rights payment for performers/labels—the impact of radio play on the overall sale of sound recordings. I have written two papers on the subject, with one being published in 2004[1] and the other a current working paper. [2]

These research papers were written for academic audiences and I have made presentations of these papers at various academic venues. The 2004 paper was published in a refereed academic journal although the second and more recent paper has not yet been published. These papers were neither commissioned nor paid for by third parties and were supported through my university, as is typically the case for academic work.

My conclusion, in a nutshell, is that there is no evidence to support a view that radio broadcasting has increased the overall sales of sound recordings. I have looked at several

[1] Liebowitz, Stan J. "The Elusive Symbiosis: The Impact of Radio on the Record Industry" *The Review of Economic Research on Copyright Issues* 2004, Vol. 1, pp.93-118.

[2] Liebowitz, Stan J. "Don't Play it Again Sam: Radio Play, Record Sales, and Property Rights" (January 5, 2007). Available at SSRN: http://ssrn.com/abstract=956527

important historical changes in music broadcasting to see what the impact of those changes was on record sales and found no evidence to support a claim that radio broadcasts increased record sales. I also have performed a statistical examination of record sales and radio play using recent data on American cities and again found no support for the claim that radio play enhances overall record sales.

It is important to emphasize that I am interested in the *overall* sales of sound recordings because I need to distinguish between radio's impact on the sale of individual sound recordings that are frequently broadcast, versus its impact on the entire market for sound recordings.

I fully agree with the claim made by the radio industry that radio airplay can increase the sales of records that are in heavy rotation at stations. Nor do I disagree with artists and record producers who think that radio airplay is important for increasing the sales of their sound recordings.

But it is easy to confuse radio's impact on the sales of individual sound recordings from radio's impact on the entire sound recording market. Radio broadcasts, by way of analogy, appear to increase the size of the individual pieces of the sound recording pie. But that is very different from saying that radio increases the size of the pie, which is the true question of interest. From what I can tell, the radio industry appears to want to keep the confusion level on this point as high as possible.

Individual vs. Overall Impacts: The Fallacy of Composition

The technical term for incorrectly drawing conclusions about a whole entity from looking at the individual components is "the fallacy of composition." One simple example: anyone who stands up at a crowded basketball game gets a better view; but if everyone stands up, no one has a better view and everyone is less comfortable. Another example that is more topical today: Any individual household that decreases its spending and increases its savings has its wealth increase; if every household does this at the same time, however, the economy goes into a tailspin and we are all the poorer for it.

The way this fallacy of thinking would work in the case of radio play of music is quite simple. When a song is frequently played on the radio, audience members become familiar with it and some listeners may decide they like it enough to purchase it for those times when they listen to purchased prerecorded music. Radio play is clearly important for deciding how to allocate the slices of the prerecorded music market pie. Does this mean that radio must have a positive effect on the entire sound recording market, which consists of sound recordings, some of which are broadcast and others of which are not? Not at all.

The time that individuals spend listening to the radio is time that could have been spent listening to prerecording music. According to the US Statistical Abstract (Table 1089) the time people spend listening to the radio (over two hours per day) is four times as great as the time they spend listening to prerecorded music (30 minutes per day). If radio did not exist, many of these individuals would likely be listening to prerecorded music in place of the nonexistent radio, since the two are substitute activities.

To clearly understand this, imagine a world where automobiles could not receive radio signals. Drivers and passengers would then have the option of listening to the sound of the car's tires on the pavement, or alternatively, listening to some prerecorded music on a tape, iPod, or CD. Faced with that choice, most automobile occupants would prefer to listen to prerecorded music. Since the average person spends an hour a day listening to the radio in automobiles, transforming this hour from radio to prerecorded music would lead to a very large increase in the amount of time listening to CDs, perhaps tripling the amount of time that average individuals currently spend listening to prerecorded music. If everyone tripled their time spent listening to prerecorded music, they would almost certainly increase their purchases of prerecorded music so that their current library didn't become stale. That is how radio can damage the sales of prerecorded music. And that is looking only at automobile listening.

Thus, on a purely theoretical level informed by usage statistics, it seems reasonable that radio broadcasting would hurt record sales. Naturally, the next question is whether the empirical evidence supports a view that radio increases record sales or decreases record sales.

There has been very little in the way of empirical examination of this issue. Industry studies seem focused on whether radio influences the sales of individual sound recordings that are broadcast, but this is an irrelevant question for the determination of radio's overall impact on record sales.

Prior to a recent NAB commissioned study, there were only the two academic studies that I have written examining the overall impact of radio on the sound recording industry. These studies used entirely different approaches.

Evidence from the History of Music Broadcasting in the U.S. and the U.K.

The first study, published in 2004, took a look at some natural experiments that could shed light on whether radio increased record sales or not. In principle, experiments could answer this question fairly unambiguously. For example, if radio broadcasters went on strike for 6 months in half of the country, we would have a wonderful natural experiment to test whether record sales increased or decreased in those areas without radio airplay relative to those areas with radio airplay. Unfortunately, we don't have any natural experiments as clean as that, nor will the radio industry shut down if asked by economists hoping to answer this question. Thus we need to search for circumstances that might provide a similar test.

In my 2004 paper I looked at two circumstances where there was a large change in radio broadcasting, to see what the impact was on the sales of sound recordings. Neither of these historical events can be thought to provide results as clean as those that would come from the experiment suggested above, but hopefully we can learn something useful.

The first experiment I looked at was the introduction of radio in the United States during the decade of the 1920s. Sound recording sales were surprisingly robust and large prior to the introduction of radio. In fact, sound recording sales, in inflation adjusted dollars or as a percentage of average disposable income, were at a level in 1922 that was about the same as the level that would later exist in the mid to late 1950s.

What I found was that record sales dropped by almost half during the early and mid 1920s, in spite of a robust economy, which was at the same time that radio broadcasting started to make important inroads in American entertainment activities. Record sales continued to drop during the depression, at the same time that radio kept increasing its

market penetration, with a total decline in sound recording revenue of over 90% by the 1932. Although much of this overall decline is likely due to the depression (and there are other caveats to these results discussed in more detail in the paper) radio usage actually grew during the depression. Nevertheless, there is certainly no evidence from this time period that radio play helped overall sound recording sales.

The second experiment that I looked at was the introduction of rock and roll radio broadcasts in Britain, beginning in the early 1970s. Up through the early 1970s radio broadcasting was controlled by the BBC, a government run monopoly. In the mid 1960s, some enterprising individuals, including some Texan's, anchored boats off the British coast and began broadcasting US style, advertising-based, rock and roll radio, which became known as "pirate radio," with colorful monikers for the stations. In response, the British government passed a law outlawing the practice of doing business with these stations, effectively pulling the plug on the business model of these stations. The government also rethought its radio regulations. After some government commissions provided reports on the problem, the BBC promised to start playing more rock and roll and private stations were allowed to compete with the BBC beginning in the early 1970s.

If radio broadcasting increases the sales of sound recording, everything else equal, we would have expected the sales of sound recordings to increase in Britain as a greater number of stations began to broadcast popular music. To control for changes in music, tastes, and technology, I examined record sales in Britain relative to the US. Because the US had an established and vibrant radio community well before that in Britain, the growth of sound recording sales in Britain should have been greater than that in the US, controlling for factors such as population and income.

When I examined record sales in Britain relative to the US, I found no evidence to support the hypothesis that increased radio broadcasts led to increases in record sales.

My conclusion, from these two experiments, was that the hypothesis that radio broadcasts increase the overall sales of sound recordings was inconsistent with the data.

Evidence from a statistical analysis of record sales and radio play

As an outgrowth of a paper that I had written about file-sharing that has since been published,[3] I decided to investigate econometrically whether there was any evidence that radio broadcasting impacted overall record sales in the US in recent years. In this most recent study ("Don't Play it Again, Sam") I examined changes in record sales in 99 US cities over a 5 year period of time (1998-2003) as other factors, such as radio listening (music and talk), Internet usage, income, education and other demographic variables (from the US Census) changed.

My findings were consistent with my earlier studies. Cities that had relatively large increases in radio listening tended to have decreases in record sales and vice versa. In other words, sound recording sales were negatively related to the intensity of radio broadcasting. The measured coefficients were quite large, although the results were of only borderline statistical significance. The coefficients imply that a one hour decrease in listening to music radio, which would be a drop to about half the current level, would increase record sales by .75 albums per person, an increase of almost 30%. This evidence certainly fails to support a view that radio broadcasting enhanced overall record sales.

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[3] Liebowitz, Stan J. "Testing File-Sharing's Impact on Music Album Sales in Cities" *Management Science*, (4) Vol. 54 April 2008, pp. 852-859.

The NAB's Attempts to Refute My Findings"

About six months after I made my study public, but shortly after the MusicFirst coalition web page linked to my study (I found out about the link from a news reporter) the NAB issued a press release criticizing my "bogus" study.[4] At about the same time they hired a consultant (James Dertouzos) to perform a study examining the impact of radio play on record sales. He also used data on 99 American cities with demographic and Internet data from the US Census, although he used some slightly different years than I used. Whereas I used time spent listening to radio as my measure of radio, he used the number of spins. All in all, the general approach he used was quite similar to mine although there were some differences.

His results, however, were diametrically opposed from mine. Whereas I found a negative impact of radio play, he found a positive impact. The results were so different, and the approaches were so similar, that I believe that the difference in results must be due to a data error as opposed to differences in techniques or the years used. There are many sources of data that needed to be combined and many chances for error to slip into the analysis.

I suggested that we exchange data so that we could figure out if there were errors in one or both of our data sets. This has become the preferred approach in economics, with many academic journals now requiring that researchers be willing to make their data available to any other researcher who might request the data, before the journal will agree

[4] "NAB RESPONSE TO BOGUS AIRPLAY STUDY" July 2007, available at: http://www.nab.org/AM/Template.cfm?Section=Search&template=/CM/HTMLDisplay.cfm&ContentID=9729

to publish an article. Nevertheless, in this case, Dr. Dertouzos told me that the NAB was unwilling to provide the data and we have therefore not been able to resolve the differences in our conflicting results. That is the state of the current literature examining the impact of radio on sound recording sales.

Conclusion

Because I do not believe that the evidence supports a view that radio benefits record sales, and because it seems likely that the time people spend listening to radio substitutes for the time they might be spending listening to sound recordings, I believe that radio broadcasting has had a harmful impact on the sound recording industry.

If this harmful impact were just progress, or "creative destruction", meaning that a new technology replaces an old one, like automobiles replacing horses and buggies, I would be all in favor of it. But this is not a productive evolution of markets as much as a usurping of a property right. Radio uses, as its primary ingredient, sound recordings. And radio stations do not need to acquire the rights to those sound recordings prior to broadcast.

If the market were functioning as portrayed in textbooks, radio stations would not be able to use sound recordings as inputs in their business model without acquiring the rights from the owners of sound recordings. Since radio stations generate profits from their use of sound recordings, the rights to broadcast those recordings should be valuable to them. And if radio was harmful to the sales of sound recordings, owners of sound recordings would not be expected to provide those rights without substantial payments.

The fact that record companies have sometimes paid radio stations to broadcast music, a fact that might seem puzzling given all that I have stated, does not diminish the argument above. There are many self published authors. There are some authors who will spend considerable resources trying to artificially boost their sales so they can make a best seller list. But this does not refute the fact that publishers normally pay authors for the rights to publish their commercially viable books. Nor does the fact that many individuals would pay to land a role in a television or movie project, or that sometimes established actors work for very little pay on movies they think will enhance their stature, refute the overall fact that producers generally pay actors to act in their films and television programs.

The payola stories focus on the fact that some record company producers, usually of less well established or perhaps fading acts, will sometimes pay radio stations to have their performers' records played on the radio. At least this is my reading of the few academic studies of the subject. But this ignores the part of the market that we would see if radio stations were required to acquire the rights to the sound recordings. It is like drawing conclusions about the publishing market by focusing only on self published books.

I do not view it as my role here to argue for the proposed law being considered by this committee. I cannot say whether a system based on a performing rights society type of approach would be superior or not to just requiring radio stations to acquire the rights to broadcast the sound recordings. But I can say that it seems far more logical, given what I know of the economic factors involved, to have a system where radio stations are being asked to pay for their usage of sound recordings as opposed to the current system where the radio stations can take their primary economic input for free without the permission of the owners of that input.

The Elusive Symbiosis: The Impact of Radio on the Record Industry

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The impact of new technologies on copyright owners has become a topic of increasing interest in the last few years. Although formerly new technologies, such as photocopying, videorecording, and audiotaping have drawn some consideration from analysts, there is apparently nothing like the threat of several hundred lawsuits against otherwise ordinary citizens, as has happened with MP3 downloads, to attract serious attention.[1]

In this paper I examine an older technology—broadcast radio—and its impact on the prerecorded music industry. Radio might, after all, be considered very much like more recent technologies, such as MP3 downloads or videorecording. In the one case we have producers of records or movies concerned that MP3s or VCRs will damage the markets for sound recordings or movies (television). In the other case we have radio broadcasters freely using sound recordings while possibly taking away business from the record industry. Since radio uses sound recordings as a basic ingredient in its broadcasts, and broadcasts might be a substitute for listening to prerecorded music, one can imagine radio threatening the sound-recording marketplace. Except for the technology, there really might be very little difference between these cases.

Of course, this requires that radio broadcast be harmful to the sound recording market. The potential harm to copyright owners from MP3 downloads or videorecorders is easy to envision, even if the existence of *actual* harm is a contentious empirical issue.[2] The potential harm to copyright owners from a

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[1] Although MP3 downloading and its impact on record sales has been the leading copyright story in the news lately, other issues are waiting in the wings. For example, the new generation of digital videorecorders, currently known as "TIVO" allow users to skip commercials while recording. If such recorders becomes common what would happen to the market for advertising based television, and what if anything would be the appropriate regulatory response?

[2] See for example Stan J. Liebowitz "Will MP3 downloads Annihilate the Record Industry? The Evidence so Far" *Advances in the Study of Entrepreneurship, Innovation, and Economic Growth*, V. 15, 2004, pp. 229-260. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=414162 or Martin Peitz and Patrick Waelbroeck (2003), "Piracy of Digital Products: A Critical Review of the Economics Literature," CESifo Working Paper Series No. 1071, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=466063.

technology such as radio is somewhat less obvious, but nonetheless real. The key is the extent to which radio listening is a substitute or complement for the purchase of copyrighted musical works. If radio listening is a substitute for purchase of copyright works, and if radio broadcasters do not have to pay for their use of these works there is an obvious potential market failure that is essentially the same as for direct copying technologies, with the only difference being that listening to a broadcast is the consumer's replacement for a purchased item, instead of a copy (e.g., MP3) of the original being a replacement. It is, however, a distinction without an economic difference.

Society has not seen radio as a threat from which the sound recording industry needed protection. For example, although the 1995 Digital Performance Right Act for Sound Recordings granted copyright owners of the recordings control over digital audio transmissions, they have no such right if the transmission is a non-subscription broadcast transmission, i.e. traditional radio, which continues its exemption from having to pay for the rights to broadcast sound recordings.[3] The logic of this distinction appears to be based on the claim that there exists a "symbiotic" relationship between radio broadcast and the sales of sound recordings.

For example, Edward O. Fritts, president and CEO of the National Association of Broadcasters, when testifying about proposed Internet radio royalties stated:

> The history of copyright protection for sound recordings reflects a dominant, recurring theme: Congress repeatedly took pains to ensure that the grant of copyright *protection did not affect the symbiotic relationship between the radio broadcasters and the record industry*. Congress recognized both that the record industry reaps huge benefits from the public performance of their recordings by

[3] This is true in the US. Other countries (such as Canada) have property rights on radio broadcast of sound recordings in addition to property rights on the broadcast of the musical composition.

> radio stations, and that the granting of a public performance right could alter that relationship to the detriment of both industries.[4] (my italics)

Of course, it is easy to understand why the president of the NAB would want to suggest that radio broadcasters should not have to pay for their broadcast of sound recordings. Imagine, by way of analogy, television broadcasters arguing that they should be allowed to broadcast movies without paying for the rights.

Nevertheless, the Courts appear to also believe this claim.[5] Judge Cudahy, in writing the Appeals Court decision about Internet radio royalties stated:

> While radio stations routinely pay copyright royalties to songwriters and composers (through associations like the American Society of Composers, Authors, and Publishers and Broadcast Music, Inc. ("ASCAP") and Broadcast Music, Inc. ("BMI")) for the privilege of broadcasting recorded performances of popular music, they do not pay the recording industry royalties for that same privilege. Perhaps surprisingly, this state of affairs, until about ten years ago, produced relatively high levels of contentment for all parties. *The recording industry and broadcasters existed in a sort of symbiotic relationship wherein the recording industry recognized that radio airplay was free advertising that lured consumers to retail stores where they would purchase recordings.* And in return, the broadcasters paid no fees, licensing or otherwise, to the recording industry for the performance of those recordings. The recording industry had repeatedly sought, however, additional copyright protection in the form of a performance copyright.[6] (my italics)

Additionally, academics and other commentators appear willing to believe in the symbiotic relationship, as evidenced in this quote from Edward L. Carter:

> In fact, there is credible evidence that AM/FM streaming benefits sound recording copyright holders: "The economics of AM/FM Radio Webcasting work the same way as they do for over-the-air broadcasting, a symbiotic relationship

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[4] From Congressional hearings on June 15, 2000 before the Judiciary Committee. http://www.house.gov/judiciary/frit0615.htm

[5] Similar phrasing can be found in Canadian Copyright Board decisions and also in arguments put forward in Hong Kong. I have not, however, performed a thorough examination of the degree to which this claim is accepted throughout the world.

[6] Bonneville International. V. Peters October 17, 2003, United States Court Of Appeals For The Third Circuit, No. 01-3720; page 5. Available http://www.ca3.uscourts.gov/opinarch/013720p.pdf

> between the record companies and the radio stations who 'promote these songs to 75 percent of Americans who listen to the radio each day.'" Evidence of online broadcasting's beneficial impact for copyright holders is not contradicted by the fact that the broadcasts are digital because streaming, unlike downloading into a format such as MP3, does not involve creation and storage of a permanent digital audio file on a radio listener's computer.[7]

Although there is much talk about symbiosis between radio and sound recordings, I have seen no reference to actual *evidence* supporting this claim although I address this point in more detail in Section IV.

This question of radio's impact on the recording industry does not appear to have received much if any attention in the modern economics literature. The focus of economists, to the extent that they have examined radio at all, has tended to be on the allocation of spectrum, with several notable papers on the subject.

Yet the impact of radio on the recording industry should be of interest for several reasons. These industries are highly influential on the popular culture and seem to have an importance far greater than their share of GDP. More generally, understanding what happened with previous technologies may help our understanding of the present and future technologies, particularly if we discover that some received wisdom is incorrect. Finally, various regulations and rules, and a form of regulatory property rights—what are commonly called "performing rights"—are based on estimates of the market outcomes likely to arise under free negotiations, and these estimates will be skewed if the impact of radio broadcast is misunderstood by the regulators.

[7] Edward L. Carter, "Promoting Progress or Rewarding Authors? Copyright Law and Free Speech in Bonneville International Corp. v. Peters", Brigham Young University Law Review, 2002, pp. 1155-1179.

I. Some Basic Economics

Americans spend approximately 2.7 hours per day listening to radio but only 40 minutes listening to prerecorded music.[8] Yet the main ingredient of radio broadcasts is prerecorded music, for which radio stations pay very little if anything. If listening to radio were treated like a substitute for listening to prerecorded music (much as blank tapes were treated as substitutes for the purchase of a prerecorded tape by partisans for the RIAA[9]) then simple arithmetic might suggest that five times as many records would be sold if radio didn't exist. Although we shouldn't take the math seriously, the possibility of harm is certainly worth examining.

Radio listening can be thought to have two possible components. One is a pure element of consumption. Listening to music is enjoyable and if a radio station can make musical selections that are in tune with a listener's tastes, the listener can derive considerable satisfaction. The fact that individuals spend, on average, almost three hours per day listening to the radio would seem to imply that there is in fact a rather important consumption element in radio listening. The other possible component of radio listening is most likely something of a by-product to the first. One motive for listening to radio is to learn about new musical compositions to help in the purchase of CDs—a motive based on future shopping plans.

It would seem, based on casual observation, that for most users the first motive dominates the second. It would be difficult to argue that the shopping motive dominates the consumption motive since it seems highly unlikely that individuals would listen to radio for almost three hours per day merely to learn

[8] 2001 data found in the US Statistical Abstract, Table No. 1102. Media Usage and Consumer Spending: 1996 to 2005. http://www.census.gov/prod/2003pubs/02statab/infocom.pdf

[9] See for example Alan Greenspan's testimony in 1983 on the Home Recording Act. Hearings before the subcommittee on Patents, Copyrights and Trademarks, October 25, 1983.

which CDs to purchase for the purpose of improving their listening experience of forty minutes per day.[10]

These impacts of radio broadcast fit neatly into a model that had been previously been created to analyze the impact of copying on the creators of originals. Liebowitz (1981) identified three effects caused by copying: substitution, exposure, and aftermarket effects.

The substitution effect, as its name implies, occurs when someone forgoes the purchase of the original (record) because they have access to an alternative (the copy or in this case, radio play). The substitution effect maps nicely into the consumption motive of radio listening. If a copy or alternative is a replacement for the purchase of an original, demand for the original falls.[11] This cannot help but harm the seller of originals.

The exposure effect occurs when someone makes a purchase they would not have made except for the fact that they were able to sample the product in another venue (listening to a copy or on the radio). This maps nicely into the shopping motive. Note that the exposure effect doesn't necessarily have a positive impact on sales, and thus doesn't necessarily have an impact different than the substitution effect. Learning more about a product prior to purchase may allow consumers to derive greater utility from any single purchase. At any given price, however, they may purchase fewer units because they become

[10] This ignores the component of radio listening devoted to 'talk' which obviously does not normally have an exposure effect.

[11] As long as the seller of the original does not receive extra payment, or indirect appropriation, of the copy when he sells the original, which is the after-market effect. If, for example, everyone makes one tape of each record they purchase, the seller can just raise the price of the record by the amount of value generated by the copy, which rotates the demand curve counter-clockwise. The aftermarket effect is clearly not relevant in the context of radio. See Liebowitz 1981 for a fuller explanation.

more quickly satiated. Producers, therefore, may discover that their revenues fall when consumers can better sample the products.[12]

The exposure effect and substitution effect, therefore, are relevant to our analysis. These two theoretical factors played an important role in the arguments made during the Napster case. The economic experts for Napster argued that individuals downloaded MP3s to *sample* songs (exposure effect). These experts suggested that Napster users would purchase CDs containing the songs discovered through downloading. The experts representing the recording industry, on the other hand, argued that downloading MP3s was undertaken as a replacement for the purchase of the original (substitution effect). The court found the arguments made by the recording industry experts to be more convincing and although the decision was probably the correct one, the empirical support put forward by the recording industry was, in my opinion, no stronger than that put forward by Napster defense.[13]

By way of comparison, the exposure effect seems likely to be stronger in the case of radio than in the case of MP3 downloads. Downloaders were unlikely to just encounter music that they enjoyed since downloaders are required to look for music using a search engine. Radio stations, in contrast, play music not chosen by and often unknown to the listener. The listener's choice of the radio station or program, however, reveals that the listener enjoys the particular genre of music played by the station, increasing the possibility that the listener will encounter new music that he or she will wish to purchase.

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[12] This is a variant of the "chocolate bar" or "light bulb" example sometimes found in textbooks. Increasing the amount of chocolate in a bar, or increasing the longevity of bulbs, holding the price of a bar or bulb constant, has uncertain impacts on the number of units sold and on the total revenues. The elasticity of demand for the now less expensive underlying product (chocolate or light output) determines whether revenues increase or decrease and whether units sold increase or decrease.

[13] The empirical evidence put forward to support the substitution effect was to compare sales in record stores near universities to record stores not near universities, under the assumption that college students were using Napster much more heavily than ordinary record buyers. In principle this test was fine but the results did not support the claimed results. See Stan J. Liebowitz, *Rethinking the Network Economy*, Amacom, New York, 2002 Chapter 7.

The substitution effect, at first blush, seems likely to be stronger in the case of MP3 downloads than for radio play of music due to the fact that downloads provide the listener with a copy of the song that has virtually identical attributes to the purchased version. There would seem to be little reason to purchase the song under these circumstances, leading to a very strong substitution effect. Listening to the radio does not leave listeners with a useable alternative that can substitute for the purchase of prerecorded music.

However, the activity of downloading files seems less likely to be a substitute for listening to prerecorded music, whereas listening to radio is an activity that can substitute for listening to prerecorded music. The three hours per day spent listening to radio are three hours that cannot be spent listening to prerecorded music. Since listening to prerecorded music generally requires the purchase of the prerecorded music, the more time individuals spend listening to radio the less time spent listening to prerecorded music and the smaller the volume of purchases of prerecorded music.

As is often the case, only empirical evidence can tell us what impact radio broadcast has on the market for sound recordings.

II. The Impact of some analogous Technologies

Before turning our attention to the empirical evidence relating radio broadcasts with on record sales, it is instructive to examine several other instances of new media technologies. In this case I briefly examine the impact of two new technologies on the movie industry since this information will be helpful when examining radio and sound recordings.

A. The Impact of the VCR

It is common in this literature, particularly in the more popular press, to encounter the claim that copyright owners always cry wolf when a new

technology appears to threaten the old, only later to discover that the new technology was nothing short of a bonanza. This claim implies that foolish copyright owners misunderstood the new technology and were fortunate to have been thwarted in their attempts to restrict the new technology.

There clearly have been times when the industry was dead wrong about a technology. But that doesn't mean the industry was always wrong.

One often reads pundits pointing out that VCRs were a boon to the movie industry although the industry fought the VCR. This claim is not exactly correct.

The facts are that shortly after the emergence of the video recorder, leading movie producers did bring a copyright infringement case (the *Betamax* case) against the producers of the device. Movie and television program producers viewed these devices as a threat to the industry. It is also true that the sale of prerecorded movies has become a leading revenue source for movie producers.

But the threat posed by VCRs was not based on substitution of viewing videotapes instead of viewing the theatrical release. Nor was it based on the possibility of a homemade videotape substituting for the purchase of a commercially prerecorded tape. Instead, it was based on the fear that videotapes would allow users to time-shift television programs and do so in a way that allowed them to avoid the commercials.

This was a legitimate concern because broadcast television depends on commercials for its revenues and if increasing numbers of videorecorder users were to have deleted commercials, television broadcasters would have lost the ability to pay for the programs and movies that made up their broadcast schedule.

In reality, the likelihood that consumers would have been able to skip many commercials was very low. Since a single machine could not both record and play-back at the same time, it is unlikely that average television households could have used VCRs for any but a small portion of their viewing. For example, the average television household watches almost 7 hours of television per day. Almost half of this viewing occurs during the prime-time period of 7:00-11:00 p.m. and a majority of television revenues are generated during this prime-time period.[14] If the average household prefers viewing prime-time programs during the prime-time period, it could not engage in a great deal of videotaping of prime-time programs unless it owned more than one VCR. At that time, use of multiple VCRs was not envisioned.

Assume, for example, that a household that normally watches 3 hours of programming on Monday evenings cannot watch television one Monday and has taped 3 hours of prime-time programming from Monday's (M) programs. Assume now that there are 3 hours of prime-time programming which members of the household would like to watch on Tuesday night. They would not be able to simultaneously watch the tapes of Monday's programs and record the programs that they would then miss on Tuesday while they were viewing Monday's programs since a single VCR cannot both record and playback at the same time. In other words, it is impossible to time-shift viewing by one day so as to skip commercials if the viewing of tapes takes place during the same time period the programs are broadcast. In fact, if members of the household enjoy watching 3 hours of prime-time television shows every night, as does the average American household, they would have difficulty fitting the three hours of Monday's taped programs into their future viewing unless they increased their television viewing above what it would have been had they not owned the VCR. This is a serious constraint on the size of any time-shifting behavior.

[14] In the Central and Mountain time zones the prime-time period runs from 6-10 pm.

In fact, no great time shifting came to pass and the VCR did not damage the television market. Eventually, it opened up an entire new market—the sale and rental of prerecorded tapes—that proved a boon to the movie industry, as I discuss below.

One of the interesting changes in technology is the current hard-disk based TIVO which allows simultaneous playback and recording, as well as automatic deletion of commercials. Because the TIVO removes the constraint of being unable to play back and record at the same time, it poses a far greater threat to advertising revenues than did the VCR. Television broadcasters have legitimate reasons to be concerned, notwithstanding the lessons from the VCR.

Nevertheless, even the TIVO requires some effort on the part of the viewer. If past history is any indicator, there is every reason to believe that many users will refrain from taking the effort to avoid commercials because the effort will seem too great. That may have to be the best hope of the advertising-based broadcast industry as technology continues to erode the intrusion of commercials.[15]

B. The Impact of Television on the Movie Industry

Television took audience away from the movies. But television also made possible the VCR which allowed the movie rental business to get started, and which has been a boon to the industry. It is sometimes claimed that television, rather than destroying movies, as was originally feared, merely brought a new source of revenues to the party, allowing movie/television producers to gain

[15] There are other defensive actions that can be taken by the broadcast industry, the most important among them making it more difficult for the TIVO to detect when a commercial is on when it is recording in 'commercial-skip' mode. At the moment the TIVO relies on information contained in the broadcast itself to identify commercials.

from the new technology just as the VCR allowed movie producers to benefit from a large new market for prerecorded movies.[16]

Unlike music, movies are usually seen only once or twice, not over and over again, so the very concept of an exposure effect is limited. Also, television cannot broadcast movies without contracting with the copyright owner for permission to do so. This prevents television from broadcasting movies until the owners of those movies decide they want them broadcast, which happens to be long after theatrical release.[17]

Since movies do not appear on television until after they have finished their theatrical run, having a movie broadcast on television cannot possibly enhance the theatrical box office for the movie (i.e., no exposure effect for theatrical revenues) although there might be some exposure effect for the sale of DVDs and videotapes from individuals who watched part or all of a movie on television.

Because of this timing, television viewing of a movie cannot be a substitute for the viewing of that movie in the theaters. Although viewing a particular movie on broadcast television cannot be a substitute for viewing that movie in the theaters, the activity of watching television is an activity that can substitute for going to see a movie at a theater. Thus there is a strong potential substitution effect in the *time* spent viewing, particularly given the large amount of time spent watching television (approximately four hours per day for adults) which precludes the viewer from engaging in other activities at the

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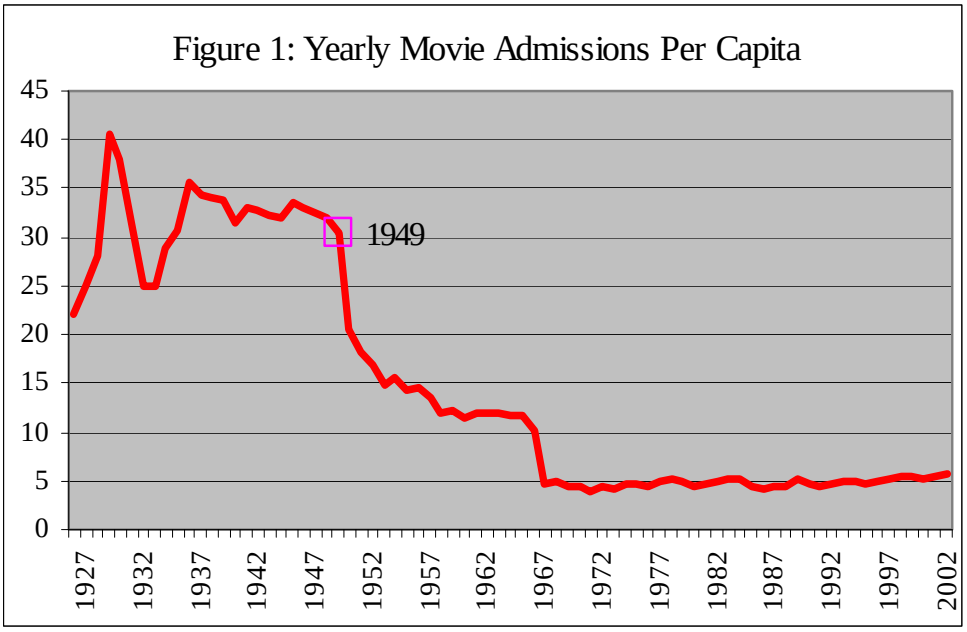
[16] Typical is this statement found in an editorial in May 6th 2002 edition of USA Today "Movie theaters thought television would ruin them. Later, they feared the VCR. If Spiderman 's $114-million weekend is any measure, both predictions were off." See http://www.usatoday.com/news/opinion/2002/05/07/edtwof.htm

[17] Movie studios are masters at price discriminating through different markets over time, going from the high valued consumers (theaters) to video/pay cable and finally to broadcast television. According to Vogel (Table 2.6) a viewing-hour in 1999 generated $4.50 in a theater, $.55 in pay cable/home video, and $.06 on broadcast television.

same, time and which provides a similar, although smaller-scale, form of video entertainment.[18]

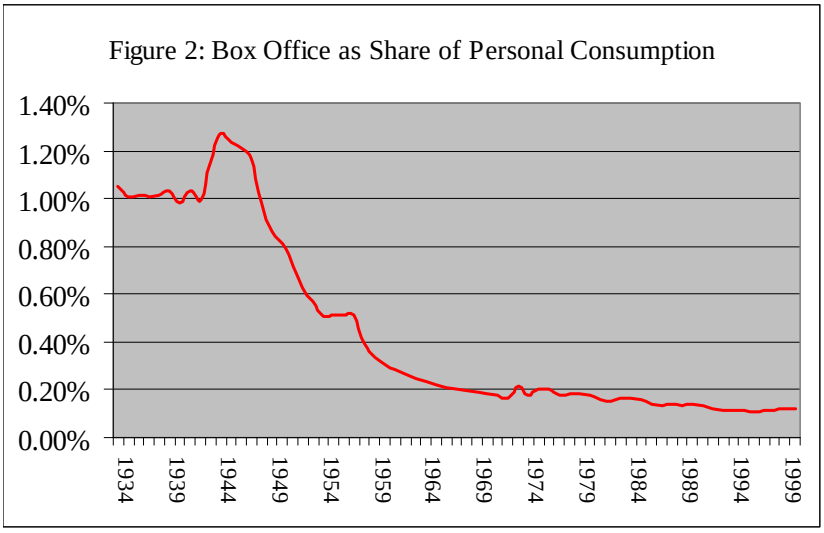
Those who have examined this issue generally understand that television delivered a powerful blow to the movie industry. The movie industry was mature when television became popular in the 1950s and was popular in a way that is hard to imagine today. In the 1930s and 1940s, as revealed in Figure 1, the average American went to the movie theater approximately 30 times per year, compared to the current frequency of approximately five times per year.[19] It is clear that the frequency of movie attendance was far greater prior to television than it is now.



[18] This is likely to become more accurate as the use of large high definition televisions with surround sound become more common.

[19] Source: Screen Source at http://www.amug.org/~scrnsrc/theater_facts.html. There was one problem with the data provided at this source. Values were given from attendance, average ticket price and box office gross. The first two variables, if multiplied together, should equal the third, and usually did. But there were major inconsistencies in the early 1960s and the 1930s. In some cases, the listed attendance figures seemed less reasonable than an attendance figure derived from ticket prices and total revenues. Nevertheless, in Figure 1 I used the listed admissions values since it makes little difference for our purposes and it provides an additional five years of data.

The penetration of television into American households was remarkably rapid during the 1950s, increasing from 9% in 1950 to 87% in 1960. As one can see from Figure 1, that period of time coincides well with a dramatic drop in the number of times Americans went to the movies per week. It also, unsurprisingly, coincides with a large drop in movie box office revenues as a share of personal consumption expenditure, as seen in Figure 2.



The timing of the onset of the new, much lower, equilibrium is another datum strongly supporting the thesis that television viewing caused the change in movie attendance. By 1960, households were spending over five hours per day watching television and by 1965 television's penetration was almost complete at 92% of households. The full effect of television, therefore, should have been felt. At the same time, movie attendance and revenue as a share of personal consumption had entered the modern era which has shown remarkable stability for four decades at approximately 5 viewings per year and approximately .15% of personal consumption expenditures.

Movies clearly have lost much of their market to the activity of viewing television. Although the evidence is overwhelming that television had a

devastating impact on the traditional movie industry in terms of theatrical admissions and revenues, there is somewhat more to the story.

Broadcast television provided the audience and the rationale for the early cable television industry. The cable networks that arose over the years had a superior revenue generation model than broadcast television since cable networks had both advertising and subscription fees as potential sources of revenues whereas broadcast television only had advertising. Eventually, cable television networks largely displaced broadcast television as an important market for movies that had finished their theatrical releases.

Similarly, the advent of the VCR, which was itself dependent on the existence of television sets, allowed the movie industry to tap directly into the view-at-home phenomenon by selling prerecorded tapes. According to numbers in Vogel's text that I have repackaged in Table 1, home-video revenues to movie studios were double those of theatrical release in 2000, and pay-cable/networks/syndication revenues from movies were virtually the same as theatrical release revenues.[20]

Table 1: Vogel's Estimates of Film Industry Revenue		
Theatrical Release	$3,100	19.25%
Home Video	$7,800	48.45%
Pay Cable	$1,600	9.94%
Network Television	$300	1.86%
Television Syndication	$800	4.97%
Made for TV	$2,500	15.53%
$ in millions; Estimates for year 2000; Foreign Revenues Excluded; From Table 2.8, p. 62		

[20] Table 2.8 in Entertainment Industry Economics, 5th edition, Cambridge University Press, 2001. Unfortunately, these data in Vogel need to be taken with a grain of salt since there are apparent inconsistencies. His Table 2.5 implies that Pay Cable revenues are almost as large as home video and two and a half times as large as network and syndicated television added together. Also, his Figure 2.9 implies that Pay Cable is between 15% and 20% of total revenue, much higher than in his Table 2.8.

The invention of broadcast television, which was revenue-depleting to movie studios, opened the door for these later revenue-enhancing technologies. What then is the net effect that television has wrought?

The numbers in Table 1 indicate that these additional sources of revenues might have quadrupled movie revenues beyond their simple theatrical levels if you examine only revenues from films made for theatrical exhibition. If you add in movies that were made for television, revenues quintuple.

Yet box office revenue as a share of personal consumption expenditure is currently at about .12%. This is one eighth the level of the 1930s. Since these additional television related revenue sources appear to be less than eight times current theatrical revenues, one would conclude, using this admittedly back-of-the-envelope level of detail, that the net effect of television on movie revenues is still negative. The impact appears even more negative in comparison to overall entertainment's share of personal consumption expenditures, which rose from 5.5% to over 8% over this period. Movies might have been expected to participate in this growth, if not for the introduction of television.[21]

One final point worth noting is that the policy implications are very different for television damaging the movie business than for, say, MP3s damaging the sound recording industry. In the former case consumers switch to a different, preferred product. The damage to the movie industry occurs because consumers no longer consume movies. There is no market failure. In the latter case consumers continue to consume the same music, but the existence of MP3s cuts off the payment stream that consumer would be willing to pay if property rights were more easily enforced. Disconnecting consumption from payment, as MP3s do, clearly causes a market failure since units of music with net social value will no longer be produced.

[21] Vogel, Page 21.

III. The Impact of Radio on the Pre-Recorded Music Market

This backdrop now brings us to the main topic of the paper: the impact of radio on sound recordings.

At the time of radio's introduction, the idea of transmitting entertainment and news through the airwaves was revolutionary. New institutions and new business models were developed to take advantage of this technological breakthrough, including the idea of using advertising to support the market, which has largely continued to this day.

Radio grew into a major industry, with a profound influence on the culture and social mores. Although it was later to be eclipsed by television, it continues to this day to be one of the major forms of entertainment, with the average American listening to approximately three hours of radio per day.[22]

Radio stations generate positive values to listeners, as evidenced by the willingness of listeners to spend several hours each day listening to radio even though they have to put up with advertising. Advertisers pay for the right to place their advertisements in radio programming, generating the revenues upon which private radio stations depend for their existence.

We have already discussed the two possible impacts that radio might have—substitution and exposure. It is likely that both effects are at work at any one time. The relative strength of each, however, determines the overall impact of radio on record sales.

The prevailing view is that radio play enhances the market for prerecorded music. Much of this view can be traced to the fact that firms in the recording industry carefully cultivate their relationship with radio broadcasters to make sure that radio stations play their recordings. Often, this cultivation crosses

[22] Arbitron claims that 20 hours per week is the average.

over into what is known as “payola”, a pejorative term indicating that record companies are paying radio stations, station programmers, or disc-jockeys to pay particular recordings. This is discussed more fully in section IV below.

As we shall see, the recording industry underwent a devastating decline shortly after the advent of radio. Even some commentators who assign the cause of the recording industry’s decline to radio’s emergence believe that the major impact of radio on record sales changed from substitution to exposure, and that radio now enhances the sales of recordings. For example, according to the BBC website:[23]

> The record industry had spent the first twenty years of the century convincing the public that they needed a source of music in the home but they didn't foresee the possibility that it may be free. Unfortunately, The Radio Corporation of America (RCA) had by the early 1920s started mass-producing commercial radios which, while acoustically inferior, offered a far wider range of news, drama and music. The Record Companies retaliated by drawing up contracts for their major artists, forbidding them to work for this rival medium. This move to limit radio's output was doomed to failure as new vacuum tube amplification rapidly improved reception and sound quality. Record sales plummeted.

Nevertheless, the BBC continues:

> Victor subsequently brought out a machine that could reproduce these [recording] innovations, and the increase in fidelity finally ended the drop in sales….Shortly afterward, players and radios were combined, ending rivalry between media. In fact, the new entertainment conglomerates could now use one (radio) to promote the other (records) and a whole new age of marketing was upon us.

We shall have more to say about this history in the next section.

A. Some Natural Experiments

Determining the empirical relationship between radio listening and the purchase of prerecorded music is not a simple task. If one could design an experiment to test this relationship, one possibility would be to prevent radio

broadcast of music in some randomly chosen localities while continuing it in others and then comparing the sales of records in the areas with and without radio broadcasts of music. Unfortunately setting up such an experiment is not within the capability of this, or probably any, researcher.

Alternatively, if one had sufficiently good data and sufficient understanding of the various exogenous and endogenous relationships, one might design a structural equation system to try to statistically determine the net impact of radio on record sales. Finding sufficiently plentiful and high quality data is a daunting if not impossible task, however, and there are always questions about the validity of any particular structural equation model.

The method I have chosen, therefore, is to examine two natural experiments that allow a before/after comparison of radio's impact on record sales. One natural experiment occurred with the advent of radio in the US, which occurred during the decade of the 1920s and 1930s. The second natural experiment was the belated introduction in the last three decades of the twentieth century of commercial radio into a British market that already had a well established record industry and public broadcasting entity.

Neither of these natural experiments is perfect, but both should be capable of providing useful insights.

B. Radio's Introduction in America

The recording industry was already fairly well established in the US when radio came upon the scene. Radio grew rapidly and became the primary entertainment medium in the country in a fairly short time. The impact of radio on the record industry appears to have been quite dramatic.

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[23] http://www.bbc.co.uk/music/features/vinyl/19201929.shtml

1. A Brief History of the Recording Industry[24]

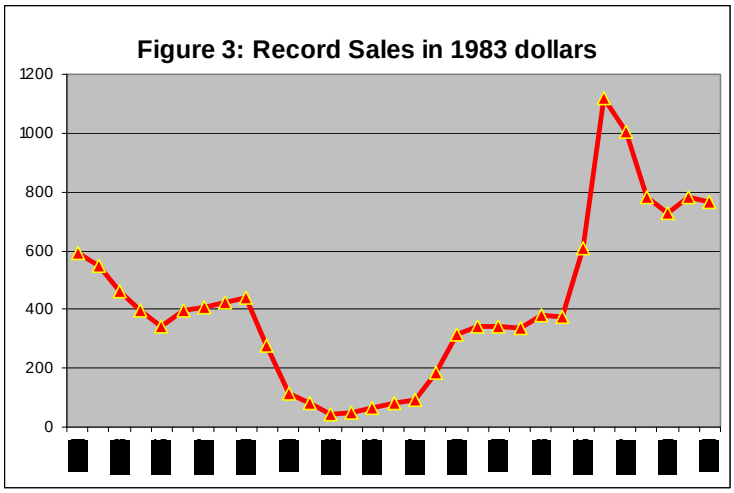
Thomas Edison invented a tinfoil recording process in 1877 which he soon improved by replacing the tinfoil with wax cylinders. To avoid Edison's patents, Emile Berliner developed in the late 1880s a competing recording technology based on discs, which came to be known as the gramophone. A battle between the cylinder and the disc took place over several decades but discs had won the day by 1920. Edison's company introduced its own disc, known as the 'Diamond Disc' with great fanfare and in a precursor to the ubiquitous "is it live or is it Memorex" commercials, embarked on public demonstrations asking the public to guess whether they were hearing live performers or a disc. Supposedly, millions of Americans took this test between 1915 and 1925.

At this time, the recording industry was still engaged in acoustic recording. There were no microphones and no amplifiers. Singers, for example, shouted into a recording horn and the sound energy was converted into a mechanical signal on the disc. In the mid 1920s engineers at Western Electric devised a new method for performers to sing into microphones, which converted the sound into electric currents controlling an electromagnetic record cutter, to produce a recording. These discs were identical in playback format to the old discs and could be played on the older equipment. Many phonographs of the time still reproduced the sound acoustically, without electrical amplifiers.

Statistics provided by the Recording Industry Association of America (RIAA) indicate that sales of records were quite robust in 1921, the first year for which I have data and, ironically, the first year of commercial radio. As shown in Figure 3, sales revenues were almost $600 million in 1921, using 1983 dollars.

[24] Some of the material for this section is based upon David Morton's "Off the Record", Rutgers University Press, 2000 and also from a very nice history that can be found at the BBC's "History of Vinyl" page: http://www.bbc.co.uk/music/features/vinyl/.

To put this value in perspective, sales revenue in 1950 was only 33% higher, in real dollars, and revenue per capita was actually slightly lower in 1950. Thus market for records was fairly mature in 1921, at least in terms of the revenues generated.



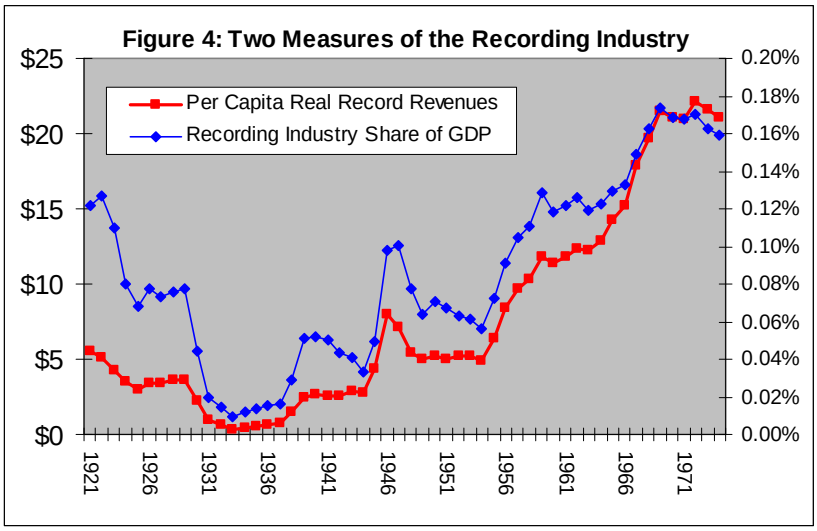
As documented in Figure 3, for almost twenty years after 1921 the market went nowhere but downhill.

The earlier quote from the BBC claimed that the sales decline came to an end when radio and the recording industry equalized quality and learned to take advantage of each other's strengths. In fact, although sales did stop their decline from 1926-1929, they remained well below their 1921 levels. Further, the apparent slight increase in the late 1920s occurred during a period of rapid economic growth when a more rapid increase in record sales might have been expected.

The drop in record sales that occurred after 1929 was far more precipitous than the drop during 1921-25. Clearly the depression must have had a large role in this painful decline, beginning as it did right after the stock market crash. The market for records dropped by more than 90% from 1929 to 1933. But although it is easy to blame most of the drop, or even the entire drop, on

the depression, we should look a little more carefully at other clues that might provide some additional insight before we attribute the entire decline to the depression.[25]

A somewhat different view of the vicissitudes of the recording industry can be gleaned from Figure 4 which measures record sales both as a percentage of GDP and in sales per capita. As can be seen, the fall in record industry revenues was far greater than the fall in GDP, since as bad as the depression was, the 26% drop in GDP was, thankfully, nowhere near the 90% decline experienced by the recording industry.



It is conceivable that extremely high income elasticities for sound recordings were responsible for the decline in record sales being so much larger than the decline in income in the early 1930s, but such elasticities are inconsistent with the decline in record industry revenues that occurred in the 1920s, at a time when the economy was experiencing robust growth (48% from

[25] The BBC history blames the decline entirely on the depression. They state: "If market forces affected the recording industry, the Great Crash of 1929 changed it irrevocably as [sic] leisure items such as electrical items becoming luxury goods. Thomas Edison's cylinders and discs ceased production entirely, while smaller independents were swallowed by new conglomerates that could weather the economic storm… For the first time business interests overtook artistic ones. While pandering to mass markets created a certain dumbing-down in the

1921 to 1928). The elasticities that would be implied if the depression were to be given credit for the entire drop in record sales are also inconsistent with the rather pedestrian improvement in recording industry revenue that occurred in the decade after WWII.

By way of comparison, the movie industry, which suffered a serious decline from 1929 to 1932, came back strongly afterward, matching its pre-depression values (at least in attendance) by 1935, as can be seen in Figure 1.[26] We will see below that radio continued to grow rapidly through the depression. Yet the market for records did not show signs of life until 1938 and even then failed to approach the levels seen in the early 1920s. As Figure 4 makes clear, even then record sales failed to keep up with the growth in the economy since it isn't until after the war that sales return to pre-depression values as measured by share of GDP.

Given this evidence, it seems difficult to blame the entire magnitude of the decline in sound recording revenues during the depression on the macro economy alone. The recording industry appears to have had some other factor(s) hindering its performance, both immediately before the depression and continuing through the depression. The most obvious candidate is the competition from the radio industry.

2. A Very Brief History of Radio

Radio, of course, did not suddenly arise fully formed. There were many experimental broadcasts and many amateur stations. Yet the first commercial American radio station is generally accepted as being KDKA in Pittsburgh, going on the air continuously in November of 1920. Numerous stations went on

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output, the effects of mass-production did result in a large drop in price of records… One very significant part of the market did, however remain buoyant - the Juke-box."

[26] It took the movie industry an additional two years to essentially catch up to total revenue from 1929.

the air in the next few years, and by 1923 the number of stations was over 500, which remained the approximate equilibrium value for the next fifteen years.[27]

The number of homes with radios grew somewhat more slowly. In 1922 it was claimed that 1 million households were going to own radios before year end. In 1926, at the time of the formation of NBC, it was claimed that 5 million households had radio, out of a total of 26 million, for a penetration rate of 20%.[28] The penetration rate of radio appears to have reached two thirds of all households by 1935.[29] Clearly, the penetration of radio largely occurred from the early 1920s until the late 1930s.[30] National broadcasting networks, with their superior production values, arose in the mid to late 1920s.

Not only did people buy radios, they used them. It is a fairly remarkable testament to the power of this new medium that during the depression households would spend the money required to purchase a radio receiver.

3. Interpretation

From 1921 on, the story of radio was one of constant growth for the next two decades. This is the inverse of the recording industry, which had fairly constant decline over this period. There are good reasons to think that this relationship is more than happenstance.

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[27] Reported in Figure 1 in Thomas Hazlett, "Physical Scarcity, Rent Seeking, and the First Amendment" *Columbia Law Review*, Vol 97: 905-944. Hazlett's data are taken from Bureau of the Census.

[28] NBC was created by Radio Corporation of America (RCA), the worlds largest producer of radio sets at the time, based upon a station purchased from AT&T. RCA took out large advertisements in newspapers in September of 1926. In the advertisement it was claimed that at that time 5 million homes had radio, with 21 million yet to have a radio. This would be a penetration rate of 19.2%. A copy of the advertisement can be found here http://earlyradiohistory.us/1926nbc.htm.

[29] According to http://history.acusd.edu/gen/recording/radio2.html.

[30] According to Herman S. Hettinger, the number of radio receivers in the US (in millions) from 1923 until 1932 was: 1.5,3, 4, 5, 6.5, 7.7, 9, 12, 15, 16.68. Table II, page 42 in A *Decade of Radio Advertising*, Arno Press, New York, 1971. From Figure 2 in Hazlett's Columbia Law Review article, a similar, fairly smooth increase in shown.

Listening to radio or sound recordings could both be done at home. The acoustic quality of radio was often better than what was available with early recordings. Sound recordings in the 1920s and 1930s tended to allow only four minutes or so of play on a side before another record would have to be loaded onto the platter, making them fairly inconvenient for listening to music at long stretches. It is not surprising, therefore, that there was a reasonable substitution effect that hurt the market for records.

If there was a strong substitution effect between listening to radio and listening to phonographs then the decline in record sales can easily be explained by the growth in radio. The strong decline in record sales implies that either there was little or no exposure effect, or that the substitution effect was overwhelmingly dominant

The timing of radio's ascendance and the record industry's fall seems more than coincidental. There are some other alternatives that might be suggested, however. The movie industry also was also likely to be substitutes for the consumers' entertainment dollar. Yet there is a stronger case for radio having the major impact. Radio was audio based, as were records, radio was music based, as were records, and radio was listened to in the home, as were records. It is also the case that movie "talkies" began in the mid 1920s and attendance skyrocketed from 1926 to 1929, yet in those particular years record sales were hardly affected as would have been expected if movies were responsible for the decline in records sales that occurred (see Figure 1). Further, the record industry had a dismal performance during the 1930s, yet movies did not grow in that decade—radio did.

Thus the evidence supports a claim that radio was strongly detrimental to record sales during this period.

Others have commented on this possibility as well. According to Morton:

> Record companies welcomed the subsequent transfer of electrical technology from radio and motion pictures to the phonograph industry, but hated the effect these two new forms of entertainment had on the record business. Radio was the biggest threat. On the eve of broadcasting's debut, between 1914 and 1921, record sales had doubled, largely because of sales of popular music. With the inauguration of network radio in the middle 1920s, the market for popular recordings collapsed, resulting in a number of companies leaving the field or changing ownership. Page 26.

The timing of the growth in record sales beginning in 1955 is also interesting although I would hesitate to draw too much from it. Returning to Figure 4, a sustained rise in the fortune of the record industry began at the same time that television began to eclipse radio as the dominant entertainment medium in the country in terms of viewers'/listeners' time. Did the shift away from radio as the premier entertainment medium in the country allow the recording industry to breakout of its longtime doldrums? Perhaps, but some alternative explanations such as the rise of rock and roll, or the rise in the Long Playing record have enough strength as alternatives to preclude a clear affirmative answer.

4. Caveats

Clearly, the imprecision in these data, the fluidity of the content and technology, and the changing market conditions all make it impossible to have a totally clear-cut test of the impact of radio on the recording industry. There are several caveats to make.

a. Quality of Sound

The relative quality of radio and recordings was different in the 1920s than it has been in recent times. Radio, of course, was based on electricity. Radio required electrical amplification and speakers in order to operate. This gave radio an initial advantage over acoustic phonographs in terms of sound quality. Although the sharing of amplifiers and loudspeakers between radio and phonographs was to become common, with the two devices often merged into a

single device, radio at first had sonic advantages. Nevertheless, when recordings increased in quality in the mid 1920s, due to the use of an electrical as opposed to acoustical recording process, there is no evidence of an exposure effect increasing record sales. At best the decline came to a halt for a few years. There is no support for a claim that radio play enhanced record sales.

The relative quality of sound on records versus radio may have been different in 1920s than it was for most of the latter part of the century. Radio, in the second half of the twentieth century, had lower quality than sound recordings. The inconvenience of using records largely disappeared, particularly when the 33 rpm LP record was introduced in 1948 and automatic record changers became more popular. The impact of radio broadcast on record sales in the 1920s and 1930s, therefore, might have changed in later decades.

b. Use of Music

One might argue, with some justification, that radio originally played live music when it played music and that it did not play records. Certainly, many of the popular network radio programs, such as Amos and Andy, did not play records. But there were many radio programs based on music. As long as the music played on radio was also recorded on records, the impact of radio play on record sales should be largely the same as it would be whether or not the specific recordings were played directly on the radio. Further there is some evidence that local radio stations did play records.[31]

Although the role of radio in creating an audience for election returns, horse races and prizefights is the stuff of legend, the mainstay of radio broadcasting was music. Analyses of network radio broadcasts by Hettinger revealed that music made up about two thirds of the content in the period 1927-32. Further breaking down the data, he discovered that popular music

[31] For example, see http://earlyradiohistory.us/1922can.htm.

made up 35%-40% of programs, with semi-classical music at about 15% and variety music at about 5%.[32] Popular music was played more frequently during the prime time hours with the largest audiences climbing from about 25% in 1927-28 to about 54% in 1931-32. Radio programming, even from this early period, was focused on music and particularly popular music, so it is reasonable to expect that the recording industry would be impacted by whatever effects radio might potentially have.

C. The Introduction of Advertising-Based Radio in England

The second experiment occurs at a considerably later period of time, the last third of the 20th century, in England. British radio broadcasting was much different from American radio during the 1950s and 1960s. This is particularly striking given that the two countries had such similar charts of best-selling records. This difference provides the basis for our second natural experiment.

1. A brief history of British Radio

Radio was monopolized for many years in England by the British Broadcasting Corporation (BBC). The BBC was originally (1922) a consortium of six radio manufacturers who were granted a virtual monopoly over the sale of receivers, with the British Post Office overseeing the consortium.[33] These manufacturers wanted to promote the existence of radio stations so that they could sell more receivers, just as RCA did by creating NBC. In return for the monopoly on the sale of receivers, the manufacturers agreed to give ten percent of the revenues from the sale of receivers to the BBC.

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[32] Table XXIII on page 218 in Hettinger. Variety music, according to Hettinger, changed over the period from mainly classical to mainly popular. Variety programs, which also contained much music tended to have about 5% of the programming.

[33] Some of this material is taken from "The Unofficial Guide to the BBC" http://www.vaxxine.com/master-control/BBC/chapters/Bbc_form.html

The BBC became a full-fledged public corporation in 1927, financed by a government tax levied on radio receivers. Being a creature or at least a quasi-creature of the government, the BBC endured certain restrictions on its practices. Initially, due to pressure from the press which was concerned with possible declines in newspaper circulation if radio were to broadcast news, the license provided "that the Company shall not broadcast any news or information in the nature of news except such as they may obtain on payment from one or more…news agencies." For years the BBC would begin its news broadcasts by acknowledging the sources from which they had purchased their information.

There were other restrictions more important for our purposes. There was a 'needle-time restriction', limiting the number of minutes that recorded music was permitted to be played weekly. This was due to agreements with the Musicians' Union—since the BBC employed its own orchestra(s) playing music, allowing the playing of records would have reduced the need for musicians.[34]

As the decades ensued, the BBC lost touch with at least one very important segment of the music listening public—the teenagers of the country. One type of music that it did not program to any great extent was rock and roll. The bottom line is that radio listeners in England had only the BBC to listen to, with its handful of networks, only one of which catered to popular tastes (the Light Programme) and even that station had only a few shows with recordings of popular music. The program that gets the most mention, a show called the "Pick of the Pops," was broadcast only once per week.[35] Since the BBC was the only game in town, listeners were captive to its choice of programming. Unlike

[34] This comes from a history of the pirate radio stations http://radiolondon.co.uk/kneesflashes/stationprofile/hist.html although another history of UK Radio http://dspace.dial.pipex.com/town/pipexdsl/r/arar93/mds975/Content/ukradio2.html suggests that it was record companies that wanted to limit the amount of time that records could be played on radio. The limit on record play, at least in the post-war era, was 37.5 hours per week.

a producer in a competitive market who must cater to the demands of customers, the BBC was free to program what it felt was appropriate.

Competition is a hardy weed, however. Radio competition, disallowed by law, arose in an unusual form—pirate radio stations, which became quite influential in the mid 1960s.

The demand for rock-and-roll was sufficiently large, and the topography of the country was such, that entrepreneurs were able to turn some converted old boats into floating radio stations parked just outside of Britain's territorial waters, with monikers such as Radio London and Radio Caroline. These were advertising-based, for-profit ventures (one was even set up by a group of Texans).

Although it seems impossible to get accurate numbers on the audiences of these stations, they were sufficiently large that the British government, in 1967, passed the Marine Offenses Bill which made it illegal for any Briton to conduct business or interact with the pirate radio stations. This essentially put the pirates out of business.

To appease discontent caused by the shutdown of the pirate stations, the BBC promised to create its own network to play popular records. The stage was also set for the entrance of commercial radio that began in the early 1970s.[36]

2. The Impact of Private Commercial Radio

Private radio stations in England are supported by advertising, thus having the disadvantage of annoying the listener by having to intersperse commercials within the broadcast. Nevertheless, the increase in stations has been

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[35] There was also the Home Service, which was speech based, the Third Programme, which was highbrow, and the World Service which went to other countries.

[36] There is a very nicely detailed history of these events at http://www.icce.rug.nl/%7Esoundscapes/VOLUME06/Fight_free_radio.html

impressive and so too has been the growth in audience. Commercial stations finally achieved the majority of listening hours in 1995.

The impact of private radio stations came in three waves.[37] A small number of private stations were licensed beginning in 1973. The government was reluctant to increase the number of stations until new legislation in 1980. The early 1980s saw another increase in the number of stations. The mid 1990s saw another burst of activity and increase in the number of stations. At first the private radio stations were heavily regulated. Over time these regulations softened.

Some evidence on the historical size of the commercial radio audience can be gleaned by the share of advertising generated by British radio stations. It grew from .24% in 1973 to 2.49% in 1978 where it largely remained until the early 1990s when it began to steadily grow, achieving a level of 6% in 2000.[38]

The end result of this is that historically, British radio audiences have not had the capacity to listen to popular recorded music on radio to anywhere near the same extent as American audiences. Prior to 1967 there was a very great difference in this ability. This difference began to diminish in the late 1960s and early 1970s and then continued to diminish in the 1980s and 1990s.

If radio play significantly increases record sales, then British record sales should have increased significantly relative to American record sales beginning in 1967 and continuing over the next decade or two, holding everything else equal. By comparing record sales in the two countries over these decades we

[37] This discussion is based upon Meg Carter's "Independent Radio: The first 30 years" The Radio Authority, 2003.

[38] These figures can be found on page 57 of Carter. British private radio's share of advertising still appears to be less than the share of other countries. Its share is about one third the US and Canadian level and one half that of Australia (data taken from TVBasics, TVB of Canada, 2003), which might not be surprising given the still very large share of BBC radio.

can test whether radio play increases record sales. Unfortunately, reliable UK data on record sales do not begin until 1973.

Figure 5 examines the ratio of UK/US sales per capita of full-length albums, whether vinyl, cassettes, or CDs. There is no evidence of an upward trend caused by greater radio airplay of popular music.

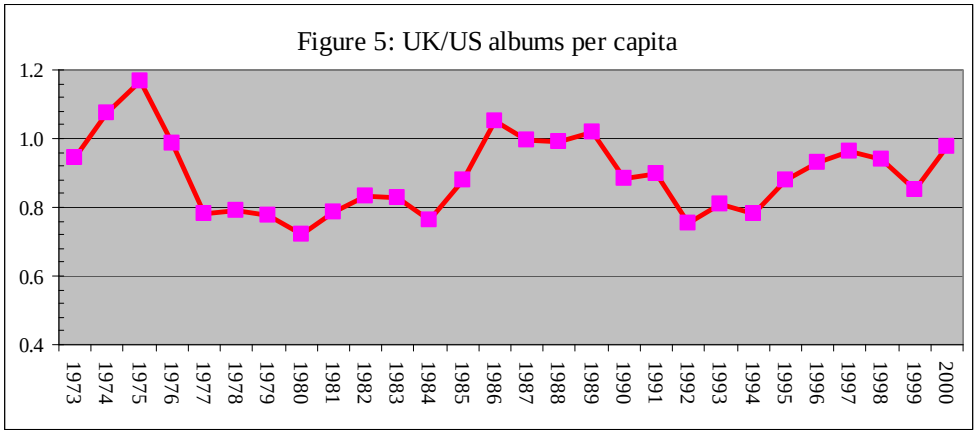
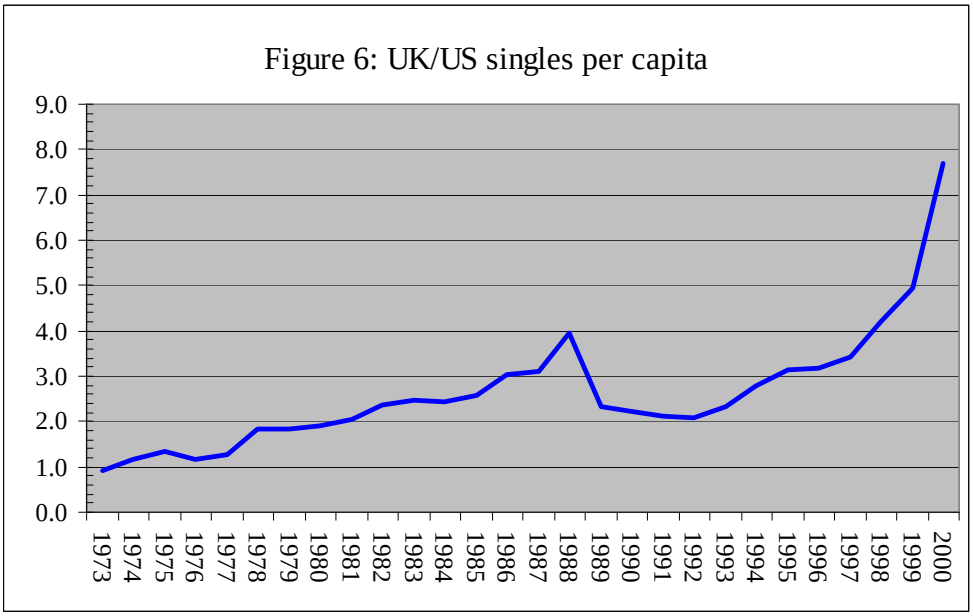
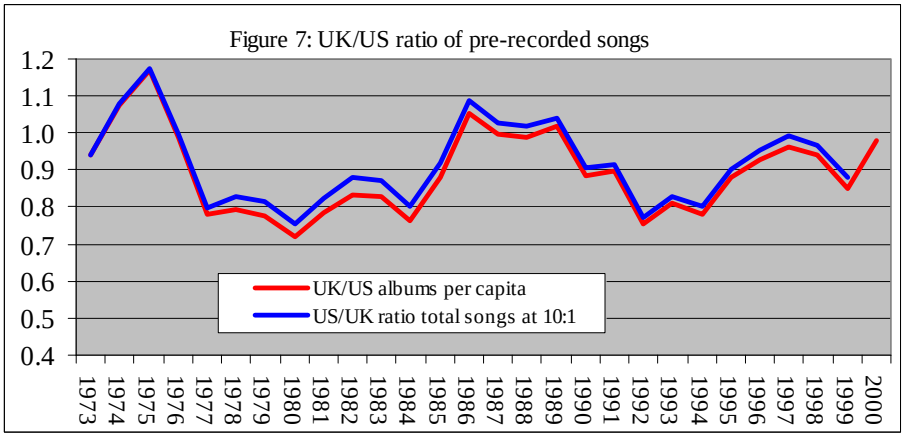


Figure 6 examines the sales of singles, regardless of physical format. Here there might appear to be some evidence for the claim that radio increases record sales since sales of singles increased dramatically in the UK relative to the US. Of course, sales of singles in both countries fell significantly over this period and singles are no longer an important market.



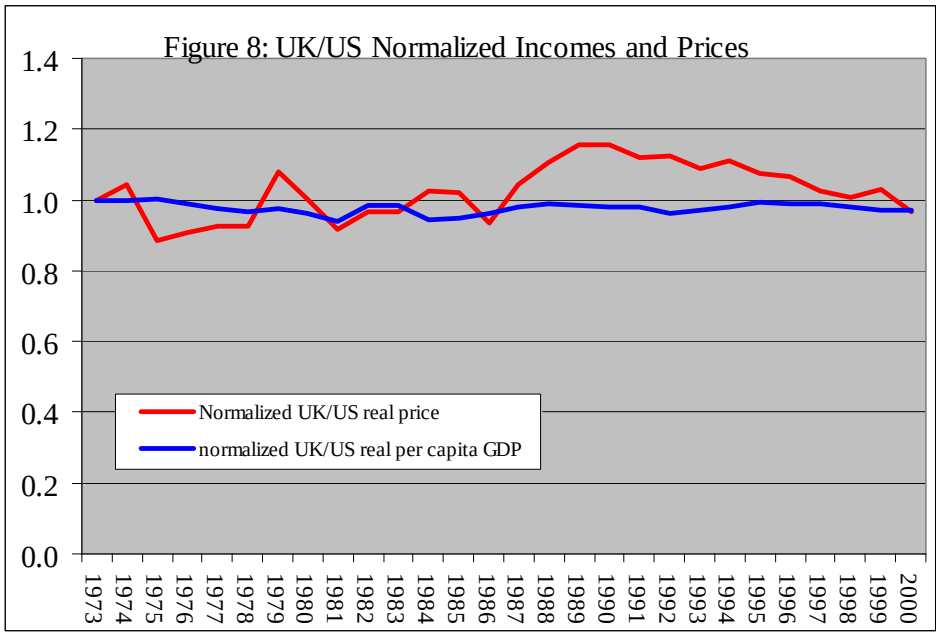
In an attempt to gauge the importance of the increase in UK singles relative to US singles, I assumed that albums contain ten singles and then merged the two series together. Figure 7 presents the results which clearly show that singles have very little impact on the overall market.



These comparisons do not control for other economic variables such as price or income. If by chance the price of records rose in the UK relative to prices in the US, then the quantity sold in the UK would have been expected to fall relative to US quantities. In that case it might still be possible that radio enhanced the market for records in the UK even if the quantity of albums sold

in the UK did not rise relative to the US. Alternatively, if incomes in the UK rose by less than incomes in the US and if record sales are positively related to income, then radio might have had a positive impact on record sales in the UK even though the quantity sold did not rise in the UK relative to the US.

These possibilities are examined, starting with Figure 8. From Figure 8 we can see that changes in both inflation adjusted record prices and GDP per capita were extremely similar between the two countries. Changes in UK inflation adjusted income (GDP per capita) very slightly failed to keep up with changes in US income over this period (2.9% lower over the entire period). Inflation adjusted record prices in the UK increased at a rate very slightly (3.3%) below the US rate although they were above the US rate for much of the period.



With this background it would seem impossible for the impact of price and income to alter the overall conclusion that the introduction of commercial radio had little impact on the quantity of records sold.

Table 2						
	B	Std. Error	t	Sig.	R-squared	Adjusted R-squared
US					0.285	0.222
(Constant)	-2.30E-02	0.021	-1.105	0.28		
Yearly Percent Change in Real Income	2.152	0.722	2.983	0.006		
Yearly Percent Change in Real Price	-0.191	0.273	-0.697	0.492		
UK					0.153	0.082
(Constant)	-9.00E-03	0.024	-0.382	0.706		
Yearly Percent Change in Real Income	1.729	0.868	1.991	0.058		
Yearly Percent Change in Real Price	-0.13	0.307	-0.423	0.676		
Dependent Variable: Yearly percent change in albums per capita						

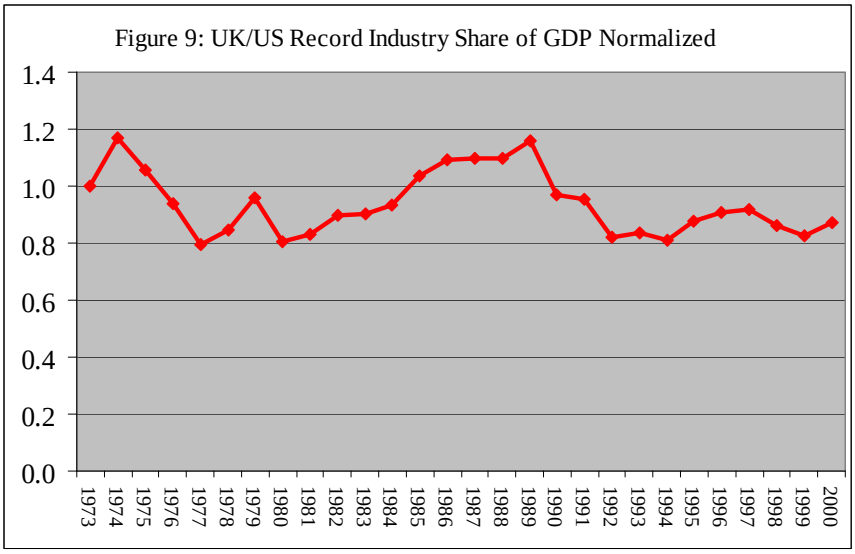
Table 2 presents the results from regressions with the percentage change in per capita album sales as the dependent variable and the percentage change in real price and percentage change in real per capita GDP as independent variables. The coefficient on income is positive and significant in both countries. The coefficients on price in either country are not statistically significant, although they are at least of the correct sign.

In both countries we have an income elasticity of approximately two but with fairly large standard errors. From Figure 8, we know that the relative income changes in the two countries never deviate by more than 5%. At the end of the period, the income change in the UK was less than 3% below that of the US. Adjusting UK sales, which rose 2% less than in the US, for the higher income growth in the US, would leave the UK with a mere 4% increase in sales over the US during a three decade period during which radio play of popular music increased dramatically. Given the standard errors we certainly cannot support a claim that radio play increased sales of sound recordings.

The final piece of evidence concerns the revenues generated in the two markets. By using revenues as the variable of interest we can allow both prices and quantities to vary in the two countries. In order to avoid difficulties often associated with trying to control for exchange rate movements, I calculate the

share of GDP going to the recording industry in the two countries.[39] The results are reported in Figure 9.

Again, we have a result inconsistent with a claim that radio airplay increases record sales. In fact, over these decades the share of GDP devoted to records in the UK fell relative to the share in the US, and the fall was in the vicinity of 13%. This is slightly more lopsided than the other measurements, but still is not a particularly large difference.



The bottom line from this examination can be stated as follows: The introduction of commercial radio in the UK did not increase the market for prerecorded music, contrary to the claims of symbiosis often made in the literature. Although there is some evidence that radio may have harmed sales slightly, the evidence is weak. The most reasonable conclusion would appear to

[39] Although not reported in the text, the 1973 share of GDP devoted to record sales was remarkably similar in the two countries (.14% in both the UK and the US). One could argue that this similarity of ratios indicates that the UK's lack of commercial radio stations in 1973 neither hurt nor hindered record sales, which is not too far from the conclusion I reach in the paper. Differences between the two countries, however, make it unwise to merely compare the absolute shares. The approach taken in the text, to compare the change in relative shares in the two countries, normalizes each country to its specific characteristics (income, tastes, and so forth). As long as these other characteristics remain constant between the two countries, the approach taken in the text is more robust and instills greater confidence.

be that the introduction of commercial radio had a fairly small negative impact on the record industry in the United Kingdom.

This conclusion is supported by statements made by the UK Monopoly and Mergers Commission:

> The broadcasting of records—for instance, the `Top 40' singles or the airing of new product by popular disc jockeys—has long been an important promotional tool for new record artists and products. We were told, however, that the growing quantity of music broadcast on radio has moved towards becoming a substitute for record sales, with a consequent negative impact on such sales. Consumers who want to hear a particular kind of music are increasingly likely to be able to find a radio station that concentrates on it. This can reduce the incentive to buy records, while the growing facility for high-quality home taping may reduce the necessity for such purchases. We were told that these effects had been reinforced by the removal in 1988 of the restriction on independent radio stations which limited them to nine hours of `needletime' per day. We have been told that this trend is likely to accelerate when high-quality digital broadcasts are introduced.[40]

D. Additional Evidence

Intuition can provide some help in achieving an understanding of the impact of radio broadcast on overall sound-recording sales. Americans spend approximately 3 hours per day listening to radio broadcasts.[41]

According to the US statistical abstract, music listeners spend about 45 minutes per day listening to prerecorded (presumably purchased) music.[42] Note that the time spent listening to radio is three to four times as large as the time spent listening to prerecorded music. Without the availability of radio, some consumers who would otherwise have listened to radio would most likely

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[40] Page 79, "The supply of recorded music; A report on the supply in the UK of prerecorded compact discs, vinyl discs and tapes containing music" Monopolies and Mergers Commission; Presented to Parliament by the Secretary of State for Trade and Industry by Command of Her Majesty, June 1994.

[41] According to Arbitron, Americans spent 20 hours per week in listening to radio in the Fall of 2002, which can be found here: http://wargod.arbitron.com/scripts/ndb/ndbradio2.asp

[42] The number is 263 hours per year found in the US Statistical Abstract, Table No. 1102. Media Usage and Consumer Spending: 1996 to 2005. http://www.census.gov/prod/2003pubs/02statab/infocom.pdf

instead listen to more prerecorded music, since that is the closest substitute. If we make the perfectly reasonable assumption that the more time one spends listening to prerecorded music, the more prerecorded music that one will buy, it is easy to see how radio might harm sound-recording sales.[43]

The most clear-cut possibility of prerecorded music sales being harmed by radio is likely found in the activity of listening to music while driving. According to an Arbitron study of in-car radio use, one third of radio listening occurs in automobiles, which works out to about one hour per day.[44]

If radio were not available, the only way to listen to music in automobiles would be to listen to prerecorded music. Alternatives, such as movies, reading, or television are not available while driving. With the alternative of silence, and no other substitutes available, it seem very likely that if radio were unavailable, the one hour per day currently spent listening to radio in automobiles would convert to time spent listening to prerecorded music.

An increase of one hour per day in listening to prerecorded music would more than double the daily amount of time the average person spent listening to prerecorded music. It is hard to believe that such a doubling would not dramatically increase overall sound-recording sales. And this is just for automobile usage of radio.

Looked at in this light, therefore, it is easy to imagine that radio broadcast might decrease the purchase of sound-recordings.

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[43] The advent of cassettes and CDs allowed prerecorded music to became portable for the first time, presumably increasing the amount of time that individuals spent listening to prerecorded music. Liebowitz (2004) demonstrates that the increase in the penetration rate of portable devices coincides with a large increase in sound-recording sales and suggests that causation runs from new uses to increased listening to increased sales. See Stan J Liebowitz "Will MP3 downloads Annihilate the Record Industry? The Evidence so Far" *Advances in the Study of Entrepreneurship, Innovation, and Economic Growth*, V. 15, 2004, pp. 229-260. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=414162

[44] The study can be found here: http://arbitron.com/downloads/InCarStudy2003.pdf

IV. Payola and the Fallacy of Composition

It is fairly well-known that record labels will often attempt to pay to have their records played by disc-jockeys. In fact, there is a special term that has been coined to describe this behavior—payola—and in the 1950s several American disc-jockeys went through well publicized congressional hearings meant to prevent such activity.[45]

The fact that some record labels were willing to pay those in charge of programming radio stations to promote some records might be taken as evidence that radio play must be beneficial to record sales. Yet that would contradict the evidence on record sales reported in the previous two sections. Is there, in fact, a contradiction?

I think not. Although it seems logical to assume that payola means that radio enhances overall record sales, that conclusion suffers from the fallacy of composition—what may be true for individual observations is not necessarily true for the entire group.

An individual record, particularly if consumers are unfamiliar with the creators, will benefit greatly from airplay. An individual record label will benefit if radio stations tend to focus on broadcasting that label's records. The benefit to that recording or label, however, comes at the expense of other records and other labels since increased play of one record must lead to a decreased play of other records. If radio listening is a substitute for listening to prerecorded music, that substitution will occur regardless of which records are being broadcast, unless listeners feel that the quality of records being played has gone down.

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[45] For an in depth history of payola see Ronald Coase "Payola in Radio and Television Broadcasting," *Journal of Law and Economics*, October 1979, 269-328. Coase does not directly address the impact of radio on record sales although he does seem to implicitly believe there is a positive linkage. His main interest is to understand the causes of the attempt to ban payola.

Since radio broadcast of a record generally increases its share of the market it makes sense for labels to try to get their records broadcast. Payola is rational until the marginal benefit from additional payola no longer covers the cost. Radio stations want to maximize their profits, which requires balancing the audience size, which is maximized by playing records that listeners most prefer, against any revenues that might be generated by 'selling' airplay to record labels a la payola. This keeps the radio stations from deviating too far from what listeners would want to hear.

Recordings of the works of well known artists are less likely to need or benefit from payola since radio stations will want to play those records in order to achieve large audiences.[46] It is not unusual for leading stations to be given 'exclusives' over anticipated new recordings for a day or two, although I do not know what the stations 'pay' for this privilege. These are the recordings for which radio stations would be expected to pay large sums for the rights to broadcast if there were property rights in the broadcast of the recording.

It shouldn't be surprising that producers of recordings using little known artists are interested in paying for airtime. This is no different than in many other markets. There are often new entrants into many types of markets and it is not uncommon for new entrants to provide free samples, giveaways, and other devices to try to achieve market share, and that is how payola should be viewed. The media are willing to pay large sums for interviews with major celebrities, whereas minor celebrities are willing to pay to get someone to interview them. It certainly cannot be viewed as indicating that the overall market price of music for performing rights on radio is negative.

[46] Coase reports that payola was favored by small record labels and that large labels (and music publishers prior to that) had attempted to outlaw activities such as payola for many decades. Coase viewed the ban on payola as anticompetitive.

Even if a majority of recordings were found to have negative prices for broadcast rights, this would not necessarily indicate that the overall market price, which is weighted by transaction size, would be negative. Only a small percentage of recordings are successful, and yet the successful ones dominate the revenue in the industry and would also likely dominate the overall market for market-based performing rights payments.

V. Conclusions

The belief that radio enhances the market for sound recordings seems firmly embedded in current regulatory, commercial, and legal thinking. Yet there appear to be no formal studies examining the relationship between the two markets.

I have examined two episodes in which the impact of radio should be relatively easy to observe. The evidence from this empirical examination indicates that, contrary to common beliefs, radio broadcast does not enhance the market for sound recordings.

Clearly, there is room for additional work. But the evidence seems strong enough, and the intuition supporting the evidence seems compelling enough, that a complete rethinking of the economic relationship between these industries, and the laws, regulations, and decisions having to do with the interaction of these industries, seems appropriate.

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Don’t Play it Again Sam: Radio Play, Record Sales, and Property Rights

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Abstract:

This paper undertakes an econometric investigation of the impact of radio play on sales of sound recordings using a sample of American cities. The results indicate that radio play does not have the positive impact on record sales normally attributed to it and instead appears to have an economically important negative impact, implying that overall radio listening is more of a substitute for the purchase of sound recordings than it is a complement. This finding indicates that creating a set of property rights to allow this market to function properly is different than has been suggested by prior research. New technologies affecting radio broadcasts are likely to make this topic increasingly important in the coming years. This research also exposes a fallacy of composition in applying to an entire market a generally accepted positive relationship that holds for individual units.

It is well known that incomplete or missing property rights are likely to lead to wasteful exploitation of resources with their attendant deadweight losses. Coase (1960), of course, taught us that trying to ameliorate such problems through taxes and bounties was not a simple task.

When we think of instances of missing property rights we naturally gravitate toward the well known examples—air and water pollution, wild animals, traffic congestion—found in most economics textbooks. Our concern in this paper is with a case of incomplete property rights associated with a ubiquitous product that the average American uses for approximately three hours per day. That product is broadcast radio.

There are two aspects of the incomplete property rights surrounding the broadcast of recorded music although economists appear to have only been aware of one of them. The missing right recognized by economists is the inability of radio stations to charge owners of sound recordings for the broadcast of those recordings, an activity which is limited by statutes against 'payola'. Sound recording companies cannot legally pay radio stations to play particular sound recordings unless the stations accede to an onerous requirement of announcing the payment each and every time that sound recording is played. This restriction received extensive publicity in the 1950s when Congress held well-publicized hearings on this issue and this where the pejorative term payola, meant to describe payments from record companies to disk jockeys, was born.[1]

The missing property right that has not heretofore been recognized by economists is the inability of sound recording owners to restrict the broadcast of their sound recordings. Simply put, radio stations can broadcast sound recordings at will, with no permission required from the owners of the

[1] A reader interested in the tawdry details of payola can consult either Coase (1979) or Caves (2000). Coase provides detailed documentation about the lengthy history of the practice which existed well before the congressional hearings in the 1950s as well as details from the hearings. Caves covers much of the same information but also provides details of Dick Clark as a peerless payola pioneer that readers of a certain generation may find of interest.

sound recordings.[2] Yet the importance of music to these stations is readily revealed by the fact that radio stations are primarily described by the genre of sound recordings that they broadcast, whether it is Classic Rock, Hot Adult Contemporary, or Cool Jazz. There is virtually no economic analysis of this latter property right.

There have been, over the years, numerous news stories written about payola but only a handful of articles written by economists, among them Coase (1979), Sidak and Kronemyer (1987) and Caves (2000). These economists all lament the lack of property rights in this market, but their view of the missing property right is limited to the inability of record labels to directly pay radio stations, in an unfettered manner, for the possibly valuable promotional component of radio broadcast. These authors seem to have neglected the possibility that payments might also be made from radio stations to record companies for the possibly valuable exclusive right to broadcast certain songs that listeners wish to hear. A well-known analogy exists in the television broadcast market where broadcasters must legally acquire the rights to broadcast television programs owned by others and where broadcasters pay large sums for these rights.[3] The neglect of this possibility by previous economic writers may be due to the widely held belief that radio play is so beneficial to record sales that requiring radio stations to obtain permission to broadcast sound recordings would be irrelevant, in the same manner that a property right for goods that are not scarce would serve no useful role.

[2] Owners of sound recordings in the United States do not have the legal ability to restrict the broadcasts of their sound recordings. In some countries owners of sound recordings have been provided a form of legal 'compensation' where radio stations must pay a fee for the use of sound recordings (with rates usually set by law or supervised by some quasi-judicial organization). Nevertheless, owners of sound recordings are not allowed to opt out of the system and engage in direct negotiations with radio stations, so there is no reason to believe that this system in any way approximates a market outcome. In contrast to the sound recording, radio stations in the US pay a "performance right" for the underlying musical compositions on the sound recordings broadcast by radio stations. The legal distinction is that performance rights payments go to composers and their publishers whereas the recording artist and record company do not receive any payments, although recording artists may be the composers and publishers may be owned by sound recording companies.

[3] The radio stations would need to acquire rights to broadcast particular sound recordings, the same way that television stations need permission to broadcast movies or television programs, and radio stations would be allowed to sell their possibly promotional services of broadcasting records on the radio to record companies.

Before we can write off the possibility that such a property right might in fact have a positive market value to radio stations in some circumstances, however, it would seem prudent to examine the impact of radio play on record sales. If radio play exerted a positive impact on overall record sales, consistent with assumptions, creating such a property right might well be superfluous. If radio play diminishes record sales, however, such a right may well be of value. Such a finding wouldn't rule out the possibility that payments might still go mainly from sound recording owners to radio stations, but it would make it far less likely.

While it seems likely that radio broadcasters can have a profound impact on the success of *individual* sound recordings, it does not appear, as Sidak and Kronemyer have commented, that anyone has empirically examined this proposition.[4] Even if radio broadcast does have the promotional impact on individual recordings normally assumed, it may not hold for the overall impact of radio broadcasts on the sound recording industry as a whole. As discussed below, there is a potentially important fallacy of composition in this market. To my knowledge there has been only a single examination of the impact of radio play on the overall market for sound recordings, Liebowitz (2004), which was a largely historical analysis.

The lack of a property right in the broadcast of sound recordings means we cannot discover the value of the right through direct observation. By way of analogy, we know through direct observation that television broadcasters place higher values on the right to broadcast movies than any possible positive value that movie owners might place on possible promotional impacts of television broadcasts (which, admittedly, seem likely to be negative for movie owners in terms of DVD sales).[5] It is easy to

[4] Sidak and Kronemyer state in their footnote 18: "There appears to be no published study confirming this complementary demand relationship, let alone estimating its empirical magnitude."

[5] Smith and Telang have examine the promotional impact of television broadcast on DVD sales and found it to be positive at the time of the broadcast and shortly afterward although they did not measure the impact on overall future sales. Nor do they examine the impact of television on the entire DVD market (there is ample evidence that the existence of television caused a dramatic decline in overall movie revenues, as found in Liebowitz 2004). Movie

observe that television stations pay positive prices for the rights to broadcast movies, and not vice-versa.[6] If there were a similar market for rights to broadcast music over radio we would know the impact of radio play by direct observation—we could examine whether and how much broadcasters might pay sound recording owners for broadcast rights. But there is no such market to turn to for such observation.

Is there a possibility that at a market based level the majority of the payments could go from radio stations to record companies for the right to broadcast recordings? The results below, where the overall impact of radio play on sound recordings is found to be negative, suggests that such a possibility is real. The currently known payments by sound recording owners to broadcasters might turn out to be similar to slotting fees paid by manufacturers which are common but do not overturn the fact that net monies flow from retailer to manufacturer and not the other way around.[7]

This issue will take on increasing importance in the near future due to a new generation of digital radio receivers—terrestrial, satellite, and Internet based—that are capable of making and storing copies of sound recordings. These receivers alter the typical "streaming" nature of radio, which has historically broadcast songs whose only trace remained in the memory of the listener. The new receivers allow users to automatically record digital songs, providing unlimited playback at the discretion of the user. This technology seems likely to exacerbate any negative impact on record sales from radio play, increasing (or making positive) the market price for the right to broadcast particular sound recordings.

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producers seem to believe that television broadcasts will cannibalize sales and it is hard to imagine that this belief is not correct.

[6] In contrast to record companies, movie owners are able to strictly control whether the station can broadcast the movie, when they can broadcast it, and for what price. Providing geographic exclusivity in these rights to single stations is common. Analyzing the historical reasons for this different set of rights granted to movie owners versus sound recording owners is beyond the scope of this paper, but several possibilities come to mind: 1) there was no copyright on sound recordings until 1971 so there was no right that could be sold and the current situation can be considered a form of grandfathering; 2) the belief that radio was beneficial to sound recording sales implied a zero or negative price; or 3) sound recording firms had less political power vis-à-vis radio broadcasters than did movie owners relative to television broadcasters and thus the sound recording owners were unable to secure for themselves the same set of rights as movie producers.

[7] For more information about slotting fees see Klein and Wright (2007).

There have already been several recent skirmishes between the sound recording and broadcast industries and we can expect more friction as these technologies mature.[8] This would seem, therefore, to be a propitious time to examine the nature of this interaction of radio on sound recordings.

I. A Brief History of Radio and Sound Recording

Radio and sound recordings have largely grown up together, with both industries reaching commercial viability early in the 20th century, although sound recordings came first. Thomas Edison is credited with creating the first sound recording in 1877 with a tinfoil recording process. Tinfoil was soon replaced with wax cylinders, leading to a long-forgotten standards battle between cylinders and disks (the disk system, known as the gramophone was developed by Emile Berliner). Just as VHS came later but nevertheless won its battle with Beta, disks came later but eventually won the day.

The first commercial American radio stations went on the air in late 1920. Numerous stations were borne in the next few years and by 1923 the number of stations was over 500, which remained the approximate number for the next fifteen years (Hazlett 1997).[9] In 1926 the penetration rate of radio was approximately 20%.[10] In those days both radio and sound recordings were more the provenance of the middle and upper classes than the lower class and the overall penetration rate of radio most likely severely underestimates the penetration rate of radio in sound recording households.

The market for sound recordings was surprisingly mature by the time of radio's entrance. For example, a magazine devoted to the sound recording industry (Talking Machine World) was established in 1905 and by 1920 monthly issues were averaging 200 pages.[11] Sound recording sales in 1921 were

[8] I include satellite radio as a species of radio broadcast in this paragraph. An example of this friction can be found in the Washington Post, "Music Labels Sue XM Over Recording Device" Annys Shin, May 17, 2006; Page D01 at http://www.washingtonpost.com/wp-dyn/content/article/2006/05/16/AR2006051601826.html

[9] Reported in Figure 1 in Thomas Hazlett, "Physical Scarcity, Rent Seeking, and the First Amendment" *Columbia Law Review*, Vol. 97: 905-944. Hazlett's data are taken from Bureau of the Census.

[10] See Liebowitz (2004).

[11] See http://www.garlic.com/~tgracyk/tmw.htm.

more than $1.1 billion, measured in 2004 dollars, and the population was only slightly more than one third of the current population.[12] To put this value in perspective, constant dollar sales revenue per capita was actually slightly higher in 1920 than in 1950. An overview of the current music market that also touches on several of the issues raised in this paper can be found in Connolly and Krueger (2006).

Liebowitz (2004) examined the historical relationship between record sales and radio play for two periods: the introduction of radio in the US in the 1920s and the introduction of commercial radio in Britain in the latter decades of the 20th century. In the first instance record sales fell dramatically after the introduction of radio, and in the second case there was no evidence of a positive relationship between increased radio play of popular music and record sales. The current paper is an attempt to more directly and more precisely measure the current relationship between radio play and sound recordings.

II. The Possible Relationships between Radio and Sound Recordings

It is often claimed that radio has a beneficial impact on sound recording sales. While it is incontrovertible that radio can direct demand to particular songs that receive heavy airplay, the impact on individual songs is quite distinct from the impact on the entire industry, although this distinction has not been generally recognized.

The particular details of the overall impact of radio depend on two competing factors. On the one hand, radio allows users to experience new songs that they may not have previously heard. If this were the primary use of radio by listeners then radio could increase overall record sales. On the other hand, the time spent listening to radio is also capable of being a substitute for the time spent listening to prerecorded music. To the extent that broadcast radio is such a substitute, radio would be expected

[12] This number comes from correspondence with the Recording Industry Association of America (RIAA) as reported in Liebowitz (2004).

to harm overall record sales. Radio is capable of delivering both impacts and the relative strength of each would determine the overall impact.

A. What can we learn from statistics on music listening?

The bare statistics on time spent listening to various technological sources of music are informative in and of themselves. The average American spent five times as much time listening to radio per day than listening to traditional sound recordings in 2003, according to the US Statistical abstract.[13] These time-usage values seem incompatible with a hypothesis that radio is used primarily as a means to learn about new music for later purchase, since it would appear infeasible that consumers spend so much more time searching for new music then they spend in the ultimate act of music consumption. These statistics imply that radio is being used largely for its own consumption value.

Certainly, this line of thinking doesn't prove that time spent listening to radio is too long to be pure search, but it illustrates the great likelihood that much and probably most radio listening is a form of consuming music, and if so, radio is likely to be a substitute for the listening to and the purchasing of sound recordings. Understanding the nature of that substitution depends on understanding the nature of music consumption.

B. Music Consumption

Listening to music is a favorite activity for many individuals. The particular forms of consumption are varied, however, and include attending live performances, listening to CDs (or other sound recording mediums), or listening to radio and television broadcasts. Our focus is on the two major sources of music consumption—broadcast radio and sound recordings. These two music sources

[13] Radio (including satellite) is listed at 2.75 hours per day and sound recordings at .5 hours per day. See Table 1116 "Media Usage and Consumer Spending for 2003." The ratio was closer to 3:1 in 1999, before file-sharing began. Available at http://www.census.gov/compendia/statab/tables/06s1116.xls.

satisfy the music listening craving in different ways and each has certain advantages relative to the other.

Sound recordings provide the highest audio quality and also allow particular songs and performances to be ideally matched to an individual's tastes. Broadcast radio, besides suffering from lower audio quality and less perfectly matched music, also suffers from numerous minutes of advertising. Nevertheless, radio has some advantages over sound recordings—disk jockey patter (which many consumers apparently enjoy); broad playlists which allow the consumer to sit back and let someone else decide what to play (which is presumably more useful than a pure randomizer switch since otherwise radio would just use such a switch); and a much lower price since radio is free whereas the legal consumption of sound recordings requires that they be purchased.

These different characteristics provide different strengths for these two sources in catering to the music listening desires of consumers. We can think of two extremes in a continuum of music listening experiences. On the one hand, an individual might wish to listen to a specific recorded performance or set of performances, which we can refer to as "specific" music consumption. Alternatively, an individual might wish to listen to a random selection of performances from a large library of performances (most likely from a particular genre) which we can refer to as generic or nonspecific music consumption. The two types of listening, which are themselves somewhat substitutable, imply different behavior toward radio and sound recordings.

If specific music consumption is desired the individual will need to access the specific sound recordings of interest, either from his personal collection, those of acquaintances, or more general libraries. Once these sound recordings are in the individual's possession, he can easily and quickly listen to the songs in which he is most interested. Radio, by way of comparison, is not an efficient technology for accessing specific songs. Since a song is considered to be in heavy rotation if it is played twice a day,

an individual would need to spend an inordinate amount of time listening to radio before even one desired song was played, to say nothing of a larger collection of songs (note that this is somewhat less true for satellite radio which sometimes has a station devoted to songs from but a single artist, e.g., the Elvis Presley or Bruce Springsteen stations on Sirius Satellite Radio).

Non-specific music consumption is another matter entirely. Radio is particularly good at catering to this desire, with its playlists and large libraries. Individuals can use their personal libraries to also provide a form of non-specific listening, perhaps by telling their CD or MP3 player to randomize the play of songs, or else choosing the music to listen to in a somewhat haphazard manner. Because sound recordings are not free, the music libraries of individuals are usually quite limited in comparison to that of radio stations. The disadvantages of radio are its lower audio quality and the fact that its collection of music is not as closely tailored to the tastes of individual listeners as their own libraries are likely to be. Nevertheless, the relative usage statistics reported above indicate that the disadvantages of radio are overwhelmed by its advantages for a great majority of individuals.

Note that radio and sound recording are substitutes for non-specific music consumption whereas specific music consumption should be dominated by the use of sound recordings. More importantly, radio broadcasts are clearly a substitute for sound recordings in the case of non-specific music consumption but may well be a complement for sound recordings in the specific music consumption category. This latter result is due to the fact that radio can provide information and therefore influence which specific sound recordings are purchased.

This dichotomy between the impact of radio in specific versus non-specific uses of radio broadcasts leads to the potential fallacy of composition. By focusing on the ability of radio to rearrange the position of songs in an individuals ranking of ‘favorites’ the analyst would only measure the positive impact of radio on sales of specific songs without capturing the true market impact.

Because radio and sound recordings compete for non-specific music uses, radio usage will have negative impacts on the sales of sound recordings for non-specific music uses, which appears to be by far the larger of the two uses. In the much smaller category of specific music use, radio will clearly influence the selection of sound recordings and may even increase the number of sound recordings sold. By focusing on the latter interaction of these music sources to the exclusion of the former interaction, previous discussion have ignored the potentially negative impact of radio on sound recording sales. We turn now to an empirical investigation of the overall relationship.

III. Data

In order to perform our analysis we need to merge three data sets together: Arbitron data on radio, Nielsen SoundScan data on record sales, and US Census data for market demographics.

The Arbitron radio data are based upon diaries filled out by respondents, similar to Nielsen television diaries. The data are produced several times a year and currently are found in digital form. We were provided access to their data for 1998 and 2003. Arbitron classifies stations by type and also aggregates groups of stations into approximately 275 (269 and 278 in 1998 and 2003 respectively) Metropolitan Survey Areas (known as Metro Areas) based on the areas in which they broadcast. Some rural residents are left out of the surveys. Arbitron data include information on the average time spent listening to radio in its Metro Areas as well as data on the share and genre of each radio station in an area, allowing a calculation to be performed separating the audiences for music radio and talk radio.[14]

Nielsen SoundScan sells data on record sales (full length albums) by geographic area, genre, and by year. Sales data come mainly from bar code scanners at retail outlets. Online sales are included in these numbers, with customer locations mapped to shipping addresses for physical units or credit card

[14] In 1998 the radio genres which we classified as 'talk' were: News, Religion, Sports and Talk. In 2003 the genres had multiplied and changed, and we classified as talk: All News, All Sports, Educational, News Talk Information, Spanish News/Talk, Sports, Talk/Personality, and Religious. Note that Gospel, although religious, is classified as music.

locations for digital downloads. As a factual matter, digital downloads played virtually no role in the analysis since they were a trivial component of the market even as late as 2003. Nielsen aggregates sales by Designated Market Areas (DMAs) of which there are 210 in the US and everyone in the United States is included in a DMA. We purchased data for the largest 100 largest DMAs which includes approximately 83% of the total population. As we will see below, smaller DMAs provide less reliable data.

The US Census, as part of it Current Population Survey (CPS) undertaken for the Bureau of Labor Statistics, conducts irregular surveys on Internet and Computer use. We use these Census surveys since we wish to control for the important impact of file-sharing on record sales. There was a survey in December of 1998 and another in October of 2003 and these are the two used in the analysis.[15] The surveys provide information on demographic variables such as average household income, age distribution by area, minority share of population, breakdown by gender, internet use, type of internet connection, as well as a host of other variables not used in the analysis. The geographic areas used in the Census are known as Metropolitan Statistical Areas (MSAs) and there are 241 of these areas in our data. As is the case with Arbitron Metro Areas, these MSAs do not include rural residents.[16] Census data are based on responses from individuals to survey questions. The size of the census survey sample (approximately 130,000 nationally) in small MSAs is sometimes insufficient to provide accurate estimates for various demographic data. We try to take account of this problem in the analysis. Arbitron Metro Areas normally correspond to Census MSAs although they are not identical to them.[17]

[15] The control for file-sharing requires that the start date occur prior to file-sharing (1999) and that only one other year be used. For details see Liebowitz (2006).

[16] The Census Data also include PMSAs (primary metropolitan statistical areas) and CMSAs (consolidated metropolitan statistical areas) which are entire or parts of more heavily populated MSAs.

[17] Arbitron states: "Arbitron Metros generally correspond to the Metropolitan Statistical Areas (MSAs, PMSAs, CMSAs) defined by the U.S. Government's Office of Management and Budget. They are subject to exceptions dictated by historical industry usage and other marketing considerations as determined by Arbitron." See page 8.2 of Arbitron Radio Market Report Reference Guide, 2002.

Combining these data sets is not a trivial task. Since Nielsen DMAs are the largest areas and represent larger populations than Census MSAs or Arbitron Metro Areas (even when they all have the same name) we aggregated the MSAs and Metro Areas to match the Nielsen DMAs. This often required adding several MSAs (or Metro Areas) together to approximate the DMA. Arbitron provides a guide to link its Metro areas to the Nielsen DMAs, although the resulting matches are sometimes far from perfect. Matching the Census MSAs to the Nielsen DMAs was based upon examining Nielsen DMA maps (which show the counties belonging to a DMA) and determining which DMA an MSA belonged to based on the county containing the MSA.

The 'matched' Metro Areas and Census MSAs sometimes contained only a small portion of the DMA population, particularly for the DMAs with smaller populations and more rural characteristics. This is because rural households in DMAs are often excluded from Metro Areas and MSAs. For that reason we constructed a variable, "Coverage", which measures the portion of the DMA population replicated by the aggregated MSAs or Metro Areas.[18] When Coverage falls to a low level it is possible that the Census or Arbitron variables, based as they are on MSAs which make up only a small percentage of the DMA population, will not properly reflect the actual population characteristics in the DMA. In the analysis that follows the sample will sometimes be restricted to observations where the Coverage is greater than 60% or 75%, in order to eliminate the influence of potentially misleading measurements.

Although the data from Nielsen SoundScan cover 100 DMAs, one DMA could not be matched with any census MSAs and was dropped from the analysis. Further, missing data for radio listenership

[18] Coverage ratios were calculated for each DMA for both Arbitron and Census data and the lowest ratio for either Arbitron or Census data is used for each DMA. One difficulty in constructing these ratios was that Nielsen populations were based on individuals over the age of 2 whereas Arbitron populations were based on individuals over the age of 12. This required that we used Arbitron listed DMA populations when calculating the Arbitron coverage ratios.

removed another three or four DMAs, depending on year and whether radio was measured as total radio audience or music radio audience.

Table 1: 2003 Values							
Variable	Obs	Mean	Std. Dev.	Min	Max	pop weighted	Rural
College Degree	99	0.204	0.051	0.087	0.345	0.216	0.139
Coverage	99	0.683	0.206	0.203	0.977	0.828	
DMA Population (00,000)	99	23.505	27.275	6.308	194.212	54.835	
Household Income (000)	99	47.966	8.986	20.380	75.895	50.540	38.255
Males	99	0.480	0.023	0.400	0.520	0.482	0.484
Minority	95	0.220	0.138	0.024	0.665	0.269	0.293
Number Radio Stations	95	22.017	4.991	12.287	38.109	25.304	
Old (55+)	99	0.227	0.054	0.130	0.410	0.215	0.250
Share Internet	99	0.613	0.071	0.440	0.740	0.621	0.545
Radio Usage (hrs/day)	96	2.711	0.161	2.371	3.233	2.769	
Music Radio Usage	96	2.298	0.190	1.861	2.976	2.293	
Talk Radio Usage	95	0.417	0.138	0.190	0.750	0.476	
Record Sales per capita	99	2.321	0.440	1.499	3.879	2.445	1.837
Calculated Weights	99	651.593	545.538	17.108	2664.062		
Young (12-29)	99	0.303	0.044	0.200	0.410	0.306	0.288
98-2003							
Change in Variable	Obs	Mean	Std. Dev.	Min	Max		
College Degree	99	0.018	0.040	-0.114	0.208		
DMA Population (00000)	99	1.643	2.361	-0.559	13.845		
Household Income (000)	99	8.523	7.087	-6.660	26.901		
Males	99	0.001	0.035	-0.137	0.143		
Minority	93	0.019	0.054	-0.115	0.186		
Number Radio Stations	96	2.172	7.311	-11.404	65.000		
Old (55+)	99	0.011	0.047	-0.120	0.191		
Radio Usage	95	-0.294	0.104	-0.600	-0.050		
Music Radio Usage	95	-0.323	0.123	-0.623	-0.036		
Talk Radio Usage	95	0.029	0.092	-0.227	0.351		
Record Sales per capita	99	-0.577	0.695	-3.484	1.049		
Share Internet	99	0.310	0.058	0.120	0.466		
Young (12-29)	99	0.001	0.045	-0.110	0.140		

Table 1 presents summary statistics for 2003 and for the change from 1998 to 2003, allowing the reader to infer the 1998 statistics if desired. A person in the average DMA spent 2.3 hours per day listening to music radio and 2.71 hours a day listening to all radio. Sales of full length sound recording albums averaged 2.32 per person per year across DMAs, somewhat less than the average weighted by

population. The combined coverage ratio in the average DMA was 68.3% and the DMA with the lowest values was about 20%, which would be a cause for concern if these observations were accorded much weight in the analyses. The national (weighted) coverage ratio was a more reassuring 82.8%, however. Small cities tend to have lower coverage ratios (the correlation between DMA size and coverage is .44).

As mentioned, the population of the top 100 DMAs represents about 83% of the national population. The MSA (Metro Area) population matched to the DMAs covers about 87% (79%) of the DMA population, so that in total our sample covers about 72% (66%) of the US population. How does the population left out of MSAs compare to the included population? Being more rural, the left out population would be expected to be poorer, have lower Internet usage, and lower education. This expectation is confirmed in the rightmost column of Table 1 where we see that left out individuals have lower Internet use, a smaller share of college degrees, lower incomes, and lower per capita record sales than the included population.

IV. Estimation

Our goal is to determine the impact of radio play on record sales. Our null hypothesis will be that radio increases record sales since that conclusion seems to have been accepted by almost everyone. All of our variables are measured as the per capita value in a city. The dependent variable will be record sales per capita. The key independent variable will be the average time spent listening to music radio. Demographic variables that are likely to influence record sales include income, Internet use, possession of college degree, relative size of age groups (over 55 and 12 through 29), and minority population (black and Hispanic).

We have data for 1998 and 2003. Having data for more than one year allows panel methods to be used and this will be our preferred methodology. The appendix present results from the single-year cross section regressions which provide similar results.

A. Radio Play and Record Sales

Table 2 presents results from running regressions using first differences. By taking first differences we control for underlying differences in the populations and circumstances of cities that do not change over this period and for which we do not have controls, in a manner identical to a fixed effects model.

The table includes regression results over the full 1998-2003 interval where all the variables are in first differences, except for the measurement of Internet usage which will be explained shortly. The dependent variable is the change in albums sold per capita. The various specifications in Table 2 differ from one another as we stratify the observations by coverage ratio and population in order to remove from the analysis observations likely to be less precisely measured.

The first column includes the full sample although these results are most vulnerable to poor measurements and are included more for the sake of completeness than for any information revealed. The second column weights each observation by a combination of population and coverage, so that larger cities are more heavily weighted and cities with greater coverage are more heavily weighted, with the weighting constructed to give approximately equal impact to population and coverage.[19] The purpose of this weighting was to reduce the impact of observations with likely mismeasurement due to low coverage or possible imprecision in the Census numbers due to the sample size being too small to provide reliable statistics. The weighting here is quite severe, with the variation from the highest to lowest weight on the order of over one hundred to one (as can be seen in Table 1). The next two

[19] The weighting was constructed taking the product of the squared coverage and the square root of the population.

columns eliminate observations (giving them a zero weight) when the coverage is less than either 60% or 75%. These cutoffs were chosen as fairly natural indicators of good if not great coverage and more demanding cutoffs would have lowered the number of observations further than deemed prudent, although we will explore the impact of choosing different cutoffs later in the paper. Columns 5 and 6 add in a cutoff for population as well as coverage.

Table 2: First Differences Regression on Change in Album Sales

Change in	Full Sample	Pop & Cov Wgt	Coverage >.6	Coverage >.75	Cov >.6; pop>.6M	Cov >.75; pop>.6M
Daily Per Capita Music Radio (Hours)	-0.0745	-0.7903	-0.7507	-1.1817	-0.6049	-0.7767
	(0.462)	**(0.076)**	(0.169)	(0.126)	**(0.067)**	**(0.056)**
Average Household Income (000s)	0.0087	0.0227	0.0299	0.0368	0.0148	0.0220
	(0.362)	**(0.025)**	**(0.047)**	**(0.086)**	(0.118)	**(0.034)**
2003 Internet Access	-1.5582	-2.7630	-3.4950	-4.5426	-2.7686	-2.5656
	(0.185)	**(0.012)**	**(0.043)**	**(0.062)**	**(0.003)**	**(0.014)**
BA Degree or above	3.1199	4.0142	6.2029	9.0215	-3.2295	0.3713
	(0.162)	(0.172)	**(0.081)**	**(0.080)**	(0.188)	(0.863)
Share 12-29	5.3332	5.2812	9.0277	8.2210	0.6868	0.8054
	(0.077)	**(0.094)**	**(0.022)**	(0.108)	(0.792)	(0.676)
Share Males	-0.8486	-2.4070	-4.6742	-4.9393	1.1555	-0.4517
	(0.721)	(0.329)	(0.159)	(0.196)	(0.452)	(0.774)
Share 55+	1.3197	1.1857	4.9417	1.0563	-0.5910	-1.2845
	(0.568)	(0.581)	(0.144)	(0.784)	(0.775)	(0.413)
Share Minority	-1.0790	-0.2796	0.4427	-0.9315	0.6420	-0.4186
	(0.475)	(0.844)	(0.806)	(0.700)	(0.675)	(0.744)
DMA Population (%)	-0.3810	-0.3324	-0.4518	0.0504	-0.8576	-0.4557
	(0.684)	(0.668)	(0.663)	(0.973)	(0.154)	(0.428)
Constant	0.2827	0.6820	0.9922	1.4393	1.0931	0.7715
	(0.719)	(0.308)	(0.342)	(0.326)	**(0.050)**	(0.145)
Observations	90	90	61	41	53	36
R-squared	0.14	0.20	0.33	0.37	0.25	0.36

Robust p values in parentheses; p value for music radio is for one tail test; bold is sig at 10% level; bold underlined at 5%, bold double underline 1%

Our primary interest is in the coefficients on music radio use. The coefficients are always negative and (excluding the full sample) imply that radio play causes a substantial decrease in the sales of CDs. The coefficients are generally at or near the border of statistical significance if we include 10% as a cutoff. The average coefficient (excluding the full sample) is -.82 but we will round this value down to -.75 in the illustrations below because when the impact of outliers is reduced the average coefficient

falls to -.68.[20] This economic significance of these coefficients tells us that a one-hour increase in usage of music radio, which is somewhat less than one half of the average value, would lead to a decline of .75 sound recordings. Although the confidence intervals around these coefficients are wider than we might like, the implied impact of radio indicates an important economic impact of radio play on record sales since the yearly per capita purchases of sound recordings is about 2.7 over the five year interval. If this coefficient could be applied to the entire range of radio usage, and we will have more to say about this below, the decline in record sales would be very large relative to actual sales. These results are certainly strongly contrary to the normal expectation of a strongly positive impact of radio play on record sales.

Income is always positive, as expected, and usually significant. An increase in household income of $10,000 would lift sound recording sales by approximately .25 units. DMA population has no clear impact on sales.

The Internet variable requires some additional explanation. In the period from 1998 until 2003 file-sharing arose from nothing to become a very popular activity. Liebowitz (2006a) demonstrates that a correct specification for a regression measuring the impact of file-sharing, if file-sharing was zero in the beginning period, would be to use the *level* of Internet use in the later period in an otherwise first differenced regressions. As was the case in that paper, the Internet variable in Table 2 indicates a very strong negative impact of file sharing on record sales, which is consistent with most other studies of the subject (see for example, Liebowitz 2006, Rob and Waldfogel 2006, and Zentner 2006). The impact of file-sharing is less than this coefficient, however, because Internet usage itself can be something of a

[20] I used the built in RREG Stata routine to determine whether weakening the impact of influential observations would change the results. Although the coefficients were slightly lower, the average p values were slightly stronger (.08 versus .10). The RREG routine first eliminates observations with levels of Cook's D that are above 1 and then it iteratively lowers the weightings of observations with large absolute residuals, until a convergence threshold is reached.

substitute for listening to sound recordings as described in Liebowitz (2006a), which controls for this factor and concludes that file-sharing still has a large negative impact on record sales.

The share of the population with college degrees appears to have a positive impact on record sales until small cities are removed. It is also the case that when outliers are made less influential this variable loses its strength. The minority and age group variables do not have much consistency. The coefficient on share of individuals aged 12-29 appears to have a positive impact on record sales, but as was the case with the college variable, the result goes away when small cities are removed or when robustness checks (for outliers) are performed.

Table 3: Concise Regressors on Change in Album Sales

First Differences	Pop & Cov Wgt	cov>.6	cov>.75	cov >.6 pop>.6M	cov >.75 pop>.6 M	Avg
Daily Per Capita Music Radio (Hours)	-0.8091	-1.2560	-1.5237	-0.6347	-0.6931	-0.9833
	(0.065)	**(0.069)**	(0.101)	**(0.033)**	**(0.019)**	**(0.057)**
Average Household Income (000s)	0.0177	0.0194	0.0347	0.0084	0.0201	0.0200
	(0.033)	**(0.079)**	**(0.044)**	(0.320)	**(0.009)**	**(0.097)**
2003 Internet Access	-2.1177	-2.9273	-4.2516	-2.4070	-2.2478	-2.7903
	(0.026)	**(0.053)**	**(0.073)**	**(0.005)**	**(0.018)**	**(0.035)**
Observations	95	61	41	53	36	
R-squared	0.076	0.074	0.137	0.147	0.284	
Robust Regressions						
Daily Per Capita Music Radio (Hours)		-0.7562	-0.7493	-0.7066	-0.6614	-0.7184
		(0.019)	**(0.035)**	**(0.028)**	**(0.055)**	**(0.034)**
Average Household Income (000s)		0.0128	0.0146	0.0142	0.0187	0.0150
		(0.065)	**(0.079)**	**(0.047)**	**(0.024)**	**(0.054)**
2003 Internet Access		-1.9139	-1.7411	-2.1668	-2.0606	-1.9706
		(0.009)	**(0.043)**	**(0.003)**	**(0.015)**	**(0.018)**
Observations		61	41	53	36	
R-squared		0.163	0.169	0.205	0.232	

Robust p values in parentheses; p value for music radio is for one tail test; bold is sig at 10% level; bold underlined at 5%, bold double underline 1%; Constant term not shown.

Due to the relatively small number of observations it is important to try to maximize the efficiency of the estimates. To this end the regressions were rerun using only the variables that appear to actually have consistent and significant impacts—music radio use, Internet use, and income. The

results are found in Table 3. The top half of that table provides the first differenced OLS regression coefficients. The general results are similar but generally stronger than in Table 2. The coefficient on music radio is somewhat larger, averaging -.98 with an average p value slightly below .06. The bottom half of the table provides the results from the robust regressions using Stata's RREG routine to weaken the impact of influential observations.[21] With these regressions the music radio coefficient is about the same as in Table 2 but the confidence interval is narrower.[22]

B. The Nature of the Substitution

We have found that, contrary to received wisdom, increases in time spent listening to music radio do not increase the purchase of sound recordings but instead appear to decrease the sale of sound recordings by an economically large amount. There are two possible explanations for a negative impact. One explanation might be that the time spent listening to radio is time that is taken away from other general entertainment activities and that listening to sound recordings is just one of these activities. The other explanation, which is the one that has been put forward in this paper, is that listening to *music* radio is a substitute for non-specific music listening that might otherwise have used sound recordings.

Fortunately, it is fairly easy to test between these two possibilities. Not only do we have a measure of time spent listening to music radio but we also have a measurement of the time spent listening to talk radio. If the former hypothesis were true, talk radio would have the same impact on record sales as does music radio since time would be the key element of substitution and an hour of talk radio takes as much time as an hour of music radio. If the latter hypothesis were true music radio would have a more powerfully negative impact on sound recording sales than would talk radio.

[21] Stata's RREG routine doesn't allow weighted regressions so the first column is blank.
[22] Although the robust regressions were not shown for Table 2, the average coefficient was .684 and the average p value was .079

Table 4 presents the partial (income and Internet coefficients are not shown) results of concise regressions which include both talk and music radio in regressions otherwise identical to Table 3. The coefficients on talk radio, although generally positive, have large confidence intervals. Certainly, talk radio does not appear to have the same impact or sign as music radio.

Table 4: Concise Regression with two types of Radio Station

	Pop & Cov Wgt	cov>.6	cov>.75	cov >.6 pop>.6M	cov >.75 pop>.6 M	Avg
Daily Per Capita Music Radio (Hours)	-0.6238	-1.1435	-0.4070	-0.8487	-0.6004	-0.7247
	(0.126)	**(0.082)**	(0.364)	**(0.017)**	(0.113)	(0.140)
Daily Per Capita Talk Radio (Hours)	0.3996	0.2398	1.9753	-0.5094	0.1904	0.4591
	(0.598)	(0.842)	(0.212)	(0.319)	(0.735)	(0.541)
Observations	95	61	41	53	36	
R-squared	0.08	0.08	0.17	0.16	0.29	
Test for Equality of coefficients (p-val)	(0.182)	(0.266)	(0.120)	(0.437)	**(0.036)**	

Coefficients for Income and File-sharing Proxy not shown; Robust p values in parentheses; p value for music radio is for one tail test; bold is sig at 10% level; bold underlined at 5%, bold double underline 1%

Because the confidence interval around talk radio is so wide we can only reject equivalence of the two coefficients for one regression specification; the other specifications have p-values ranging from .12 to .44 when the equivalence of the coefficients are tested. Nevertheless, the impact of talk radio certainly appears to be different than music radio and in a manner consistent with expectations. Our conclusion, therefore, is that music radio is a direct substitute for sound recordings independent of the time taken listening to radio. This is really not much of a surprise.

V. Further Checks

A. Outliers and Cutoffs

One possible issue is the impact of outliers. In all instances, beyond those mentioned in the text, the robust regression technique built into Stata were examined and the results were in close agreement

with those presented in the text. The DfBetas for the radio coefficient were also examined and there is no evidence that the results presented are due to a small number of influential observations.

It is also possible that the cutoff points chosen may have inadvertently impacted the results relative to other possible cutoff values. Examining other cutoff values (based on the concise regression specification), as shown in Table 5, reveals that the cutoff values chosen did not lead to unusual results. [Note that as some cutoff values change the number of included observations may not change.] An examination of p-values, found in the bottom half of Table 5, also reveals that the chosen cutoff points in the main text do not provide unusual results.

Table 5: Music Radio Coefficients (and p-values) for Different Cutoff Values

Pop \ Cov	0.5	0.550	0.6	0.650	0.7	0.750	0.8	Average
none	-0.9572	-1.1719	-1.2560	-1.4040	-1.4725	-1.5237	-2.0500	-1.4050
400,000	-0.9289	-1.0739	-1.1722	-1.4040	-1.4725	-1.5237	-2.0500	-1.3750
500,000	-0.9517	-1.0974	-1.2012	-1.4414	-1.5140	-1.6070	-2.1453	-1.4226
600,000	-0.4671	-0.5597	-0.6347	-0.8320	-0.7323	-0.6931	-0.6219	-0.6487
700,000	-0.4632	-0.5597	-0.6347	-0.8320	-0.7323	-0.6931	-0.6219	-0.6481
800,000	-0.3684	-0.4496	-0.5162	-0.6963	-0.6993	-0.6296	-0.5314	-0.5558
Average	-0.6894	-0.8187	-0.9025	-1.1016	-1.1038	-1.1117	-1.3368	-1.00921
p values								
Pop \ Cov	0.5	0.550	0.6	0.650	0.7	0.750	0.8	Average
none	**(0.0945)**	**(0.0805)**	**(0.0690)**	**(0.0555)**	(0.1005)	(0.1005)	**(0.0615)**	**(0.0803)**
400,000	(0.1140)	(0.1020)	**(0.0860)**	**(0.0555)**	(0.1005)	(0.1005)	**(0.0615)**	**(0.0886)**
500,000	(0.1120)	(0.1020)	**(0.0855)**	**(0.0550)**	**(0.1000)**	**(0.0955)**	**(0.0590)**	**(0.0870)**
600,000	**(0.0700)**	**(0.0530)**	**(0.0325)**	**(0.0050)**	**(0.0265)**	**(0.0185)**	**(0.0635)**	**(0.0384)**
700,000	**(0.0735)**	**(0.0530)**	**(0.0325)**	**(0.0050)**	**(0.0265)**	**(0.0185)**	**(0.0635)**	**(0.0389)**
800,000	(0.1210)	**(0.0965)**	**(0.0645)**	**(0.0125)**	**(0.0260)**	**(0.0240)**	**(0.0915)**	**(0.0623)**
Average	**(0.0975)**	**(0.0812)**	**(0.0617)**	**(0.0314)**	**(0.0633)**	**(0.0596)**	**(0.0668)**	**(0.0659)**

B. Simultaneity

Finally, another potential problem with the estimation is the possibility of simultaneity. We have examined the role of radio broadcasts on the sales of sound recordings. The argument might be made that the sales of sound recordings have an impact on radio listening just as radio has an impact on sound recording sales. After all, they are substitutes for each other when individuals want to listen to

non-specific music. Could the amount of time individuals spend listening to radio depend on the number of sound recordings that they purchase?

Although a linkage is clearly possible, there are reasons to doubt the importance of sound recording purchases on time spent listening to radio. First, the number of sound recordings available is the stock of owned recordings which is likely to be much larger than the flow of purchases, so the current flow might be at most only weakly related to the number of purchases unless the stock of older CDs depreciates rapidly over time. Second, for specific music consumption, sound recordings are the much preferred solution and radio will not be much of a substitute. Sound recording purchases intended mainly for specific listening (which might be the main use of sound recording purchases) should not, therefore, impact time spent listening to radio.

It is also useful to consider factors that might change the number of sound recordings purchased and the impact on radio listening. One very important factor during this period is file-sharing, and to this we should add instances of non-Internet based sharing, such as ripping borrowed CDs. Although we have a variable for internet based file-sharing, it might not pick up all of the impact of borrowed or pirated music. If it did not, individuals would decrease their purchase of sound recordings and at the same time likely decrease their listening to radio since they can now have a very large free library of music to which they can listen. In this case, a reduction in record sales would be associated with a decrease in radio listening, not an increase.

Nevertheless, we can perform a test to determine whether there is evidence of simultaneity or not. The test is a form of Hausman specification test in which we regress radio music listening on a set of exogenous variables, calculate the residuals, and then include those residuals in the regression on record sales. In this case the exogenous variables include all the demographic variables used in the above regressions plus, for the regression on radio music listening, changes in both the number of radio

stations and time spent listening to talk radio, each of which should be independent of the possible music-radio/sound-recording tradeoff. Table 6 reports the coefficients on the variable consisting of the first stage residuals for our various combinations of cutoff, which are insignificant with all cutoff values.

Table 6: Coefficients of Residuals in Hausman Test

	Pop & Cov Wgt	cov>.6	cov>.75	cov >.6 pop>.6M	cov >.75 pop>.6 M
coefficient	0.2619	0.1648	1.0382	-0.7221	0.2765
p value	(0.812)	(0.928)	(0.654)	(0.539)	(0.784)

The conclusion that would be drawn from this is that there is no simultaneity problem to worry about. Nevertheless, this test cannot be considered conclusive so we proceed to use instrumental variables in order to more fully expunge the possibility of simultaneity. We should keep in mind that because we have a fairly small sample size, instrumental variables, which provide biased and inefficient estimates, may not provide better estimates than OLS.

Equation (1) represents the equation that we have been estimating with OLS up to this point. Equation (2) represents a structural equation explaining music radio usage. The two new variables in this equation are the number of radio stations (Stations) and the amount of time that individuals spend listening to talk radio (RadioTalk).

(1) $\text{Albums} = a_0 + a_1 \text{RadM} + a_2 \text{Inc} + a_3 \text{BA} + a_4 \text{Yng} + a_5 \text{Male} + a_6 \text{Old} + a_7 \text{Int} + a_8 \text{Minority} + a_9 \text{Pop}$

(2) $\text{RadM} = b_0 + b_1 \text{Albums} + b_2 \text{Stations} + b_3 \text{RadioTalk}$

Listening to talk radio fulfills a very different taste than does listening to sound recordings and should not be a substitute for listening to sound recordings, at least no more than any other activity that takes up time. Further, we have already seen that the time spent listening to talk radio does not impact

the number of albums sold. If talk radio is independent of album sales, it should be uncorrelated with the error term in the regression on Albums.

Our other instrument is the average number of stations in a DMA, which is a construct based on the average number of stations found in Arbitron metro areas weighted by the populations of the metro areas in a DMA and as such doesn't relate directly to any particular set of physical stations since a single station can appear in more than one metro area.[23] We expect this count of stations to be independent of record sales except through its impact on the radio music-use variable. The number of stations is determined in part by regulations since radio stations need government permission to broadcast. The number of stations is likely to impact the variety of programming and might allow listeners to find programming closer to their tastes, impacting the time spent listening to music radio, but there does not appear to be any other mechanism by which the number of stations would impact the sales of albums.

Our procedure will be to instrument for RadM in equation (1) with the fitted values of RadM from equation (3) that includes all the other exogenous variables that are found in equation (1) and the two instruments where X1…X8 is a vector representing variables 2-9 in equation (1).

$$(3)\ \text{RadM} = c_0 + \left|c_1 \ldots\ldots c_8\right| \begin{vmatrix} X1 \\ \cdot \\ . \\ \\ X8 \end{vmatrix} + c_9\text{Stations} + c_{10}\text{RadioTalk}$$

The results of the second stage regression coefficients for radio music are found in Table 7. As a byproduct of using instrumental variables, the standard errors on radio music are larger than is the case for OLS which can explain why the coefficient is more variable than when using OLS and in one

[23] Not all stations in a metro area were counted. If a station was listed as having an audience rating (percentage of audience) of zero, it was excluded from the analysis. This is similar to Arbitron's listings which include stations only if they have a measurable presence, although they do not base it on ratings points but instead on audience size.

instance is even positive. Nevertheless, the average coefficient is about the same as before (-.826) which further supports the view that there is no evidence that the OLS estimates are impacted by simultaneity.

Table 7: Second stage IV estimates of change in sound recording sales					
	Pop & Cov Wgt	Coverage >.60	Coverage >.75	Cov >.6; pop>.6M	Cov >.75; pop>.6M
radio music change in hours*	-0.9375	-0.9658	-2.2727	0.4015	-0.6441
p values (one tail)	(0.177)	(0.256)	**(0.021)**	(0.301)	**(0.100)**
Sargan [non heteroskedastic-robust] Instrument validity; P-value	0.4303	0.4193	0.4112	0.7297	0.659
Hansen J Statistic on instrument validity [hetero robust Sargan]; P-val	0.2178	0.1278	0.1044	0.5537	0.4436
Heteroskedastic robust [quasi-Hausman] exogeneity test; Chi-sq p value for RadM	0.931	0.7223	0.5618	0.2698	0.9549
Anderson Canon Corr Underidentication LR test; p value	0.0000	0.0000	0.0001	0.0008	0.0004
Partial First Stage Results; Music Radio is dependent variable					
station count change	0.0025	0.0025	0.0023	0.0022	0.0024
	0.000	**0.000**	**(0.001)**	**(0.004)**	**(0.002)**
radtalkchg	-0.6657	-0.5962	-0.6768	-0.5600	-0.6778
	0.000	**0.000**	**0.000**	**0.000**	**0.000**
Observations	90	61	41	53	36
R-squared	0.537	0.486	0.642	0.476	0.626
Robust p values in parentheses; *=instrumented variable; bold is sig at 10% level; bold underlined at 5%, bold double underline 1%					

The Sargan test for instrumental validity implies that our instruments are likely to be valid and not related to the error term. The Hansen J Statistic, which differs from Sargan in that it is robust in the face of heteroskedasticity, provides a less sanguine answer to the same question although it too suggests, but more weakly, that the instruments are valid. A test similar to the simultaneity test reported in Table 6 but robust to heteroskedasticity leads to the same conclusion as before—there is no evidence that music radio is endogenous and thus no need for instrumental variables to begin with. Finally, the Anderson canonical correlation likelihood ratio test tells us that the instruments identify the equation. The bottom of Table 7 provides some coefficients and other results from the first stage regressions

where it is easy to see that the two variables used as instruments are highly correlated with changes in music radio usage.

We conclude that simultaneity is not a problem for the OLS results.

C. Errors in Variables

Although we have taken steps in our estimation to eliminate or weaken any impact of measurement error, one might argue that such errors cannot have been completely eliminated. It is well known that under classical errors-in-variables circumstances (which assumes the measurement error term is not correlated with the true values of the variables) coefficients on all the rhs variables will be biased and inconsistent if any of the variables is mismeasured.

Of course, our interest is centered on the coefficient for music radio listening. If there were only one explanatory variable in the regression the nature of the bias due to the mismeasurement is much easier to determine since it would simply become the typical error-in-variables attenuation bias, where the coefficients are biased toward zero. For this reason the regressions were rerun leaving out the other rhs variables except music radio listening time. Table 8 shows that the results from these regressions are very similar to those obtained from the complete regression. Under standard EIV assumption we can conclude that measurement errors are likely to lower our estimates of the impact of music radio.

Table 8: Regression with Radio Music Use as Sole Independent Variable

	Pop & Cov Wgt	Coverage >.6	Coverage >.75	Cov >.6; pop>.6M	Cov >.75; pop>.6M	Average
Music Radio Sole	-0.7505	-1.0323	-1.1118	-0.3877	-0.4976	-0.7560
Variable	(0.113)	(0.143)	(0.200)	(0.157)	**(0.073)**	-0.1369
Observations	95	61	41	53	36	
R-squared	0.024	0.024	0.031	0.013	0.043	
In Full	-0.7903	-0.7507	-1.1817	-0.6049	-0.7767	-0.8209
Regression from	**(0.076)**	(0.169)	(0.126)	**(0.067)**	**(0.056)**	-0.0985

Robust p values in parentheses; p value for music radio is for one tail test; bold is sig at 10% level; bold underlined at 5%, bold double underline 1%

If the true coefficient were larger than the measured coefficient would not alter our analysis since it would merely strengthens the conclusions already drawn.

A solution often proposed for errors-in-variables is to use instrumental variables. Although we have performed such as examination above, there are difficulties with using it as a salve for the errors-in-variables problem beyond the difficulties mentioned for issues of simultaneity. Among those difficulties is the fact that most potential instruments (including the ones chosen) will suffer from the same errors-in-variable problems as the variables used in the OLS results unless instruments could be found that were based on DMA level data as opposed to constructed from the MSA level data, which we have not been able to do.

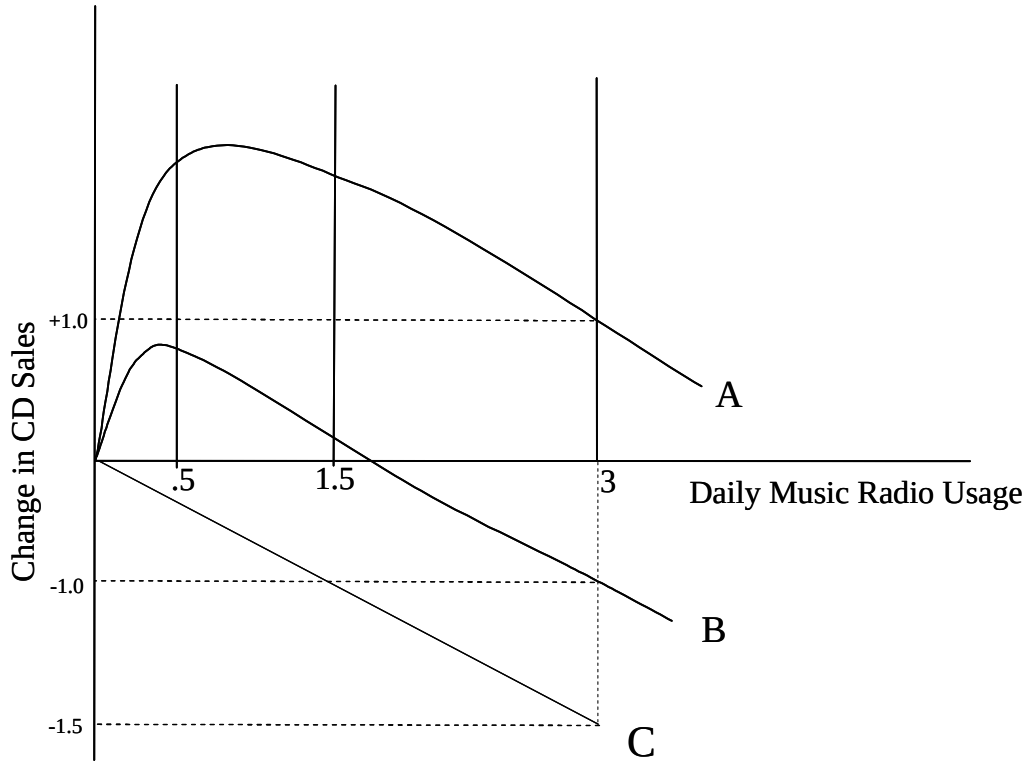
VI. Gauging the Overall Impact of Radio

We have found that radio use lowers sales of sound recordings. Because we have only a limited range of observations to work with the regression results that we have found could be compatible with other scenarios that might allow for overall positive impact of radio play on record sales. For example, radio at first might have a positive informational aspect on sales, which then turns negative when greater radio use becomes a substitute for listening to CDs. In this case the overall impact of radio could be positive or negative in spite of our negative findings. Assume, for the sake of example, that radio has a positive impact for approximately the first .5 hours of daily use and a negative impact thereafter. This is illustrated in Figure 1 for three possible cases, A, B, and C.

Correctly estimating the impact of music radio when all observations are between 1.5 and 3 will lead to a conclusion that music radio lowers record sales, which is correct within the bounds of the data. Attempting to extrapolate the impact of a factor, such as radio use, to levels that are outside the bounds of the sample can easily provide misleading results if the relationship looks like A or B, however. The negative relationship found in measured portion of A could obscure an overall positive

impact that radio play might have on sound recordings since the large positive impact from the first half hour of music radio would be obscured.

Figure 1: Out of Sample Estimates can be Misleading



The bounds of music radio use in our 2003 sample (see Table 1) run from a low of 1.9 hours to a high of 3 hours, with an average of 2.3 hours. The 1998 values are just slightly higher. The range of changes in music radio use is .6 hours from 1998 to 2003. Within these ranges of observations the measured impact of radio play on the sales of sound recordings is negative. The average album consumption stood at 2.3 units per capita in 2003. If we were to assume that the relationship between music radio and CD purchases were linear throughout its range, as illustrated in case C, an increase in radio use from 0 to 2.3 hours per day could be expected to reduce album sales by more than one and a half albums, given a coefficients of -.75. This would be a very large negative impact of overall radio use. Yet the relationship represented by curve B would imply a loss of only 1 unit and the relationship

represented by A would imply a gain of 1 unit, and either of these other two curves could also be consistent with the data at hand.

Is there any evidence for or against such a nonlinearity that might overturn the results found in generalizing these regression results? First, we ran quadratic specification of the amount of radio music use to see whether there was any evidence of nonlinearity within our data. There was not. We also split the data in half based upon music radio usage and ran separate regressions for each half. The cities with smaller music radio usage had a larger negative impact than the cities with greater music radio usage, contrary to what we would expect from the type of nonlinearity suggested by lines A or B. Still, the limitations on our data keep us from being able to say much more.

The historical approach used in Liebowitz (2004), however, can be used to throw some light on this possible nonlinearity. That paper examined the sales of sound recordings immediately before, during, and after the introduction of radio into the American market. If there was an initial positive promotional element in radio, and if it were large enough to overpower the later negative impacts, that positive impact should have clearly shown up in historical data which included the very first hours of music radio listening. As already mentioned, the sound recording market was already quite mature at that time, with per capita sales the equivalent of those in 1950. Yet, as that paper reported, there was no evidence of any but a negative impact of radio on sound records since sales fell significantly during the first few years of radio's growth in spite of a healthy and growing economy. The fact that record sales fell during the birth of radio would seem to imply that the net effect is negative, even at an initial stage.

That conclusion is echoed in Morton (2003):

> Record companies welcomed the subsequent transfer of electrical technology from radio and motion pictures to the phonograph industry, but hated the effect these two new forms of entertainment had on the record business. Radio was the biggest threat. On the eve of broadcasting's debut, between 1914 and 1921, record sales had doubled, largely because of sales of popular music. With the inauguration of network radio in the middle 1920s, the market for popular

> recordings collapsed, resulting in a number of companies leaving the field or changing ownership. (Page 26).

To be sure, this issue cannot be completely settled since one can argue the radio/sound-recording relationship in the early 1920s might have been very different than the current relationship. Nevertheless, the lack of any evidence in favor of the possibility of a net positive impact, when compared to the more substantial evidence of the negative impact of music radio, provides a prudent analyst with at least a tentative conclusion that radio has a net negative impact on sound recording sales. Further research is warranted.

VII. Discussion

Can this result be reconciled with the well-documented existence of payments to radio stations for the promotion of records? The existence of payola seems to have been taken as evidence that radio stations generate sufficient positive impact on record sales that the typical market clearing price for the right to broadcast sound recordings would be negative price for the rights to a sound recording. Does it provide evidence on whether a property right controlling the broadcasts of recordings would have economic value?

I think not. The overall negative impact of radio play found in the above regressions would be beyond the feasible control of record companies due to the current lack of broadcast property rights in sound recordings. Any record company that attempted to, let's say, pay radio stations to play fewer hours of sound recordings would only receive a portion of the benefits which would accrue to all sound recording companies. Nor would it make sense for a record company to pay radio stations to reduce the hours of broadcast of just that record company's songs since this would tend to decrease its market share and not have any salutary impact on overall record sales since those radio signals would still be

broadcast for the same amount of time, allowing the same level of substitution of radio for sound recordings by consumers. Further, antitrust laws would prevent the entire industry from collectively trying to make such payments. Even if they could do so, entry problems would likely doom such an agreement since any station (talk radio, say) could then threaten to play more sound recordings (by changing formats) in order to generate payments not to.

It is also the case that payola is consistent with the possibility of an overall negative impact of radio play for the simple reason that payola doesn't impact the total quantity of radio broadcasts of sound recordings. Payola only impacts which particular songs are broadcast. There does not appear to be any evidence, for example, that record companies tried or can alter the share of music relative to talk on radio stations, or that they tried to convert talk radio stations into music radio stations.

Both Caves and Coase note that numerous attempts were made by record companies and before them, music publishers, to stop paying radio station personnel or well-known performers to play particular records or songs, beginning, according to Coase, with an episode in 1890. Some of these attempts, including the congressional hearings in the late 1950s, appear to be instances where established record companies were trying to reduce the airplay of a group of smaller upstart record companies who were heavy users of payola and who happened to specialize in that evil music otherwise known as rock-and-roll. Caves suggests that modern attempts to limit payola have largely been attempts by major record companies to restrict competition from smaller independents. There may well be truth to these claims of redistributional impacts from attempts to control payola. Nevertheless, if payola type activities benefited record companies in an overall sense the industry should not have wanted to eliminate the practice altogether.

The results of this paper are entirely consistent with a modified version of the conclusions of the economists who have argued for a market solution. Their focus on only part of the property rights

problem have led them to conclude that payola should not be illegal, that it is payment for a useful service, and that the market should determine what the payments should be.

For example, Coase concludes (p 318):

> ..if the playing of a record by a radio station increases the sales of that record, it is both natural and desirable that there should be a charge for this. If this is not done by the station and payola is not allowed, it is inevitable that more resources will be employed in the production and distribution of records, without any gain to consumers, with the result that the real income of the community will tend to decline. In addition, the prohibition of payola may result in worse record programs, will tend to lessen competition, and will involve additional expenditures for regulation.

Caves states (p 292):

> The evidence supports a simple interpretation of the economics of payola in broadcasting. Promotional benefits to the label cannot be captured directly by the broadcaster, who lives by advertising revenue that generally will not reflect this benefit. Payola compensates for valuable promotion, and leaves us wondering why it is stigmatized as bribery rather than recognized as payment for services rendered.

We agree completely with this call for a fully functioning market. A complete market, however, would not merely allow payola to be legal. A fully functioning market would allow a complete set of property rights over the sound recording being broadcast, including the ability of record companies to restrict radio play and to provide geographically exclusive territories for the broadcast of songs.

VIII. Conclusions

The impact of music radio broadcast on the sales of sound recordings has received scant attention by researchers. The analysis above provides evidence that radio play is negatively related to the overall level of record sales and that the size of the negative impact is large. This implies that radio play is largely a displacement for the sales of sound recordings, a result that seems at odds with most conventional thinking.

The negative impact of radio on record sales only exists for music broadcasts and not for talk radio, which is consistent with a view that listening to music on the radio is a close substitute for listening to music on sound recordings. The measured negative impact of music radio on record sales is in the vicinity of 20% within the range of our observations. Extrapolating these results outside the bounds of our sample provides for a considerably larger impact, although such extrapolation is fraught with difficulties. Those difficulties are ameliorated somewhat by appealing to other evidence and other tests.

This finding is likely to become increasingly important in the near future as the transmission of music becomes increasingly digitized and the putative property rights (or lack of property rights) of the copyright owners come under greater scrutiny and political pressure. These results also provide some suggestions for public policy that is likely to become increasingly important in the next few years. As new broadcasting techniques (e.g., digital transmissions that allow high quality copies to be made automatically) make using the radio a closer substitute for the purchase of sound recordings, the above results should provide useful information in a discussion of whether the owners of sound recordings should be given the ability to exclude such usage.

On a methodological note, the apparent divergence between the impact of radio play on the sales of individual records versus its impact on sales for the entire industry indicates an important danger in trying to estimate the impact on an entire market by examining the impact on individual units, such as records. This potential fallacy of composition should be kept in mind whenever there are reasons to believe that the behavior of the whole may be different than the behavior of the individual parts (besides radio broadcasting, the example of file-sharing's impact on individual recordings vis-à-vis the entire recording industry come to mind). In these instances, the technology's impact on market shares can occur quite independent of the impact on overall market sales and it is important not to conflate share changes with overall market changes.

These problems highlight the difficulty of using any form of analysis to help regulators try to imitate markets. With a full property rights system in place, record companies could control how frequently their records were played and extract payments from radio broadcasters, or they might make payments to broadcasters as the case might be. A complete market solution would have a set of rights like the one between the television and movie industries. Record companies would be able to enter into whatever contracts they wished, including restricting the playing of songs to particular stations in particular localities. With this additional proviso, the market solution suggested by Coase, Caves, and Sidak and Kronemyer can be readily supported. In that case, the true value of the various rights could be determined where they are best determined—by direct observation in the market.

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