Too Much Rock and Roll? Station Ownership, Programming and Listenership in the Music Radio Industry

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Abstract

This paper uses rich station-level data to examine how common ownership affects the programming and listenership of contemporary music radio stations. A common owner of stations playing the same type of music in the same local radio market differentiates their playlists and their audiences increase. Their playlists become more similar to those of competitors which lose roughly the same number of listeners. These changes are consistent with theoretical predictions if incentives for strategic differentiation are relatively weak and total listenership is inelastic. Common ownership of stations in different markets is associated with limited playlist homogenization, consistent with economies of scope in offering similar programming in different markets. These stations are also able to play more commercials without losing listeners, suggesting that the economies of scope lead to increases in station quality.

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1 Introduction

This paper examines how ownership of multiple products affects the selection of product characteristics using detailed, station-level data from the contemporary music radio industry. It shows that both common ownership of stations in the same local market and common ownership of stations in different local markets are associated with changes that are beyond those described in the existing empirical literature and that are relevant to both merger analysis and the current policy debate concerning the deregulation of media ownership.[1]

The 1996 Telecommunications Act allowed greater within-market common ownership by allowing a firm to own more local stations.[2] The average four-firm concentration ratio, based on station listenership, in the 50 largest markets rose from 0.53 in March 1996 to 0.67 in March 2002.[3] Using station playlist data from April 1998 to December 2001, I show that observed changes in common ownership are associated with significant changes in differentiation and the redistribution of listeners across stations. In particular, if two stations playing the same type of music become commonly owned then they tend to differentiate their playlists (by 20% based on one of my measures) and their listenership tends to increase (by 8%). On the other hand, they tend to become more similar to competitor stations and these stations lose as many listeners as the commonly owned stations gain. The changes in differentiation roughly cancel out so that common ownership has no effect on several measures of aggregate variety. I also find some evidence that the commonly owned stations increase how many commercials they play.

Section 2 describes a simple model of product differentiation. The observed changes in differentiation are consistent with the model if stations have relatively weak incentives to strategically

[1] The Federal Communication Commission (FCC) is required to review its ownership rules biennially and federal court decisions have required the FCC to use factual evidence in deciding whether to retain or change rules on media ownership ("Federal court turns back FCC-approved loosening of media ownership limits", Chicago Tribune, June 25, 2004). Senator Feingold of Wisconsin claimed in 2002 that as "corporations buy stations in the same market, they combine newsrooms and reporters and share playlists and radio personalities - all with the same effect: less choice in music and less information for consumers" (http://www.senate.gov/~feingold/statements/02/06/2002613529.html). In 2003 he introduced a bill into the Senate which would have tightened rules on local common ownership.

[2] For example, in markets with more than 45 stations the 1996 Act allowed a single firm to own as many as eight stations, compared with four previously.

[3] Author's calculation based on Arbitron data on station listenership and BIAfn data on station ownership.

differentiate their programming to soften competition in choosing how many commercials to play and radio listening is relatively inelastic. The increase in commercial loads indicates that common owners find it more profitable to exercise market power over listeners than to exercise market power over advertisers by restricting commercial loads to raise advertising prices. This is an interesting result because the Department of Justice's investigations of radio mergers have focused on the possibility that common owners might exercise market power over advertisers (Klein (1997)). The results also raise a more general issue with the analysis of differentiated product mergers. Current analysis considers whether *competitors* may respond to a unilateral price increase by the merged firm by repositioning their products to take the merged firm's customers, but it does not consider how the *merged firm* may reposition its products.[4] I provide an empirical example where the change in how the merged firm programs its stations appears to toughen competition, so that competitors lose listeners and may exit the category, even though the merged firm may increase prices (commercial loads) for listeners.

Common ownership of products in different markets is widespread in many industries including restaurants, newspapers and retail outlets. The existence of economies of scope in offering the same product in different markets makes it likely that common ownership will result in homogenization. Cross-market homogenization in media industries is potentially controversial because of the traditional commitment of US policy-makers to "localism".[5] The 1996 Act eliminated the previous forty station limit on how many stations a firm could own nationwide, and the four-firm concentration ratio at the national level, based on advertising revenues, increased from 0.19 in 1996 to 0.51 in 2002, when fourteen firms owned more than 50 stations each and the largest firm (Clear Channel) owned over 1,100 stations nationwide.[6]

I find that common ownership is associated with limited homogenization, as commonly owned stations play more of the same songs and stations owned by large national radio companies use shorter

[4] See Section 2.212 and Section 3 of the Department of Justice and Federal Trade Commission's (1997) Horizontal Merger Guidelines. Gandhi et al. (2005) discuss this issue in a theoretical model where firms choose location and price simultaneously which removes incentives for strategic differentiation.

[5] The FCC announced the creation of a Localism Task Force in August 2003 in response to Congressional concerns about how cross-market media ownership has affected the local nature of broadcasting (http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-238057A1.pdf).

[6] Figures taken from Appendix C of the FCC's 2002 review of the industry (Williams and Roberts (2002)).

playlists.[7] Although it is not surprising that scope economies lead to profitable homogenization, theory is ambiguous about whether they increase station quality. I provide evidence that homogenization does increase station quality, at least from the perspective of the marginal listener, by showing that stations owned by large national radio companies have also been able to increase their commercial loads (by 5%) without losing listeners. One explanation for quality-increasing homogenization, which is consistent with anecdotal evidence from the industry, is that commonly owned stations may be able to share information about which songs are popular with listeners.

Despite the presence of multi-product firms in many markets, few empirical studies have tried to identify how common ownership affects product differentiation. Borenstein and Netz (1999) find evidence that a single airline tends to cluster the departure times of its flights more than competing airlines do. Corts (2001) finds that a movie distributor tends to differentiate the release dates of its movies. Williams et al. (2002), as part of the FCC's review of its radio ownership rules, find no significant evidence that common owners differentiate their stations using top 10 playlist data but, because of the small size of their sample (174 stations in 1996 and 2001), they look at the effects of ownership for stations playing different types of music (e.g., a Rock station and a Country station) which have little overlap between their playlists. I find small effects for these stations but large and significant effects for stations in the same music category. My analysis looks not only at how a common owner differentiates its own products, but also at how it locates its products relative to those of competitors and the effects of common ownership on pricing (commercial loads). I show that quantities (station listenership) change in a way that is consistent with the changes in differentiation and which suggests that common ownership toughens competition.

Several papers have tried to assess the related question of whether common ownership increases aggregate variety in radio. Berry and Waldfogel (2001) compare the number of programming formats available in a market before and after the 1996 Act. Formats are self-reported labels that stations

[7] Ahlkvist and Fisher (2000) find using airplay and survey data from prior to the 1996 Act that stations making use of music consultants are more likely to play the same songs. Their finding is consistent with my results. Williams et al. (2002) find no statistically significant effects of cross-market common ownership on differentiation.

use to describe their programming. They find larger increases in the number of available formats in larger markets where the Act allowed greater increases in common ownership, suggesting that common ownership increases variety. FCC (2001), using an alternative format classification, and Chambers (2003), using a single cross-section of playlist data, find evidence suggesting that common ownership does not increase variety.[8] While I also find that common ownership does not affect variety using a panel of playlist data for music stations, I show that this is because common ownership is associated with offsetting changes in differentiation rather than because it has no effect on programming.

The rest of the paper is structured as follows. Section 2 summarizes the different ways in which both types of common ownership may affect programming. Section 3 describes the data. Section 4 analyzes how changes in ownership affect playlist differentiation and playlist length. Section 5 examines how ownership affects commercial loads and Section 6 examines its effects on station listenership. Section 7 concludes.

2 The Theoretical Effects of Common Ownership on Programming

This section describes how common ownership may affect broadcast radio or television programming. Section 2.1 summarizes the effects of within-market common ownership, previously studied by Steiner (1952), Beebe (1977), Spence and Owen (1977), Anderson and Coate (2005) and Dukes and Gal-Or (2003).[9] Section 2.2 explains why cross-market common ownership may lead to playlist homogenization and how I try to identify whether homogenization increases station quality for listeners. The footnotes provide anecdotal evidence that these effects are recognized in the industry.

[8] FCC (2001) find, using format category definitions from BIAfn MediaAccessPro database, that since 1996 "the number of formats has declined slightly in some of the larger markets while increasing in most of the smaller ones" (p. 7). This is the opposite of Berry and Waldfogel's finding using format data from Duncan's *American Radio* from 1993 and 1997 for stations listed in Arbitron's market reports. Chambers (2003) finds, using a single week of playlist data from 2002 for stations from the 50 largest markets, that there is no significant correlation between ownership concentration and counts of the number of different songs played that are less than 1 one year old. He finds a negative correlation for songs that are more than one year old. George (2001) finds results that are similar to Berry and Waldfogel for the newspaper industry using data on reporters' beats.

[9] Other recent papers include Gabszewicz et al. (2001) and Cunningham and Alexander (2004).

2.1 Common Ownership of Stations in the Same Local Market

Consider a simple "circular city" model with three stations. For simplicity, assume that stations B and C are located on a unit circle, as shown in Figure 1. In the first stage of the game A chooses its location by choosing the distance a and in the second stage the stations simultaneously choose their commercial loads. Listeners are distributed around the circle, listen to at most one station and dislike commercials and travelling. The listenership of station i when the vector of commercial loads is $\underline{c}$ is given by the function $L_i(a, \underline{c})$. The price per minute per listener of a commercial is $p(\underline{c})$, so that station i's revenue is $c_i p(\underline{c}) L_i(a, \underline{c})$. The cost of choosing any location is normalized to zero so that station owners maximize revenues.[10] I now describe informally how station incentives change when A and B are commonly owned rather than separately owned. C is assumed to be owned by an independent firm. Appendix A shows how a station's first order conditions change with common ownership.

In the second stage of the game stations choose commercial loads given A's first stage location choice. Common ownership has two effects. First, a common owner will tend to increase its stations' commercial loads if they are substitutes for listeners $\left(\frac{\partial L_j(a,\underline{c})}{\partial c_i} > 0\right)$, a standard multi-product pricing effect described by Anderson and Coate (2005).[11] A reduction in the marginal costs of selling commercial time would have a similar effect and increased loads will tend to decrease station listenership. Competitors may also increase their commercial loads if loads are strategic complements. If $\frac{\partial p(\underline{c})}{\partial c_i} < 0$ then a common owner will have an offsetting incentive to reduce its stations' commercial loads to increase advertising prices. On the other hand, if advertising prices are set in a wider

[10] Music stations purchase blanket licences from each of the major performing rights organizations ASCAP, BMI and SESAC which, for a fee proportional to the station's estimated advertising revenues, give the station the right to play any song in the organization's repetoire. Music stations do not pay per song or per play fees. For further discussion see Connolly and Krueger (2005). The type of economies of scope discussed in Section 2.2 might lead to commonly owned stations in the same market playing more of the same songs, but I ignore this effect here to concentrate on the effects of competition for listeners and advertisers.

[11] Dukes and Gal-Or (2003) also predict that commonly owned stations play more commercials. SchardtMedia's "Listener Choice Radio Study 2000" found that "Part of the reason the amount of commercial inventory has increased is the pressure to enhance the stock price of publicly traded companies by increasing advertising revenue. Another reason is that with station clusters, competition between stations within a market has decreased and owners have less fear that high commercial loads will chase listeners to another station. Now, they probably own the other station." (http://www.listenerchoice.com/research/RS2000.html).

media market then common ownership should increase commercial loads, increasing the welfare of advertisers.

Common ownership has two types of effect on A's first stage choice of a. The first type is a "direct" or "cannibalization" effect. For given commercial loads, A takes listeners from C and loses other listeners to B as a increases. If A and B are commonly owned then A has no incentive to cannibalize B's audience so that A will tend to differentiate itself from its sister station and move towards C.[12] The second type are "strategic effects" arising from how a affects second stage equilibrium choices. A station has an incentive to strategically differentiate itself from competitors to soften second stage competition (increasing competitors' commercial loads). If A and B are commonly owned then A has no incentive to strategically differentiate itself from B but it still has an incentive to strategically differentiate itself from C, and this will tend to lead to A and B becoming less differentiated.[13] On the other hand, if $\frac{\partial p(\underline{c})}{\partial c_i} < 0$ then, under common ownership, A may have an offsetting strategic incentive to move towards C to toughen second stage competition (reducing C's commercial load).[14]

While the theoretical effects on differentiation are ambiguous, it is plausible that in radio the direct effects of common ownership will be more important than the strategic effects, leading commonly owned stations to differentiate their playlists and to increase their listenership.[15] Of course, in a more general product space A would also have the option of moving away from C when it differentiates itself from B, a change that might reflect an increase in aggregate "variety". However, if strategic incentives

[12] Clear Channel's Director of Urban Programming in Memphis quoted in Billboard on February 22 2003, "I can't play Luther Vandross, because he needs to play on my adult R&B, KJMS; I need to drive listeners there. If I'm playing him on my mainstream [WHRK], what reason do listeners have to tune in to KJMS?" An Infinity Programming Director in Cleveland quoted in Billboard on October 14 2000, "We're far more focused on a specific part of the audience. Before, you could attract a certain demo, knowing full well there would be a spill-over of audience. Now we're more target orientated...you want to win the battle and beat [your sister stations] but not kill them."

[13] If listeners are evenly distributed around the circle, the price of commercials is fixed and transportation costs are quadratic then this effect dominates the direct effect and A and B move closer together, increase their commercial loads and lose listeners.

[14] Dukes and Gal-Or (2003) present a model with endogenous commercial loads in which separately owned stations choose minimal differentiation because a smaller quantity of commercials allows them to extract additional rents from advertisers in a bargaining game.

[15] To be precise, A will move towards C when it becomes commonly owned if, at the location chosen under separate ownership, a small increase in a results in a capture of listeners from C that is more profitable than the loss of listeners that occurs because C reduces its commercial load. This reasoning is consistent with Corts's (2001) finding that movie distributors differentiate the release dates of their own movies because price competition between movies is limited. One reason why competition in commercial loads may be limited in radio is that listeners are always able avoid commercials they particularly dislike by temporarily switching stations regardless of how many commercials the station plays.

are reasonably weak then increasing variety will only be more profitable than moving towards C if it adds more listeners. As both total and category listenership are known to be quite inelastic (Borenstein (1986), Rogers and Woodbury (1996) and Berry and Waldfogel (1999a)), it is plausible that commonly owned stations will find it profitable to move towards competitors in order to take their listeners.

2.2 Common Ownership of Stations in Different Local Markets

Stations in different markets do not compete for listeners or advertisers but common ownership may affect programming if there are economies of scope to offering similar programming in different markets. The emergence of firms that specialize in a particular type of programming, such as Radio One (Urban) and Univision (Spanish), is consistent with scope economies. One might imagine that it would be profitable for a common owner to use the same playlist in every market in order to avoid all local programming costs. While my results are not consistent with this extreme type of homogenization, they are consistent with an alternative scope economy where commonly owned stations choose their playlists locally but share research information about which songs are popular with listeners.[16] Appendix A presents a simple model where sharing research leads to playlist homogenization.

While economies of scope lead to profitable homogenization, they may or may not increase station quality, but this may determine the effect of homogenization on listener welfare.[17] I use changes in station listenership and commercial loads to provide evidence that homogenization, or some other effect of cross-market common ownership, increases quality for the marginal listener. Ignoring inter-

[16] An article in Billboard on November 16, 2000 described how "at Infinity Radio - with more than 180 stations - regular conference calls are held, with programmers from similarly formatted stations discussing what music is working in their markets. This networking is intended to allow programers to maintain control, while enhancing the information upon which they base music decisions." A Senior Vice President Programming at Clear Channel, quoted in same Billboard article, argued that "generally local PDs have complete authority with respect to music additions. They are encouraged to consult with their brand managers and share relevant research data as part of the decision process." The CEO of Clear Channel's radio division, quoted on Rolling Stone.com on August 13, 2004, estimated that Clear Channel spends more than $70 million each year on research to identify to "find what [listeners] like, what they want, what they don't want".

[17] The same issue arises with homogenization in other settings. For example, if a retail chain enjoys economies of scope from stocking the same products in every market then this may allow it provide products that independent stores would not, benefitting customers, or it may mean that it does not provide products that match local tastes, harming customers. The natural way to assess these effects would be to look at what happens to quantities and prices or mark-ups, following changes in chain ownership. This is the same type of approach that I propose here.

actions with other local stations, suppose that station i chooses its commercial load c_i to maximize profits $pc_iL_i(c_i,\theta) - x_ic_i$. p is the price of commercials (assumed fixed), $L_i(c_i,\theta)$ is the station's listenership (assumed to decrease with c_i), θ measures station quality and x_i is i's marginal cost of selling commercial time. The station's first order condition $\left(\frac{pL(c_i)-x_i}{pL(c_i)} = -\frac{c_i}{L_i(c_i,\theta)}\frac{\partial L(c_i,\theta)}{\partial c_i}\right)$ implies that i will play more commercials if either its cost of selling commercial time falls (for example, cross-market owners may have lower costs in selling commercials to national advertisers) or its listenership becomes less elastic with respect to its commercial load, which is the likely effect of an increase in quality for the marginal listener. An increase in quality should also increase a station's audience but this may be offset if the cost of selling commercial time also falls.[18] I find that cross-market common ownership is associated with homogenization and increases in commercial loads but that station listenership does not fall. This suggests that homogenization increases station quality which is consistent with scope economies in music research helping cross-market owners to identify the songs that listeners like.

3 Data

I use a new dataset of station programming for 1,095 contemporary music stations created from station airplay logs. The logs were provided by Mediabase 24/7, a company which collects airplay data using electronic monitoring equipment. As shown in Table 1, a log lists every song played and indicates where a commercial break is played between songs. A log contains no information on non-commercial talk programming. I have airplay logs from weekdays in the first week of each month from April 1998 to December 2001.

The airplay data is combined with data from BIAfn's Media Access Pro database (hereafter BIAfn) which provides historical information on station ownership, formats and ratings (listenership). The ratings company Arbitron defines local radio markets which correspond to Metropolitan Statistical Areas "subject to exceptions dictated by historical industry usage" (Arbitron (2002), p. 82). Arbitron

[18] Brown and Williams (2002) find that markets with a greater presence of large radio companies have lower prices for regional and national advertisers, which is consistent with these companies having some cost advantages in selling commercial time.

Table 1: Extract from a Daily Log of a Classic Hits (Rock) station

Time	**Artist**	**Title**	**Release Year**
5:00PM	CLAPTON, ERIC	Cocaine	1980
5:04PM	BEATLES	While My Guitar Gently Weeps	1968
5:08PM	GRAND FUNK	Some Kind of Wonderful	1974
5:12PM	TAYLOR, JAMES	Carolina in My Mind	1976
5:16PM	RARE EARTH	Get Ready	1970
5:18PM	EAGLES	Best of My Love	1974
Stop Set	*BREAK*	*Commercials and/or Recorded Promotions*	-
5:30PM	BACHMAN-TURNER	Let It Ride	1974
5:34PM	FLEETWOOD MAC	You Make Loving Fun	1977
5:38PM	KINKS	You Really Got Me	1965
5:40PM	EDWARDS, JONATHAN	Sunshine	1971
5:42PM	ROLLING STONES	Start Me Up	1981
5:46PM	ORLEANS	Dance with Me	1975
Stop Set	*BREAK*	*Commercials and/or Recorded Promotions*	-
5:56PM	JOEL, BILLY	Movin' Out (Anthony's Song)	1977

allocates each station to one "home" market. The majority of a station's audience typically lives in its home market.[19] BIAfn lists a format for each station in each Arbitron ratings quarter. BIAfn groups together formats which it views as similar into format categories which, for simplicity, I will call categories.[20]

The airplay sample stations are home to 148 different local markets, ranging in size from New York City to Muskegon, MI, and are in seven contemporary music categories (75 formats). These categories are Adult Contemporary (AC), Album Oriented Rock/Classic Rock (AOR), Contemporary Hit Radio/Top 40 (CHR), Country, Oldies, Rock and Urban.[21] The airplay sample does not include every station in these categories in the 148 markets, but it does include the stations which account for the vast majority of category listenership. Table 2 provides some statistics on the coverage of the sample based on station categories and listenership in Fall 2001. For example, there is an AC station in the sample from 66 of the largest 70 Arbitron markets (there are no stations from Puerto Rico which

[19] Based on Arbitron data for Fall 2001, an average of 79% (70%) of the audience of a station rated in at least two (five) local markets comes from its home market.

[20] I use BIAfn's Fall 2001 classification of formats into categories, as listed in BIA Financial Network (2001), Appendix F.

[21] The music categories without stations in the airplay sample are Classical, Easy Listening, Jazz and Nostalgia/Big Band.

is the 13^{th} largest market). There are 221 home market AC stations in these 66 markets which have enough listeners to be rated by Arbitron, of which 162 are in the airplay sample. The airplay sample stations account for, on average, 89.2% of home market AC category listening. The sample is more complete in larger markets and there are relatively few Oldies stations. On average, 13 million people were listening to these stations at any point during Arbitron's broadcast week (Monday-Sunday 6 am-12 pm) in Fall 2001.

The airplay panel is unbalanced in three dimensions.[22] First, the number of stations in the sample expands over time from 702 stations in 1998 to 886 in 1999, 953 in 2000 and 1,095 in 2001. Second, 14 weeks have less than five days of data: in particular, one week in 1998 and ten weeks in 1999 have only one day of data for all stations, while three weeks have four days of data. Finally, a large number of individual station-days are also missing. Overall there are 133,994 station-days of airplay logs and 766 stations are in the dataset in at least 30 different weeks. There are 452 changes in ownership for the airplay stations while they are in the data, affecting 412 different stations.

A few comments are necessary about entry and exit from the radio industry. Station exit is rare unless the FCC cancels a station's license for rule-breaking. In particular, there is no evidence that common owners close stations even though they might have an incentive to do so in order to avoid duplicating fixed costs.[23] Entry is also limited, partly because of capacity constraints on the available radio spectrum (particularly FM spectrum) in larger markets.[24] Only eight of the airplay stations started broadcasting after April 1998. Satellite radio also only went national in November 2001, just before the end of my sample. It is far more common for stations to switch categories. BIAfn lists 118

[22] The results appear to be quite robust to using subsets of the stations to give a more balanced panel.

[23] I have been unable to find any cases of large radio companies closing down stations. For example, from 1996 to 2002, Clear Channel, the largest radio station owner, owned four stations which temporarily ceased broadcasting but all of them have subsequently resumed broadcasting and are still owned by Clear Channel. The four stations were KTXX-AM (now KABL-AM), WKCI-AM , WFOR-AM, and WBZT-FM.

[24] These constraints have led the Department of Justice to take the view that in most urban markets new entry could not constrain the exercise of market power created by radio station mergers. See, for example, United States Department of Justice (2000c). The Department of Justice has applied this reasoning in medium-sized markets such as Harrisburg (ranked 78) and Colorado Springs (98). Based on data in Appendix F of the FCC's 2002 review of the industry (Williams and Roberts (2002)) the average number of licensed stations in the largest 100 Arbitron markets increased from 32.9 in November 1997 to 34.3 in March 2002. The average number of licensed stations in smaller Arbitron markets increased from 16.3 to 16.8 over the same time period. There are more cases where small, unrated stations gain enough listeners to start being rated by Arbitron in smaller markets.

category switches for the airplay stations, although disproportionately many of these (56) are between categories which I show are quite similar such as AOR and Rock. In most of the analysis I condition on the number of stations in the category but in Section 6 I provide evidence that within-category common ownership is associated with competitors leaving the category.

4 Station Ownership and Playlist Differentiation

In this section I examine the relationship between station ownership and music programming. Section 4.2 shows that stations in the same local market and the same music category become significantly more differentiated (by 20% based on one of my measures) when they become commonly owned. Section 4.3 shows that the commonly owned stations become more similar to competitors and that common ownership has little effect on several measures of aggregate variety. These changes in differentiation are consistent with a firm's incentives to strategically differentiate its stations from competitors being relatively weak and total radio listening being relatively inelastic. Section 4.4 shows that common ownership of stations in the same music category in different markets leads to playlist homogenization, consistent with cross-market economies of scope.

4.1 Measuring Playlist Differentiation

I define a station's weekly playlist by a vector which lists how many times the station plays each artist during the week.[25] There are 10,542 different artists listed in the logs. I use weekly playlists because stations only update their playlists every week or so. When a station has one or more days of airplay logs missing, its weekly playlist is defined using the remaining days although dropping these weeks does not affect the qualitative results. There are 35,750 station-weeks of data and during a five-day week a station plays, on average, 1,367 songs (standard deviation 195) by 177 different artists (67). Oldies stations play the largest number of artists (average 279) and Country stations play the least

[25] Results are very similar using artist-song title combinations. If listeners view different songs by the same artist as being much more similar than songs by different artists then it is more appropriate to use measures of differentiation based on artists.

(121).

I use two measures of the degree of differentiation between playlists although I have tried several alternatives which give similar results.[26]

Measure 1. Artists as Orthogonal Dimensions of Product Space. Stations are located in a music product space where each artist defines an orthogonal dimension of the space and a station's location is defined by each artist's share of its playlist. For example, if there were only three artists (X, Y and Z) and station i played X, Y and Z 10, 0 and 5 times respectively then i's (X,Y,Z) location would be $(\frac{2}{3}, 0, \frac{1}{3})$. The degree of differentiation or "distance" between two stations is measured by the angle (in radians) between their location vectors. This distance can vary between 0 (identical playlists) to $\frac{\pi}{2}$ (no artists in common).[27] Continuing the example, if station j played X 5 times, Y 0 times and Z 10 times then the distance between i and j would be 0.6435.

Measure 2. Proportion of Unique Artists. This distance measure is based on how much a station plays artists who are not played at all by a different station during the same week. For a pair of stations i and j in week w the distance is defined as

$$\frac{\sum_{\forall a} p_{iaw}\mathrm{I}(p_{jaw}=0) + p_{jaw}\mathrm{I}(p_{iaw}=0)}{2}$$

where p_{iaw} is the proportion of station i's songs which are by artist a and I(.) is an indicator function. This distance varies between 0 (the same artists are played by both stations) and 1 (no artists in common). In the example the distance between i and j would be zero by this measure because the stations play the same artists, even though they do so in different proportions.

The first measure uses playlists to locate stations in product characteristic space and then measures

[26] It is important to try several alternatives because there is no obviously correct way to measure product differentiation without information on listener tastes. The alternatives I have tried include Euclidean distance measures based on projections of artists into low dimensional spaces, correlation coeffcients and various non-linear transformations of the measures presented here.

[27] For two stations i and j with location vectors v_i and v_j the distance is given by $\arccos\left(\frac{v_i.v_j}{\|v_i\|\|v_j\|}\right)$ where $v_i.v_j$ is the dot product of the vectors. Jaffe (1986) uses a similar angular measure to calculate the distance between firms' research activities.

the distance between stations. This corresponds to how we would normally think about measuring differentiation. The second measure calculates the difference between playlists without defining where stations are located but it has the advantage of a more direct interpretation. For example, a 0.1 increase in the measure reflects a 10 point increase in the average percentage of songs by artists who are not played at all on the other station.

Table 3(a) shows the average distances between station-pairs by category. The distance measures show a similar pattern. On average, 50% of an Adult Contemporary (AC) category station's songs are by artists who are not played at all on a different, randomly-chosen AC station in the same week. Country station playlists are much more similar than those in other categories. The last two columns show that stations in the same format do not have identical playlists, although they are more similar than the playlists of stations in the same category but different formats.[28]

Figures 2(a) and (b) provide some evidence on the relationship between formats and types of music. They were constructed using the playlists of AC stations in November 2001. The procedure is described in detail in Appendix B and it was motivated by noticing that artists who seem particularly similar tend to be played heavily by the same stations. For example, Elton John, Phil Collins, the Dave Matthews Band and U2 are all heavily played by AC stations, but stations which play a lot of Elton John also tend to play a lot of Phil Collins (correlation in their plays is 0.82) and relatively little of U2 (correlation -0.66). Instead, stations which play U2 tend to play the Dave Matthews Band (this correlation 0.72). The first stage of the procedure uses these correlations to project artists into a two dimensional space. The result for the thirty most played artists is shown in Figure 2(a). Artists are located relative to each other so that the axes have no direct interpretation and Elton John, the most played artist, is arbitrarily chosen to be at the origin. The location of the artists is intuitive with Elton John close to Phil Collins, Rod Stewart and Billy Joel while U2 and the Dave Matthews Band are in a different area of the product space. In the second stage stations are located based on the

[28] One can also compute the distance between a station's playlist in one week and its own playlist in the first week of the following month: these average distances are 0.441 and 0.085 by Measures 1 and 2 respectively. These distances increase with the length of time between weeks particularly for stations playing current hits.

artists which they play, as shown in Figure 2(b) where stations in different formats are marked with different symbols. The pattern of formats is plausible with Soft Rock stations close to Elton John and Modern AC stations located closer to the Dave Matthews Band and U2.

Two features of Figure 2(b) show the advantages of using playlist data rather than formats to measure differentiation. First, there are some different formats, such as Lite Rock, Soft Rock, Lite AC and Soft AC, that are very similar.[29] Second, there are some formats in which stations play quite different music. This is particularly true in the AC format which has the largest number of stations.

Table 3(b) shows the average distances between station-pairs in different categories. On average, there is relatively little overlap between the playlists of stations in different categories although there is more overlap between stations in the Adult Contemporary (AC) and Contemporary Hit Radio/Top 40 (CHR) categories, the Album Oriented Rock/Classic Rock and Rock categories and the CHR and Urban categories. There is very little overlap between Country stations and stations in any other category.

4.2 Differentiation Between Commonly Owned Stations in the Same Local Market

The first specification tests whether a common owner of stations in the same local market tends to differentiate its stations more than separate owners. The linear regression specification is

$$d_{ijw}^{PAIR} = X_{ijw}\beta_1 + C_{ijw}\beta_2 + N_{ijw}\beta_3 + W_w\beta_4 + \varepsilon_{ijw} \tag{1}$$

where d_{ijw} is the distance between stations i and j in week w, C and W are category and week dummies, N are dummies for the number of stations in the market and ε is a residual. X is a dummy variable ($SAME\_OWNER$) which is equal to 1 if i and j are commonly owned. The observations are pairs of stations which are home to the same local market.[30] Summary statistics for the main

[29] The similarity between these formats also holds using the distance measures defined above. For example, the average Measure 2 distance between two Soft Rock stations is 0.317, while the average distance between a Soft Rock station and a Soft AC station is 0.284.

[30] I have also examined the effects of common ownership on stations which are not home to the same market but are both rated by Arbitron in at least one market. For example, a Boston, MA station and a Providence, RI station

variables used in all of the regressions are listed in Appendix C. As the εs will be correlated across different pairs from the same market and for the same pair over time, I calculate standard errors which are clustered on the market and are robust to heteroskedasticity.

4,787 distinct pairs of stations are home to the same market of which 688 are in the same category at some point while they are in the sample. 154 of these same category pairs are commonly owned at some point and there are 46 changes in whether pairs are commonly owned affecting 40 distinct pairs. 31 of these changes involve switches from separate to common ownership and 15 involve the opposite switch.[31] There are 862 pairs in the same market but different categories which are commonly owned at some point and there are 231 changes in common ownership.

Table 4(a) presents the regression results for both distance measures. Rows 1-6 only use pairs from the same category. If stations in different categories do not compete for the same listeners then common ownership is likely to have a greater impact on stations in the same category. The number of station dummies include full sets of dummies for both the number of airplay stations (even if their logs are missing in a particular week) and the total number of stations in the market-category.[32]

Row 1 presents the coefficients from regressions without station-pair fixed effects so that the ownership coefficients are identified from both cross-sectional and time-series variation. The same owner coefficients, which are highly significant, show that commonly owned station-pairs are more differentiated than separately owned stations. On average, 55% of a station's songs are by artists not played at all by a separately owned station in the same market-category. The Measure 2 coefficient indicates that this increases to 67% (a 12 percentage point or 21% increase) for stations with the same

may both be rated in Providence, partly because many Providence residents may listen to Boston stations when they commute to Boston. There are no significant effects of common ownership for these stations which is consistent with stations choosing their music based on conditions in their home market.

[31] 10 changes are due to group purchases where one multi-station owner buys another multi-station owner and 14 are due to divestitures required by the Department of Justice. The group purchases requiring divestitures are Clear Channel's purchase of Jacor (deal closed in May 1999), Entercom's purchase of Sinclair (July 2000) and Clear Channel's purchase of AMFM (August 2000). The divestitures are listed in United States Department of Justice (1999, 2000a, 2000b). The 22 remaining changes involve firms trading particular stations, 7 of these involving the sale of a single station and the rest involving multiple stations being swapped or traded.

[32] The coefficients are very similar using many different definitions of the number of station dummies and using no dummies at all. I present the results using two sets of dummies as the airplay stations typically have significantly more listeners than other stations and so may have different effects on differentiation.

owner.

The regressions in row 2 include station-pair dummies (fixed effects) so that the ownership coefficients are only identified from changes in differentiation and common ownership. Stations which become commonly owned become more differentiated. This is consistent with a common owner having more incentive to avoid cannibalizing of its own audiences when it chooses its stations' programming than it does to strategically differentiate its stations from competitors. The coefficients are smaller than in row 1, with the Measure 2 coefficient implying a 7 percentage point (13%) increase in the average percentage of songs by artists not played by the other station. A couple of robustness checks which are not reported in the table show that the effects are very similar for pairs which become and cease to be commonly owned and that they are similar if I only use playlist information from certain hours of the day such as Arbitron's "afternoon drive" (3-7 pm).[33]

To identify whether commonly owned stations become more similar to competitors I restrict attention to those market-category-weeks where I observe at least three stations. The regressions in row 3 show that pairs in these market-categories become more differentiated when they become commonly owned. 26 changes in common ownership affect pairs in this subset of market-categories. The coefficients are smaller but still statistically significant (0.0603 (0.0255) for Measure 1 and 0.0597 (0.0300) for Measure 2) if I only use market-categories where I observe two stations.

It is plausible that a common owner may only differentiate stations that start off being reasonably similar if these stations are closer substitutes for listeners. I investigate this possibility in row 4 by allowing common ownership to have a different effect for station-pairs which are quite similar at some point while they are in the sample. I define a pair as being "ever close" if the Measure 1 (2) distance between the stations is ever less than 1.2 (0.7). 34 (35) changes in common ownership affect pairs which are ever close by this definition. The coefficients indicate that a common owner only

[33] In a regression which allows different effects for the two types of ownership change the Measure 1 coefficients are 0.0922 (0.0403) for pairs which cease to be commonly owned and 0.0785 (0.0227) for pairs which become commonly owned. The Measure 2 coefficients show the opposite pattern with a smaller effect for pairs which cease to be commonly owned (0.0539 (0.0363)) than for the pairs which become commonly owned (0.0780 (0.0234)). The same owner coefficients using only afternoon drive hours are 0.0571 (0.0185) for Measure 1 and 0.0534 (0.0148) for Measure 2. Both of these coefficients are statistically significant at the 1% level.

tends to differentiate "ever close" pairs and for these pairs the effects are larger than for all pairs taken together. Of course, a common owner could differentiate stations with dissimilar playlists by changing non-music aspects of their programming, such as the style of the DJs.

It may take time for a new station owner to change a station's programming and six changes in common ownership were soon reversed by a second transaction.[34] In row 5 I drop observations from the 12 months following a change in common ownership. The estimated effect of a change in common ownership for close pairs is now very similar to that found in the cross-section in row 1, with the Measure 2 change reflecting a 12 percentage point (20%) increase in differentiation.

The regressions in row 6 include a full set of format-pair dummies (e.g., a "Hot AC-Lite AC" dummy). If common owners change their stations' formats to reflect the changes in differentiation then I expect the coefficients to become much smaller. While they are slightly smaller than in row 5 the differences are not significant.

One obvious concern is that changes in station ownership may not be exogenous to changes in differentiation. There is no obvious instrument for changes in ownership at the station-level.[35] However, I can include pair-specific time trends to control for the possibility that firms buy stations which were becoming more differentiated prior to becoming commonly owned. In this case the effects for ever close pairs are slightly larger, 0.1890 for Measure 1 and 0.1233 for Measure 2, and they are statistically significant at the 5% and 7% levels respectively.

An alternative possibility is that firms buy pairs which are unusually similar, perhaps because differentiating these pairs is particularly profitable. While the increases in differentiation which I find might be due to common ownership, the increases in differentiation might be smaller if a randomly-selected pair of stations became commonly owned. I can test whether pairs which change whether

[34] An additional issue is that for stations that have been traded more than once, BIAfn lists the announcement date of the deal rather than the completion date. Therefore the deal may actually only become effective several months after the date that I use.

[35] Berry and Waldfogel (2001) exploit the structure of the 1996 Telecommunications Act by using market size to provide an instrument for changes in the number of owners at the market level. I have also tried using instruments based on market size but they are very poor instruments for whether pairs of stations in the same category are commonly owned or change common ownership. This is may be because most of the pairs of stations in the same category are home to relatively large markets.

they are commonly owned are significantly less differentiated when separately owned than pairs which never have the same owner. To do this, I regress the distance measures for station-pairs with different owners on a dummy for whether the pair is ever commonly owned, together with the same category, week and number of station dummies as in row 1. The coefficients on the dummy for whether the pair is ever commonly owned are very small and statistically insignificant (-0.0006 (0.0368) for Measure 1 and -0.0060 (0.0342) for Measure 2). Pairs which change common ownership are not unusually similar when they are separately owned.

Table 4(b) repeats the regressions in rows 1 and 2 for each category separately. No Oldies stations in the same market are commonly owned. The coefficients show the same pattern for all categories except Country which is impressive given the small number of ownership changes in each category. The increase in differentiation associated with common ownership is largest for the Contemporary Hit Radio/Top 40 category. The small, but positive, Country coefficients are also interesting. Country stations have very similar playlists (see Table 3(a)) suggesting that Country listeners have quite homogenous tastes. If so, a significant increase in differentiation might simply result in commonly owned stations losing listeners.

The bottom part of Table 4(a) repeats several of the regressions using pairs from all categories. In the regressions with station-pair dummies I do not include category-pair (e.g., "Country-Rock") dummies so that the coefficients reflect changes in differentiation which happen when stations change categories. The average Measure 1 and 2 distances between separately owned stations in all categories are 1.46 (standard deviation 0.20) and 0.86 (0.20). The pattern of the coefficients is the same as in the earlier regressions, with common ownership associated with more differentiation especially for ever close stations.[36] However, the implied increases in differentiation are smaller than before (the Measure 2 increase in differentiation after 12 months for ever close stations is 7 percentage points (8%)) even though these regressions allow for larger, cross-category changes in programming. This

[36]There are 45 pairs in different categories which are ever close together by Measure 1 (50 by Measure 2). The coefficients for these pairs alone are also significant but slightly smaller. For example, the Measure 1 coefficient for ever close pairs in a regression equivalent to row 9 is 0.0367 (0.0127) which is statistically significant at the 1% level.

indicates that while common owners differentiate similar stations they do not typically change the type of the music that they play. One possible explanation for this is that owners avoid changing the categories of successful stations because listeners who are loyal to the station are likely to be lost. An alternative explanation is that a common owner wants to avoid creating gaps in product space into which other stations might move.[37]

4.3 Playlist Differentiation between Commonly Owned Stations and Other Stations in the Same Local Market

I now examine whether common owners make their stations more similar to competitors when they differentiate them. We would expect them to do so if strategic differentiation incentives are relatively weak and it is hard to attract additional listeners to the category by increasing variety. The analysis uses those market-category-weeks where I observe at least three stations. These observations come from 112 different market-categories and in some market-categories I observe as many as six stations.[38] The results in row 3 of Table 4(a) show that common owners do differentiate their own stations in these market-categories.

To look at whether a common owner makes its stations more similar to stations owned by other firms I measure the distance between each station and each pair of other stations in the same market-category. The distance between a station and a pair of stations is simply the minimum of the distances between the station and each member of the pair. For example, if the station is A and the members of the pair are B and C then the distance from A to the pair is the minimum of the AB and AC pair distances. I want to test whether the station and the pair tend to be closer together when the pair

[37] An Infinity Programming Director in Cleveland, quoted in Billboard on October 14, 2000, described how "I initially made that mistake when I was programming KPNT (The Point) in St. Louis. We made sure The Point and [sister station] The River were programmed so far away from each other that you could drop something in the middle of them and that's what the competition wants you to do." Berry and Waldfogel (2001) also suggest that increases in variety are limited by entry deterrence incentives.

[38] 89 of these market-categories are in the largest 50 local markets where the coverage of the sample is more complete (Table 2).

is commonly owned by a firm which does not own the station. The regression specification is

$$d_{ijkw} = X_{ijkw}\beta_1 + C_{iw}\beta_2 + N_{iw}\beta_3 + W_w\beta_4 + \varepsilon_{ijkw} \tag{2}$$

where d_{ijkw} is the distance between i and the pair jk in week w, and X is a dummy variable ($PAIR\_SAMEOWNER$) which is equal to 1 if both j and k are owned by the same firm and this firm does not own i. The category, week and number of station dummies are the same as in the regressions in Table 4(a).[39]

The results are presented in Table 5(a) for the two distance measures. The coefficients in columns (1) and (3) come from regressions without station-pair combination dummies. The negative coefficients indicate that a pair with the same owner is, on average, significantly closer to other stations than a pair with different owners. The average Measure 2 distance between a station and a pair of stations which do not have the same owner is 0.51 i.e., 51% of the station's songs are by artists not played on the member of the pair which is most similar to it. The coefficient in column (3) implies that this percentage falls by almost 8 points (16%) when the pair have the same owner. The coefficients in columns (2) and (4) give the results when station-pair combination dummies (e.g., an A-BC dummy) are included in the regressions. There are 28 changes in the common ownership of the pair which identify the coefficients. The coefficients are almost the same size as in columns (1) and (3) although they are only marginally significant at the 10% level. The fall in statistical significance is not particularly surprising given both the small number of ownership changes and the possibility that commonly owned stations become more similar to some stations (including stations which might not be in the airplay sample) but not others.[40]

[39] For a market-category where there are 3 (4) observed stations in a given week there will be 3 (12) observations in the regression. The standard errors are clustered on the market.

[40] I also estimated a specification which examines whether a station faces a closer competitor when any other stations in the market-category are commonly owned. This specification has one observation per station-week and the dependent variable is the distance from the station to the station which is closest to it. The difference in this specification is that it allows the closest competitor to be a station which is not itself commonly owned, perhaps because the commonly owned stations compress the area of the product space in which the separately owned stations locate (imagine, for example, a model where stations locate on a circle and commonly owned neighbours move apart and the other stations move closer together). The results were consistent with those in Table 5(a) and the coefficients were statistically more significant in regressions with fixed effects.

The changes in differentiation are consistent with strategic differentiation incentives being relatively weak so that a common owner chooses to take listeners from other stations rather than cannibalizing its own audience. However, this does not imply that there are *no* incentives for strategic differentiation, which would be the case in the model of Section 2.1 if stations did not compete for listeners when setting commercial loads. Evidence of strategic differentiation comes from observing that the average distance between separately owned stations in the same market-category (1.14 (0.55) for Measure 1 (2)) is significantly greater than the average distance between separately owned stations in the same category and different markets (0.95 (0.41)). We would expect to observe the opposite pattern, with minimal differentiation between competitors, if there was no strategic differentiation.[41]

The next set of results show that, consistent with the offsetting increases and decreases in differentiation, common ownership has no significant effects on measures of aggregate variety.[42] I consider three different measures of variety. The first measure is simply the average of the Measure 1 pair-distances between the observed stations in the market-category. The second measure, which is similar to the Measure 2 distance for a pair of stations, reflects how much each station's playlist adds to playlists of other stations in the market-category. To be precise, it is defined as

$$\frac{\sum_{i=1}^{n_{mw}} \sum_{\forall a} p_{iaw} \mathrm{I}\left(\sum_{j \neq i} p_{jaw} = 0\right)}{n_{mw}}$$

where p_{iaw} is the proportion of station i's songs which are by artist a, I(.) is an indicator function and n_{mw} is the number of observed stations in the market-category. The average value for market-categories with at least three observed stations is 0.3787 (standard deviation 0.1530). The third measure looks at the amount of variety provided by the market-category's playlist which combines

[41] It is easier to interpret this pattern by restricting attention to cases where there are only two stations in a market-category. In a simple Hotelling model where listeners are distributed on a line and each listener listens to exactly one station, the incentive to take listeners from the other station leads two stations to choose exactly the same location if they do not compete when setting commercial loads. The average distances between stations in these market-categories are 1.11 and 0.51. This pattern is also found in regressions including week and category dummies.

[42] A necessary limitation of this analysis is that I do not observe all of the stations in some market-categories. However, as shown in Table 2, the observed stations do account for the majority of market-category listenership especially in larger markets.

the playlists of the individual stations. It is defined as $\frac{1}{\sum_{\forall a} p_{maw}^2}$ where p_{maw} is the proportion of songs in market-category m's playlist which are by artist a. An increase in this measure reflects a decrease in the "concentration" of the combined playlist. The average of this measure is 125.5 (40.1), and I use its natural logarithm in the regressions. The regression specification is

$$v_{mw} = X_{mw}\beta_1 + C_m\beta_2 + N_{mw}\beta_3 + W_w\beta_4 + \varepsilon_{mw} \tag{3}$$

where v_{mw} is the variety measure in market-category m in week w. C and W are category and week dummies and N are dummies for the number of stations in the market-category.[43] X is a count ($OWNERS$) of how many different firms own the observed stations. A negative coefficient on this variable implies that common ownership is associated with greater variety. An observation is a market-category-week and I only use market-category-weeks where I observe at least three stations.

Table 5(b) presents the results. The regressions in columns (1), (3) and (5) do not include market-category dummies. The coefficients on the number of owners are negative, consistent with common ownership increasing variety within the market-category, but they are all small and statistically insignificant. The estimated coefficients are similar in the remaining columns where the regressions include market-category-observed group dummies. This means that there is a new market-category dummy whenever any station enters or exits the airplay sample or an observed station changes category. The finding that common owners do not increase variety is consistent with category listening being relatively inelastic. Of course, these regressions condition on the number of stations in the market-category and common ownership might change variety by changing the number of stations. In Section 6 I find evidence that common ownership is associated with other stations leaving the market-category.

[43] Dummies for the number of observed stations in the market-category-week are included in the regressions in addition to the two sets of number of station dummies used in the regressions in Table 4(a). This is necessary because the variety measures tend to vary systematically with the number of observed stations. Including these additional dummies in the earlier regressions does not change any of the results.

4.4 Playlist Homogenization and Cross-Market Common Ownership

I now show that cross-market common ownership does result in statistically significant playlist homogenization, consistent with the existence of economies of scope. The effects are relatively small (3-4%), indicating that differences in local tastes and competition for listeners makes the use of identical playlists in different markets unprofitable.

To examine whether commonly owned stations in different markets play the same music I use the same regression specification (1) as in Table 4(a) except that the observations are for station-pairs in the same category, the same geographic region (BIAfn defines 9 regions) and different home markets. I use pairs from the same region because several people in the industry suggested that commonly owned stations in the same region are more likely to share music research, although the results using pairs from all regions are quite similar. I use pairs from the same category as common owners are unlikely to homogenize the playlists of stations playing different types of music. In addition to the previous distance measures, I also use the Measure 1 distance between stations where artist-song title combinations define orthogonal dimensions of the product space. A shared playlist may specify the exact songs that stations are to play and most music research, such as telephone or auditorium testing, asks whether people like particular songs rather than artists.[44] The average distance between stations in the same category and region but different markets by this measure is 1.13, compared to 0.95 (0.40) for Measure 1 (2) using artists. 1,721 out of the 13,500 distinct pairs are commonly owned at some point and there are 964 changes in common ownership.

Table 6(a) presents the results using the three distance measures. The regressions in row 1 do not include station-pair dummies. The negative coefficients indicate that stations tend to have more similar playlists when they are commonly owned. On average, 41% of a station's songs are by artists not played at all by a station with a different owner from a different market. The Measure 2 coefficient indicates that this percentage falls by 3 points (7%) for stations with the same owner. I

[44] Many stations use music research to identify which songs by well-known artists they should play rather than to identify new artists. Edison Music Research's website (http://www.edisonresearch.com/edison_music.html) has many interesting articles about how stations use music research.

include station-pair dummies (fixed effects) in row 2. The coefficients are smaller than in row 1 and only the coefficient for the artist-song title measure is statistically significant at the 5% level. This coefficient implies that common ownership reduces the distance between stations by less than 1.5% of the average distance.

Large owners may homogenize their stations around more than one playlist in each market-category (e.g., a Hot AC playlist and a Soft AC playlist). I examine this possibility in row 3 by allowing common ownership to have a different effect for stations in the same format, i.e., stations which describe their programming in the same way. There are larger homogenization effects for stations in the same format and the sum of the ownership coefficients is statistically significant at the 1% level for both of the Measure 1 distance measures (the p-values are reported below the table). I drop observations from the 12 months following a change in common ownership in row 4. The estimated homogenization effects are larger and, as with the results for within-market common ownership, they suggest that common owners do not change their stations' playlists immediately. The artist-song title coefficient in row 4 implies that the average distance between stations in the same format falls by 3.8% when the stations become commonly owned.

While I do find statistically significant evidence of homogenization, the results show that common owners do not use the identical playlists in different markets, even on stations which describe their programming in the same way.[45] This suggests that differences in tastes and competition for listeners make it profitable for common owners to program their stations locally as using identical playlists in different markets would almost certainly minimize costs. The results are also consistent with anecdotal evidence (see footnote 16) that multi-market owners share music research across stations to complement, rather than substitute for, local programming.[46] Of course, homogenization *relative* to

[45] As a specific example I examined the playlists of the CHR/Top 40 stations which Clear Channel brands as "KISS-FM" stations. Many of these stations have almost identical logos, slogans and websites, suggesting economies of scope in aspects of marketing. However, their playlists are not identical. For example, in the first week of November 2001 the KISS-FM stations in Phoenix and Los Angeles played 159 and 158 different artist-song titles respectively, and only 49 of these were played on both stations. Most of the overlapping songs were also being played heavily on non-Clear Channel Top 40 stations across the country.

[46] Of course, the evidence only applies to the selection of music. There may be greater homogenization of other aspects of programming by, for example, using the same announcers on different stations, a practice known as "voice tracking".

independent stations may also be limited by the ability of independents to copy the programming of stations with multi-market owners if they believe that these stations have better information about which songs listeners like.

An additional homogenization effect is that stations owned by large national radio companies have tended to adopt shorter and more concentrated playlists (a smaller number of artists played more often). The regression specification is

$$LENGTH_{iw} = X_{iw}\beta_1 + C_{iw}\beta_2 + N_{iw}\beta_3 + T_w\beta_4 + \varepsilon_{iw} \tag{4}$$

where C and N are dummies for the station's category and number of stations in its market-category. An observation is a station-week. I consider two measures of playlist length: the number of different artists played and the proportion of songs by the station's twenty most played artists. As these measures are sensitive to how much of a station's playlist I observe I only use station-weeks with a full five days of data. X includes two variables. The first variable is a count ($COMMONLY\_OWNED\_STATIONS$) of the number of airplay stations which station i's owner has in the market-category. This controls for any effects of within-market ownership on playlist length.[47] The second variable is a dummy ($LARGE\_OWNER$) which is equal to 1 if station i has a large national owner. A firm is defined as a large national owner if it owns at least 30 different stations in the category nationwide in week w. Seven different firms are defined as large owners in at least one category during the sample period and 438 stations have a large owner at some point.[48] Unreported regressions show that the homogenization effects identified in Table 6(a) are slightly, although not significantly, larger for these stations. T_w are a set of month dummies (January to December) and an annualized time trend which reveals an interesting pattern in the data. The average number of

[47] The count is made using stations in the category which are in the airplay sample at some point, so the variable does not change just because a different station has missing airplay logs in a particular week. The results are qualitatively the same using a dummy for i being commonly owned with other stations or defining common ownership using all stations not just the larger stations which are in the airplay sample.

[48] These firms are AMFM, CBS/Infinity, Citadel, Clear Channel, Cumulus, Jacor and Radio One. Clear Channel is a large owner in every category and the effects are similar for Clear Channel and the other large owners. Varying the 30 station cut-off does not change the qualitative results.

artists played is 177 (standard deviation 67) and it varies from 37 to 569. The twenty most played artists account for, on average, 0.47 (0.10) of a station's playlist and this proportion varies from 0.20 to 0.91.

Table 6(b) presents the results. Negative coefficients in the regressions using the number of artists played and positive coefficients in the regressions using the proportion of songs by the twenty most played artists indicate shorter playlists. The regressions in columns (1) and (2) do not include station fixed effects and they indicate that stations with large owners use shorter playlists. The column (1) large owner coefficient indicates that large owners have playlists which are shorter by 9.4 artists or 5.3% of the average number of artists played. The time trend and within-market ownership coefficients are not significant.

Columns (3) and (4) include station-category fixed effects. There are 376 changes in whether a station has a large owner.[49] Stations shorten their playlists when they become owned by large owners. The time trend coefficients show that there has also been a general trend towards using shorter playlists, with the number of artists played falling by 2.5 artists per year.[50] I show in Section 5 that commercial loads have increased over time and that large owners have increased their loads more than other stations. A concern is that the coefficients in columns (3) and (4) reflect these changes as more commercials will tend to mean less music. I address this possibility in column (5) by normalizing the number of artists by the number of songs played. The pattern of the coefficients is very similar to column (3), and multiplying the coefficients in column (5) by 1.367 (the average number of songs played is 1,367), shows that the size of the large owner and time trend effects are almost unchanged.

Why have playlists become shorter? One plausible explanation is that large owners have increased their expenditure on music research and found that shorter playlists tend to appeal more to their

[49] There are two ways a station can become owned by a large firm. The first way is that a station can be purchased by a large owner when it was previously owned by a smaller firm. The other way is that a station's owner becomes a large owner by buying other stations. There are 130 changes of the first type. An unreported regressions shows that both types of change have very similar effects on playlist length.

[50] I repeated these regressions including station-specific time trends. The large owner coefficients were -6.4896 (2.5967) for the number of artists and 0.0098 (0.0043) for the proportion of plays of the twenty most played artists.

stations' marginal listeners.[51] Smaller owners, who can observe how large owners program their stations, may have followed this trend towards shorter playlists.

5 Commercial Loads and Common Ownership

If listeners dislike commercials, a common owner of stations in the same market has an incentive to increase its stations commercial loads because of a standard multi-product pricing effect. The two-sided nature of radio markets implies that this may be offset by an incentive to reduce commercial loads to raise the prices paid by advertisers. I find some evidence that within-market common ownership is associated with increases in commercial loads. I find stronger evidence that cross-market common ownership is associated with increases of 4-5% in commercial loads. The model in Section 2.2 implies that cross-market common ownership must therefore be associated with either an increase in station quality or a decrease in the marginal cost of selling commercial time.

As shown in Table 1, the airplay logs list when a commercial break is played between songs. Unfortunately, most of the logs from 1998 and 1999 do not show commercial breaks, although there is some data for 709 stations in these years. The vast majority of the logs from 2000 and 2001 do show commercials. I can measure a station's commercial load in a particular hour by either counting the number of commercial breaks shown in the log or by estimating the minutes of commercial time using the time between songs where commercial breaks are indicated.[52] The number of commercials is likely to be mismeasured when there are long periods of non-music programming between songs which is common during the morning drive. To reduce this problem, I only use hours between 10 am and 7

[51] Some critics of industry consolidation have claimed that stations owned by large firms have adopted shorter playlists because they appeal to certain kinds of listener. For example, an article in the San Francisco Bay Guardian on November 25, 1998, argued that "radio stations are playing fewer and fewer songs, over and over again. Corporate program directors have found that tightening their playlists helps attract casual listeners, who are more likely to stop at a station playing a song they've already heard a dozen times."

[52] The first step in this procedure is the estimation of the length of each song. This is done using the median number of minutes between the start time of the song and the start time of the next song where no commercial breaks are indicated. The gap between songs is calculated assuming that the song is played its full length. The results are very similar if one imposes restrictions on the maximum length of a break by assuming, for example, that no break has more than six minutes of commercials.

pm and drop station-hours with less than 8 songs.[53] This leaves 53,955 station-hours in 1998, 41,050 in 1999, 408,643 in 2000 and 456,986 in 2001. The average number of commercial breaks per hour is 2.2 (standard deviation 0.78) with 24,840 commercial-free hours. The most common arrangements are 2 commercial breaks (562,043 station-hours) and 3 breaks (238,518 station-hours). The estimated average number of commercial minutes per hour is 11.95 (standard deviation 4.69) which is very close to an industry estimate that music stations were playing 12 minutes of commercials per hour in 2000.[54]

The regression specification is

$$c_{idh} = X_{idh}\beta_1 + C_{idh}\beta_2 + N_{idh}\beta_3 + T_{idh}\beta_4 + \varepsilon_{idh} \tag{5}$$

where c_{idh} is the number of commercials which station i has on day d in hour h. C and N are dummies for the station's category and the number of stations in its market-category. T are dummies for the hour, month, day of week and year. X contains three variables. $COMMONLY\_OWNED\_STATIONS$ and $LARGE\_OWNER$ are the same as in the analysis of playlist length. The other variable ($OTHER\_STATIONS\_COMMONLY\_OWNED$) is a dummy which is equal to 1 if other air-play stations in the market-category are commonly owned by a different firm. If a common owner plays more commercials then other stations may also play more commercials if commercials are strategic complements. On the other hand, if stations which are commonly owned compete more aggressively for listeners, as suggested by the changes in differentiation, then other stations may play fewer commercials.

Table 7 presents the results. The regression in column (1) uses the number of minutes of commercials as the dependent variable and does not include station fixed effects. The year dummy coefficients show that stations played an additional minute of commercials per hour in 2000 and 2001 relative

[53] Less than 2% of station-hours have less than 8 songs between 10 am and 7 pm, and the results are not affected if these hours are used as well. The 2005 edition of Arbitron's "Radio Today: How America Listens to Radio" study, available on its website http://www.arbitron.com, shows that radio listening is significantly lower after 7 pm than between 10 am and 7 pm.

[54] Radio and Records (April 21, 2000) quoted by SchardtMedia's "Listener Choice Radio Study", http://www.listenerchoice.com/research/RS2000.html.

to 1998. Stations play more commercials towards the end of the week, leading up to Christmas and just before Mother's Day, and significantly fewer commercials in early January. This seasonal pattern almost certainly reflects variation in retailers' demand for commercials. Stations owned with an additional station in their market-category and stations owned by large owners play approximately 30 seconds more commercials per hour (4% of the average load). The pattern is consistent with a within-market common owner increasing its stations' commercial loads because they do not compete for listeners (multi-product pricing). The negative, but statistically insignificant, coefficient on the dummy for whether other stations in the market-category are commonly owned would be inconsistent with commercials being strategic complements if stations' locations were fixed, but it might be explained by competitors facing tougher competition for listeners because of the changes in differentiation.

Column (2) includes station-category-hour fixed effects. The increase in commercial loads from 1998 to 2001 is estimated to be larger than in column (1).[55] Both of the within-market ownership coefficients are small and statistically insignificant. Commonly owned stations play more commercials but I do not find that stations which become commonly owned increase their commercial loads.[56] This may reflect the incomplete time-series aspect of the panel together with the fact that commonly owned stations may try to gain new listeners before increasing their commercial loads. There is no evidence that common owners have exercised market power in the advertising market by reducing their commercial loads.

[55] I repeated the regressions including station listenership shares and found that stations with higher shares play more commercials, with the coefficient on the station's share highly significant at the 1% level. This is consistent with the interpretation that higher quality stations play more commercials because they have less elastic listenership. The coefficients on the other variables change relatively little except that the coefficient for other stations being commonly owned becomes larger in the regression in column 2 (-0.4963 (0.3374)), which is consistent with other stations facing tougher competition for listeners, although the coefficient is still insignificant at the 10% level. Unfortunately without an instrument for changes in stations' shares it is difficult to estimate a structural model of the station's decision about how many commercials to play.

[56] The lack of a clear effect of changes in within-market ownership is consistent with research on changes in the price of radio advertising. For example, Waldfogel and Wulf (2005) find that increases in ownership concentration at the market or market-category level, which they instrument for using the structure of the 1996 Act, had no significant effects on advertising prices, measured by average revenues per listener, between 1995 and 1998. Brown and Williams (2002) do find a statistically significant positive relationship between market concentration and prices, but it explains only a very small fraction of the increase in advertising prices between 1996 and 2001. Unreported regressions showed that common ownership of stations in different categories has no effect on commercial loads.

The large owner coefficient is statistically significant at the 1% level and indicates that stations which become owned by large owners increase their commercial loads by 36 seconds per hour (5%). The large owner coefficient increases to 0.8627 (0.2297) in an unreported regression where observations from the 12 months following a change in ownership are dropped, with the other coefficients remaining statistically insignificant. Column (3) presents the estimates from a conditional station-category-hour fixed effects Poisson model (Hausman et al. (1984)) where the dependent variable is the number of breaks per hour. The Poisson model is appropriate because the number of breaks is always small. The pattern of the coefficients is the same as in column (2) and the large owner coefficient implies that a large owner increases the number of breaks by 3.9%. One would expect a slightly smaller effect on the number of breaks if large owners play more commercials per break as well as having more breaks. The finding that large owners have increased the number of commercials is consistent with Brown and Williams's (2002) result that advertising prices increased by less between 1996 and 2001 in markets with a greater presence of large national owners.

As explained in Section 2.2, cross-market common ownership may result in increases in commercial loads because it increases station quality, possibly through research-based homogenization, or because it reduces the marginal cost of selling commercial time. These changes have different implications for what we should expect to see happening to station listenership.

6 Station Listenership and Common Ownership

I use Arbitron data from its Spring and Fall ratings surveys from Spring 1998 to Fall 2001 to examine how ownership affects station listenership. Within-market common ownership is associated with significant increases in listenership, in the order of 8%, with competitors losing a similar number of listeners. This is consistent with the changes in differentiation resulting from a common owner's incentive to take listeners from other stations rather than cannibalizing its own audience. Cross-market common ownership is associated with no change in station listenership, despite the increase in commercial loads, suggesting that cross-market owners must also increase quality for the marginal

listener.

Arbitron estimates listenership using diaries completed by a sample of listeners. I define a station's listenership share as the proportion of the population aged 12 and above who listen to the station during an average quarter hour in Arbitron's broadcast week (Monday-Sunday 6 am-midnight).[57] The average share for a station in the airplay sample is 0.0084 (standard deviation 0.0041), i.e., 0.84% of the market's population listens to the station. The highest observed share is 0.0376 for a Country station in Knoxville, TN, in Fall 1998. Radio listening declined by 9.1% between 1998 and 2001 in the airplay markets. This decline began in 1989, several years before ownership concentration increased.[58]

I consider two different sets of regressions. The first set look at the effects of common ownership of station-pairs which are home to the same local market and are in the same music category.[59] To be as consistent as possible with the analysis of programming I only use pairs while they are in the airplay sample.[60]

Table 8 presents the results. The regression in column (1) is a regression of the natural logarithm of the pair's combined listenership share on a dummy for whether the pair is commonly owned, together with station-pair, number of station and ratings quarter dummies. 34 changes in common ownership identify the same owner coefficient.[61] The coefficient implies that common ownership is associated

[57] BIAfn provides data on Arbitron's estimates of each station's share of radio listening by people aged 12 and above in each market in each Spring and Fall quarter, known as the Average Quarter Hour (AQH) share. This was combined with data from Duncan's *American Radio* and M Street's STAR database on the Average Persons Rating (APR) for each market, which measures the average proportion of people aged 12 and above listening to radio in each quarter hour. Combining these numbers gives the average proportion of the population aged 12 and above who are listening to each station. Observations from Birmingham, AL in Fall 2001 were dropped because of missing APR data.

[58] Duncan (1999), Spring 1999 National Rankings Supplement, p. 2.

[59] I also investigated whether common ownership affects the listenership of stations in the same market but different categories. I found no significant effects even though I do find small but statistically significant increases in differentiation for these pairs. This difference in the results may be explained by the fact that is hard to identify small effects in the relatively coarse and noisy listenership data compared with the very detailed data on station airplay.

[60] A pair is included if I have observations on both stations for at least one week during the ratings quarter. The Spring quarter runs April-June and the Fall quarter runs October-December. A pair is defined as being commonly owned if it is commonly owned throughout the ratings quarter. Sweeting (2004) provides an analysis of the effect of common ownership on listenership for a much wider sample of stations using a nested logit model. The results, that within-market common ownership increases listenership and cross-market common ownership does not change listenership, are consistent with those presented here.

[61] There are fewer ownership changes in the listenership data because I only use Arbitron data for the Spring and Fall quarter and some of the changes in ownership for pairs in the airplay sample were reversed within a few months.

with a 2.7% increase in listenership but this effect is not statistically significant at the 10% level. In column (2) I drop observations from the 12 months following a change in common ownership. The increase in listenership associated with common ownership is much larger (7.7%) and it is statistically significant at the 1% level.[62] The delayed increase in listenership is consistent with the fact that it appears to take some time for common owners to differentiate their stations' programming. It may also take listeners several months to adjust to changes in what stations play.

Column (3) allows for a larger effect for pairs which are ever close together defined by the Measure 1 distance between the stations being less than 1.2 at some point while the stations are in the airplay sample. In Section 4.2 I found that common ownership only increases the degree of differentiation between these pairs. The results for listenership are slightly different with the point estimates indicating that common ownership increases the listenership of all pairs, although the increases are larger and more statistically significant for close pairs, with the sum of the coefficients equal to 0.0875 which is statistically significant at the 1% level.

If common owners change their stations' playlists to take more listeners from other stations in the same market-category, we would also expect to see the combined audience of the other stations decreasing. I examine whether there is evidence for a redistribution of listeners in columns (4)-(7). To make audience gains and losses directly comparable I measure the audience share in levels rather than logs. I also do not include dummies for the number of stations in the market-category as controls because I am interested in what happens to the aggregate listenership of other stations. I address the issue of whether common ownership is associated with changes in the number of stations in the category in a moment.

The pair's own combined share is the dependent variable in column (4) and the 12 months following a change in common ownership are dropped. The coefficient implies that common ownership increases the average pair's listenership by 7.1% which is close to the effect found in column (2). The conclusion that the commonly owned stations increase their listenership holds whether or not we condition on

[62] I repeated this regression including pair-specific time trends and the effect of common ownership increased in magnitude to 0.2044 (0.0608).

the number of stations in the market-category. The combined listenership of all of the other stations in the market-category, including stations which are not in the airplay sample and which are not home to the market, is the dependent variable in column (5).[63] The coefficient is negative and shows that the combined listenership of other stations falls by almost exactly the same amount as the listenership of the commonly owned stations increases. A very similar way of performing the same analysis is to use total category listenership as the dependent variable. In this regression the coefficient on common ownership of the pair is -0.00002 (0.00055). Common ownership increases the listenership of the commonly owned stations but, consistent with inelastic category listenership and the absence of effects on aggregate variety, it does not increase total category listenership. As Section 5 showed that commonly owned stations do not reduce, and may increase, their commercial loads, the changes in differentiation provide the most obvious explanation for these changes in station listenership.

In Section 4.3 I used market-categories with at least three airplay stations to show that common owners make their stations' playlists more like those of other stations. Columns (6) and (7) repeat columns (4) and (5) for this subset of market-categories and the coefficients are very similar. In a separate regression using the combined listenership of only the other observed airplay stations as the dependent variable I found that the coefficient is negative but not statistically significant (-0.00056 (0.00044)). Commonly owned stations gain listeners from all other stations not just those in the airplay sample.

A couple of back-of-the-envelope calculations illustrate the size of these effects. First, how many people are switching stations? Out of the set of station-pairs which change common ownership, a pair of Cincinnati stations had the median home market audience in Spring 2000 with 24,848 people aged 12 and above listening to the stations during an average quarter-hour. An audience increase of 7.1% would increase the audience of these stations in an average quarter-hour by 1,764 listeners.

[63] On average there are 2.6 other home market stations in a market-category with 1.6 of these stations rated by Arbitron. The non-rated stations have estimated listenership which is too small for the station to be given a share in Arbitron's market reports. There are also an average of 0.4 rated out of market stations in a market-category. The results are very similar if one uses tobit methods to deal with the problem that there are some quarters where no other stations in the category are rated by Arbitron.

The mean home market audience was 29,308, so a 7.1% increase from the mean would be a gain of 2,080 listeners in an average quarter-hour. The results above imply that other stations in the same market-category would lose a similar number of listeners. Second, how large are the implied changes in station revenues? BIAfn provides estimates of the annual advertising revenues for each station. The estimated revenues of the Cincinnati pair were $17.7 million in 2000. Assuming that revenues increase proportionately with listenership, an increase in listenership of 7.1% would increase their annual revenues by $1.25 million.[64]

Columns (8) and (9) examine whether common ownership is associated with changes in the number of stations in the market-category. It is plausible that other stations may exit the category if common ownership toughens competition for listeners because of changes in differentiation. The dependent variable in column (8) is the number of other home market stations in the market-category. This includes stations which have too few listeners to be rated by Arbitron in a particular quarter. The average number of other stations is 2.6 and it ranges from 0 to 13. The dependent variable in column (9) is the number of other home market airplay stations in the market-category.[65] The average number of other airplay stations is 1.1 and it ranges from 0 to 4. I estimate conditional station-pair fixed effects Poisson models as the number of stations is discrete and small. The coefficient in column (8) implies that common ownership is associated with the number of other home market stations in the market-category falling by, on average, 0.65 stations. The coefficient in column (9), which is statistically significant at the 1% level, implies that common ownership is associated with, on average, a reduction of 0.32 in the number of other airplay stations. This reduction reflects airplay stations switching categories as none of the airplay stations exit the industry during the sample period. If a common owner recognizes that category exit is possible then it may have even stronger incentives to take listeners from other stations by changing its stations' playlists and not, at least in the short-run, increasing their commercial loads.

[64] The BIAfn station revenue estimates are calculated using a proprietary BIAfn formula and are not based on reports by the stations.

[65] This count includes airplay stations which have not yet entered the airplay sample or have missing airplay logs in a particular ratings quarter.

Table 9 examines whether ownership of airplay stations by large national owners affects their listenership. The specification is the same as (5) except that the dependent variable is the natural logarithm of the station's listenership share in its home market and the time dummies are replaced by ratings quarter dummies. The regression in column (1) does not include station fixed effects. Stations which are commonly owned in their market-category and stations with large owners tend to have larger audiences. The regression in column (2) includes station-category fixed effects and, as ownership appears to have a delayed effect on listenership, I drop observations from the 12 months following changes in any of the ownership variables. As expected, within market-category common ownership increases station listenership and common ownership of other stations in the same market-category tends to reduce listenership, although the second effect, which is the effect for airplay stations which stay in the category, is statistically insignificant. Ownership by a large owner is associated with a very small (less than 1%) and statistically insignificant increase in listenership. As stations owned by large firms increase their commercial loads, this result suggests that they are able to increase some other aspect of station quality. One way that this could happen, consistent with homogenization, is that programmers in different markets share music research information to identify the songs and the type of playlist that are most popular with the marginal listener.

Another back-of-the-envelope calculation illustrates the increase in revenues associated with ownership by a large firm. Out of the set of stations which change whether they have a large owner, the median estimated annual revenue was $5.5 million in 2000. If this station's commercial load increased by 5% and, because it does not lose listeners, its revenues increased by 5% as well, then the increase in its revenues would be just under $300,000.[66]

[66] Of course, if a station can only charge a lower price per listener per minute of commercials when it has more commercials the revenue effect will be smaller.

7 Conclusion

This paper has examined how ownership of multiple products affects the selection of product characteristics using data from the music radio industry. As well as being relevant to policy, the radio industry provides an excellent setting for examining these effects because stations can easily change their playlists and we can observe many changes in ownership affecting stations in well-defined local markets.

I find that both within-market and cross-market common ownership have significant effects. In particular, commonly owned stations in the same local market and music category tend to differentiate their playlists and gain listeners, and their playlists also become more similar to those of competitors which lose similar numbers of listeners. This is consistent with theoretical predictions if stations' incentives to strategically differentiate their programming are relatively weak and radio listening is relatively inelastic. I also find some evidence that commonly owned stations play more commercials, consistent with a common owner exercising market power in the market for listeners rather than in the market for advertisers. Cross-market common ownership is associated with a limited homogenization of programming, consistent with a common owner enjoying economies of scope in offering similar programming in different markets. The fact that stations owned by large national radio companies have been able to play more commercials without losing listeners suggests that homogenization has increased station quality, at least for the marginal listener, consistent with these companies using information from different markets to identify which songs appeal to listeners.

Three issues merit further discussion. The first issue is how these findings may apply in other industries. The result that cross-market common ownership results in homogenization seems likely to hold generally and economies of scope are likely to explain the success of many retail and service chains. I find relatively small homogenization effects, even for stations that describe their programming in the same way, and find evidence that homogenization increases product quality. It would be interesting to know the extent to which cross-market firms in other industries homogenize their products.

The theoretical effects of within-market common ownership are ambiguous because the direct and strategic effects described in Section 2.1 may operate in opposite directions. In industries where changes in product positioning have only weak effects on the intensity of price competition and the total size of the market is relatively inelastic, common ownership should have the effects that I describe. On the other hand, in industries where price competition between similar products is intense, a common owner is more likely to cluster its products to soften price competition with other firms.

The second issue concerns the implications of my results for welfare. Preferences over music are surely heterogeneous so that changes in playlists are likely to affect the welfare of listeners in different ways, and the overall welfare effects of changes in product differentiation cannot be assessed without more information on listener tastes. Assessing welfare is difficult because changes in listenership and station choices are determined by the preferences of the marginal listener, and these may be quite different from the preferences of inframarginal listeners. For example, while the results suggest that the marginal listener prefers shorter and more homogenized playlists, a music-lover may have strong preferences for songs by local artists. A stronger welfare result is that neither within-market nor cross-market common ownership appear to have reduced the welfare of advertisers, as they have been associated with increases in commercial loads.

The third issue concerns the implications of the results for policy. The Department of Justice's investigations of radio mergers have focused on the question of whether within-market mergers may increase prices for advertisers. I find some evidence that instead common owners of stations in the same category tend to exercise market power over listeners. I also find that changes in how a common owner positions its stations toughen competition for listeners. This type of effect is ignored in merger analysis, but it is clearly important in this industry. The FCC and Congress have been more concerned with how common ownership affects non-commercial aspects of programming. Within-market common ownership appears to have had little effect on aggregate variety even though it does change what stations play. While cross-market common ownership has resulted in a limited homogenization, my results indicate that this has benefitted advertisers and at least some listeners,

and that competition for listeners continues to provide stations with strong incentives to serve local tastes.

References

[1] Ahlkvist, Jarl A. and Gene Fisher (2000), "And The Hits Just Keep on Coming: Music Programming Standardization in Commercial Radio", *Poetics*, 27(5), 301-325

[2] Anderson, Simon P. and Stephen Coate (2005), "Market Provision of Broadcasting: A Welfare Analysis", *Review of Economic Studies*, forthcoming

[3] Arbitron Company (2002), *Arbitron Radio Market Report Reference Guide*, New York, NY: Arbitron Company

[4] Beebe, Jack H., "Institutional Structure and Program Choices in Television Markets", *Quarterly Journal of Economics*, 91(1), 15-38

[5] Berry, Steven T. (1994), "Estimating Discrete-Choice Models of Product Differentiation", *RAND Journal of Economics*, 25(2), 242-262

[6] Berry, Steven T. and Joel Waldfogel (1999a), "Free Entry and Social Inefficiency in Radio Broadcasting", *RAND Journal of Economics*, 30(2), 397-420

[7] Berry, Steven T. and Joel Waldfogel (1999b), "Mergers, Station Entry and Programming Variety in Radio Broadcasting", National Bureau of Economic Research Working Paper No. 7080

[8] Berry, Steven T. and Joel Waldfogel (2001), "Do Mergers Increase Product Variety? Evidence from Radio Broadcasting", *Quarterly Journal of Economics*, 116(3), 1009-1025

[9] BIA Financial Network, Inc. (2001), *Media Access Pro User's Manual, version 3.0*, Chantilly, VA: BIA Financial Network, Inc.

[10] Billboard Publishing, *Billboard*, various issues, Cincinnati, OH: Billboard Publishing Company

[11] Borenstein, Severin (1986), "Too Much Rock and Roll?: Business Stealing Effects in Radio Station Format Choice", mimeo, University of Michigan

[12] Borenstein, Severin and Janet S. Netz (1999), "Why Do All the Flights Leave at 8 am? Competition and Departure-Time Differentiation in Airline Markets", *International Journal of Industrial Organization*, 17(5), 611-640

[13] Brown, Keith and George Williams (2002), "Consolidation and Advertising Prices in Local Radio Markets", mimeo, Federal Communications Commission

[14] Brown, Keith and Peter J. Alexander (2004), "Market Structure, Viewer Welfare, and Advertising Rates", *Economic Letters*, 86(3), 331-337

[15] Chambers, Todd (2003), "Radio Programming Diversity in the Era of Consolidation", *Journal of Radio Studies*, 10(1), 33-45

[16] Connolly, Marie and Alan B. Krueger (2005), "Rockonomics: The Economics of Popular Music", National Bureau of Economic Research Working Paper No. 11282

[17] Corts, Kenneth S. (2001), "The Strategic Effects of Vertical Market Structure: Common Agency and Divisionalization in the US Motion Picture Industry", *Journal of Economics and Management Strategy*, 10(4), 509-528

[18] Cunningham, Brendan M. and Peter J. Alexander (2004), "A Theory of Broadcast Media Competition and Advertising", *Journal of Public Economic Theory*, 6(4), 537-636

[19] DiCola, Peter and Kristin Thomson (2002), *Radio Deregulation: Has It Served Citizens and Musicians?*, Washington DC: Future of Music Coalition

[20] Dukes, Anthony and Esther Gal-Or (2003), "Minimum Differentiation in Commercial Media Markets", *Journal of Economics & Management Strategy*, 12(3), 291-325

[21] Duncan, James H., *Duncan's American Radio*, issues from Spring 1996 to Spring 2001

[22] Economides, Nicholas (1989), "Symmetric Equilibrium Existence and Optimality in Differentiated Product Markets", *Journal of Economic Theory*, 47(1), 178-194

[23] Federal Communications Commission (2001), *Review of the Radio Industry, 2001*, Mass Media Bureau Policy and Rules Division, Washington DC: Federal Communications Commission

[24] Gabszewicz, Jean J., Didier Laussel and Nathalie Sonnac (2001), "TV-Broadcasting Competition and Advertising", mimeo, Université Catholique de Louvain

[25] Gandhi, Amit, Luke Froeb, Steven Tschantz and Gregory J. Werden (2005), "Post-Merger Product Repositioning", *mimeo*, Vanderbilt University

[26] George, Lisa M. (2001), "What's Fit to Print: The Effect of Ownership on Product Variety in Daily Newspaper Markets", mimeo, Michigan State University

[27] Greene, William H. (1997), *Econometric Analysis*, 3^{rd} Edition, Upper Saddle River, NJ: Prentice Hall

[28] Hausman, Jerry A., Bronwyn H. Hall and Zvi Griliches (1984), "Econometric Models for Count Data with an Application to the Patents-R & D Relationship", *Econometrica*, 52(4), 909-938

[29] Jaffe, Adam B. (1986), "Technological Opportunity and Spillovers of R&D: Evidence from Firms' Patents, Profits, and Market Value", *American Economic Review*, 76(5), 984-1001

[30] Klein, Joel I. (1997), "DOJ Analysis of Radio Mergers", speech delivered in Washington, DC , February 19, 1997, http://www.usdoj.gov/atr/public/speeches/1055.pdf

[31] MacFarland, David T. (1997), *Future Radio Programming Strategies*, 2^{nd} edition, Mahwah, N.J.: Erlbaum

[32] M Street Journal, *STAR Ratings* (www.stationratings.com), Littleton, NH: M Street Journal

[33] National Association of Broadcasters (2002), "Future of Music Coalition Circulates Flawed Study Containing Inaccurate Conclusions About the Radio Industry", press release, 15 November 2002, Washington DC: National Association of Broadcasters

[34] Radio Advertising Bureau (2004), *Radio Marketing Guide & Fact Book for Advertisers*, New York: Radio Advertising Bureau, www.rab.com

[35] Rogers, Robert P. and John R. Woodbury (1996), "Market Structure, Program Diversity and Radio Audience Size", *Contemporary Economic Policy*, XIV(1), 81-91

[36] Rogers, William H. (1993), "Regression standard errors in clustered samples", *Stata Technical Bulletin*, 13, 19-23

[37] Spence, A. Michael and Bruce Owen (1977), "Television Programming, Monopolistic Competition, and Welfare", *Quarterly Journal of Economics*, 91(1), 103-126

[38] Stata Corporation (2003), *Stata Statistical Software: Release 8.0*, College Station, TX: Stata Corporation

[39] Steiner, Peter O. (1952), "Program Patterns and Preferences, and the Workability of Competition in Radio Broadcasting", *Quarterly Journal of Economics*, 66(2), 194-223

[40] Sweeting, Andrew T. (2004), "Music Variety, Station Listenership and Station Ownership in the Radio Industry", Center for the Study of Industrial Organization Working Paper No. 49, Northwestern University

[41] Tirole, Jean M. (1988), *The Theory of Industrial Organization*, Cambridge, MA: MIT Press

[42] United States Department of Justice and Federal Trade Commission (1997), *Horizontal Merger Guidelines*, Washington DC: Department of Justice

[43] United States Department of Justice (1999), "Justice Department Approves Clear Channel's Acquisition of Jacor Communications after Parties Agree to Divestitures", press release, April 22 1999

[44] United States Department of Justice (2000a), "Justice Department Requires Divestitures in Kansas City Radio Acquisition", press release, July 14 2000

[45] United States Department of Justice (2000b), "Justice Department Requires Clear Channel and AMFM to Divest 99 Radio Stations in 27 Markets", press release, July 20 2000

[46] United States Department of Justice (2000c), "United States v. Clear Channel Communications, Inc. and AMFM Inc.: Competitive Impact Statement", November 15, 2000

[47] Waldfogel, Joel and Julie Wulf (2005), "Measuring the Effect of Multimarket Contact on Competition: Evidence from Radio Broadcast Ownership Deregulation", mimeo, University of Pennsylvania

[48] Williams, George, Keith Brown and Peter Alexander (2002), "Radio Market Structure and Music Diversity", Media Bureau Staff Research Paper, Washington DC: Federal Communications Commission

[49] Williams, George and Scott Roberts (2002), "Radio Industry Review 2002: Trends in Ownership, Format, and Finance", Media Bureau Staff Research Paper, Washington DC: Federal Communications Commission

A Theoretical Effects of Common Ownership

A.1 Within-market common ownership

In this Appendix I show how common ownership affects the first-order conditions of station A in the within-market model described in Section 2.1.[67]

When stations A and B are separately owned, A's first order condition in the second stage of the game is

$$p(\underline{c})L_A(a,\underline{c}) + c_A L_A(a,\underline{c})\frac{\partial p(\underline{c})}{\partial c_A} + c_A p(\underline{c})\frac{\partial L_A(a,\underline{c})}{\partial c_A} = 0 \tag{6}$$

The second and third terms reflect how increasing commercial loads may reduce the price of advertising if $\frac{\partial p(\underline{c})}{\partial c_A} < 0$ or reduce A's listenership if listeners dislike commercials $\left(\frac{\partial L_A(a,\underline{c})}{\partial c_A} < 0\right)$. When A and B are commonly owned, A's first order condition is

$$p(\underline{c})L_A(a,\underline{c}) + \sum_{j=A,B} c_j L_j(a,\underline{c})\frac{\partial p(\underline{c})}{\partial c_A} + c_j p(\underline{c})\frac{\partial L_j(a,\underline{c})}{\partial c_A} = 0 \tag{7}$$

The additional terms reflect how A's commercial load affects B's revenues. Common ownership gives A an additional incentive to increase its commercial load if $\frac{\partial L_B(a,\underline{c})}{\partial c_A} > 0$ (the standard multi-product pricing effect for substitutes) and an additional incentive to reduce its load if $\frac{\partial p(\underline{c})}{\partial c_A} < 0$ (a market power effect in the market for advertisers).

In the first stage of the game A chooses its location. To limit the amount of notation, define $\Pi_A(a) = c_A^*(a)p(\underline{c}^*(a))L_A(a,\underline{c}^*(a))$ where $\underline{c}^*(a)$ are the equilibrium commercial loads in the second stage. The envelope theorem implies that $\frac{\partial \Pi_A}{\partial c_A} = 0$. A's first order condition when all stations are separately owned is

$$\frac{d\Pi_A}{da} = \underbrace{\frac{\partial \Pi_A}{\partial L_A}\frac{\partial L_A}{\partial a}}_{\text{Direct effect}} + \underbrace{\frac{\partial \Pi_A}{\partial L_A}\left(\frac{\partial L_A}{\partial c_B}\frac{dc_B^*}{da} + \frac{\partial L_A}{\partial c_C}\frac{dc_C^*}{da}\right)}_{\text{Strategic effect 1 through A's listenership}} + \underbrace{\frac{\partial \Pi_A}{\partial p}\left(\frac{\partial p}{\partial c_B}\frac{dc_B^*}{da} + \frac{\partial p}{\partial c_C}\frac{dc_C^*}{da}\right)}_{\text{Strategic effect 2 through price of advertising}} = 0 \tag{8}$$

The direct effect reflects how changing a affects the distance that listeners have to travel to A. When a increases, all else equal, some listeners will switch from A to B, and others will switch from C to A. The second term reflects how the choice of a affects other stations' choices of commercial loads and how this changes A's listenership. The standard effect is that A has an incentive to "strategically differentiate" its location from B and C to soften competition, increasing their commercial loads, because this tends to increase A's listenership. The third term reflects how the choice of a affects other stations' choices of commercial loads and how this changes the price of commercials. If the price falls when other stations play more commercials then A may want to toughen second stage competition to increase advertising prices.

When A and B are commonly owned a is chosen to maximize $\Pi_{A\&B}(a) = c_A^*(a)p(\underline{c}^*(a))L_A(a,\underline{c}^*(a)) + c_B^*(a)p(\underline{c}^*(a))L_B(a,\underline{c}^*(a))$. The envelope theorem implies that both $\frac{\partial \Pi_{A\&B}}{\partial c_A} = 0$ and $\frac{\partial \Pi_{A\&B}}{\partial c_B} = 0$. The

[67] The assumption that station choices will satisfy first-order conditions does not hold in many simple models of firm location. For example, a two-stage circular city model with separately owned firms, a uniform distribution of consumers and linear transport costs has no subgame perfect equilibrium (Economides (1989)).

first order condition with respect to a is

$$\frac{d\Pi_{A\&B}}{da} = \underbrace{\frac{\partial \Pi_{A\&B}}{\partial L_A}\frac{\partial L_A}{\partial a} + \frac{\partial \Pi_{A\&B}}{\partial L_B}\frac{\partial L_B}{\partial a}}_{\text{Direct effect}} + \underbrace{\left(\frac{\partial \Pi_{A\&B}}{\partial L_A}\frac{\partial L_A}{\partial c_C} + \frac{\partial \Pi_{A\&B}}{\partial L_B}\frac{\partial L_B}{\partial c_C}\right)\frac{dc_C^*}{da}}_{\text{Strategic effect 1 through A and B's listenership}} + \tag{9}$$

$$\underbrace{\frac{\partial \Pi_{A\&B}}{\partial p}\frac{\partial p}{\partial c_C}\frac{dc_C^*}{da}}_{\text{Strategic effect 2 through price of advertising}} = 0$$

The change in the direct effect provides a common owner with an incentive to increase a, so that A takes listeners from C rather than "cannibalizing" B's audience. The change in the strategic effects is that, because A and B set commercial loads cooperatively in the second stage, A only has an incentive to affect C's choice through a strategic choice of A. If reducing a softens competition and an increase in C's commercial load increases A and B's profits then the strategic effects will tend to move A away from C and towards B because A no longer benefits from strategically differentiating itself from B.

A.2 Cross-market common ownership

The following model illustrates how economies of scope may lead to playlist homogenization. Two stations in different markets have to choose which of two songs, S_1 and S_2, to add to their playlists. One song is the better match in each market and a station gets a payoff of $\Psi > 0$, from a larger audience, if it picks the better matched song. Tastes are correlated across markets so that if S_i is a better match in one market then it is the better match in the other market with probability $\lambda \geq \frac{1}{2}$. Before choosing a song, each station can do research in its own market to improve its information about listener tastes. Prior to research, each station believes that the probability that each song is the better match in its market is $\frac{1}{2}$. The research technology allows a station to do a series of experiments. Each experiment is successful with probability $p \leq 1$ in which case it correctly reveals the better matched song and otherwise it provides no information. Each successive experiment is more expensive, so that there are declining returns to research expenditure, and a station sees the results of an experiment before having decide whether to do another one. If a station finds out nothing about listener tastes then it is assumed to choose either song with equal probability.

If commonly owned stations can share research and separately owned stations cannot then it is straightforward to show that commonly owned stations are more likely to choose the same song if $\lambda > \frac{1}{2}$ (correlated tastes).[68] A common owner has more incentive to get one research success than an independent owner, because the first success benefits its other station. This effect leads to homogenization and makes it more likely that a commonly owned station will play the better matched song. There is also a research redundancy effect, where a common owner has less incentive to get a second success which is likely to only duplicate the first. This also leads to homogenization but it has the implication that the commonly owned stations may be less likely to play the better matched

[68] A sketch of the proof: under separate ownership the probability of choosing the same song is λ if both stations have a success and $\frac{1}{2}$ otherwise. Under common ownership it is λ if they both have a success, 1 if only one of them has a success and $\frac{1}{2}$ otherwise. The probability of choosing the same song is therefore certainly higher under common ownership if the probability of at least one station having a success is higher under common ownership. This follows from comparing the expected marginal benefits of doing a particular project on an unsuccessful to date separately owned station and on a commonly owned station when both of the stations have been unsuccessful to date. In particular, the expected marginal benefit of the last project which a separately owned station would choose to undertake is $\frac{p\Psi}{2}$ whereas a commonly owned station would have an expected marginal benefit from undertaking the same project of $p\lambda\Psi$. The common owner therefore has more incentive to continue to do research until he gets a success if $\lambda > \frac{1}{2}$.

songs.[69]

In practice independent stations can partially observe what stations in other markets are playing by listening to them, hiring consultants or looking at the airplay charts reported in trade publications, such as *Radio and Records*.[70] While this may mean that some of the economies of scope in music research are available to non-commonly owned stations, the ability of independent stations to free-ride on the research of other stations may provide another reason why we would expect a firm which owns many similar stations to be more willing than independent firms to invest in music research that improves station quality.

B Projection of Artists and Stations into Two Dimensional Music Product Space

This Appendix describes the construction of Figures 2(a) and (b). Artists and Adult Contemporary category stations are projected into a two dimensional music space using station playlists from the first week of November 2001. The procedure is:

1. artists are located in a high dimensional space where each station is an orthogonal dimension of the space. An artist's location reflects the proportion of its plays coming from each station. For example, if there were three stations and an artist was played 15, 5 and 0 times on stations X,Y and Z respectively then the artist's location vector would be $(\frac{3}{4}, \frac{1}{4}, 0)$;

2. the distances between each of the 60 most played artists (who account for 47% of the songs played by all of the stations in the category) are measured by the angle (in radians) between their location vectors;

3. the 60 most played artists are projected into the plane minimizing the difference between the distances between the artists in the plane and the distances between them in the high-dimensional space. The objective function is

$$\sum_{i=1}^{59} \sum_{j=i+1}^{60} \left(d_{ij} - \sqrt{(x_i - x_j)^2 + (y_i - y_j)^2} \right)^2 \tag{10}$$

   where d_{ij} is the high-dimensional distance between artists i and j found in step 2 and (x_i, y_i) are the coordinates of artist i in the plane. These are the parameters to be estimated. The most played artist is fixed at the origin and the second most played artist is fixed on the x-axis. (10) may have multiple local minima so the minimization is repeated from 100 different sets of starting values. The first set places all artists at the origin and the other sets are formed by drawing the x- and y-coordinates from an independent, bivariate standard normal distribution;

4. the distance between the 61^{st} most played artist and each of the 60 most played artists in the high dimensional space is measured. The 61^{st} most played artist is then located by minimizing $\sum_{j=1}^{60} \left(d_{61j} - \sqrt{(x_{61} - x_j)^2 + (y_{61} - y_j)^2} \right)$ where the locations of the 60 most played artists are fixed. A single starting point, at the average coordinates of the artists already located, is used.

[69] This can be seen in a very simple example with $p = 1, \Psi = 3, \lambda = 0.8$ and the cost of the first experiment on each station equal to 1. With these parameters the separately owned stations both perform one experiment and play the better matched song. On the other hand, a common owner does the experiment on only one of its stations and plays the better matched song on the second station with probability 0.8.

[70] MacFarland (1997), p. 153, describes many programmers are "chart-watchers".

This procedure is repeated for each subsequent artist, taking the location of all of the more heavily played artists as given; and,

5. each station is located at the weighted average of the coordinates of the artists which it plays, with the weights equal to the share of each artist in its playlist.

Appendix C: Summary Statistics

Regression Table	Variable	Number of Observations	Mean	Std. Dev.	Minimum	Maximum
4(a) same category	Measure 1 Pair Distance	15,792	1.1698	0.3466	0.1878	1.5708
4(a) same category	Measure 2 Pair Distance	15,792	0.5795	0.2784	0.0149	1
4(a) same category	*SAME_OWNER*	15,792	0.2351	0.4240	0	1
4(a) all categories	Measure 1 Pair Distance	134,611	1.4588	0.1994	0.1878	1.5708
4(a) all categories	Measure 2 Pair Distance	134,611	0.8631	0.1942	0.0149	1
4(a) all categories	*SAME_OWNER*	134,611	0.1898	0.3923	0	1
5(a)	Measure 1 Pair Distance	14,475	1.0917	0.3082	0.2991	1.5708
5(a)	Measure 2 Pair Distance	14,475	0.4962	0.2449	0.0195	1
5(a)	*PAIR_SAME_OWNER*	14,475	0.1621	0.3686	0	1
5(b)	Average Measure 1 Distance	2,436	1.2093	0.2042	0.4058	1.5277
5(b)	Average Proportion of Unique Artists	2,436	0.3787	0.1530	0.0340	0.8520
5(b)	Inverse Concentration of Combined Market-Category Playlist	2,436	125.5	41.0	22.4	299.3
5(b)	*OWNERS*	2,436	2.4889	0.6969	1	5
6(a)	Measure 1 Pair Distance	300,839	0.9455	0.3638	0.1778	1.5708
6(a)	Measure 2 Pair Distance	300,839	0.4002	0.2772	0.0073	1
6(a)	Measure 1 Pair Distance (Artist-Song Titles)	300,839	1.1306	0.2814	0.2056	1.5708
6(a)	*SAME_OWNER*	300,839	0.1067	0.3087	0	1
6(b)	Number of Artists	21,095	176.5	66.7	37	596
6(b)	Proportion of Songs By 20 Most Played Artists	21,095	0.4728	0.1025	0.2039	0.9132
6(b)	Number of Artists per 1,000 Songs	21,095	131.5	51.6	23.6	481.2
6(b)	*COMMONLY_OWNED_STATIONS*	21,095	1.2452	0.4749	1	4
6(b)	*LARGE_OWNER*	21,095	0.3179	0.4657	0	1
7	Number of minutes of commercials in hour	960,634	11.9504	4.6989	0	39
7	Number of commercial breaks in hour	960,634	2.2046	0.7835	0	7
7	*COMMONLY_OWNED_STATIONS*	960,634	1.2335	0.4643	1	4
7	*OTHER_STATIONS_COMMONLY_OWNED*	960,634	0.0766	0.2660	0	1
7	*LARGE_OWNER*	960,634	0.3349	0.4720	0	1
8	Pair Combined Listenership Share	3,023	0.0138	0.0048	0.0027	0.0398
8	*SAME_OWNER*	3,023	0.2319	0.4221	0	1
8	Combined Share of Other Stations in Market-Category	2,947	0.0076	0.0067	0	0.0443
8	Number of other stations in market-category	2,947	2.6149	2.3380	0	13
8	Number of other airplay in market-category	2,947	1.0778	1.0927	0	4
9	Station Listenership	6,758	0.0084	0.0041	0.0005	0.0376
9	*COMMONLY_OWNED_STATIONS*	6,758	1.2217	0.4493	1	4
9	*OTHER_STATIONS_COMMONLY_OWNED*	6,758	0.0725	0.2593	0	1
9	*LARGE_OWNER*	6,758	0.2850	0.4514	0	1

Figure 1: Location of Stations in Within-Market Competition Model

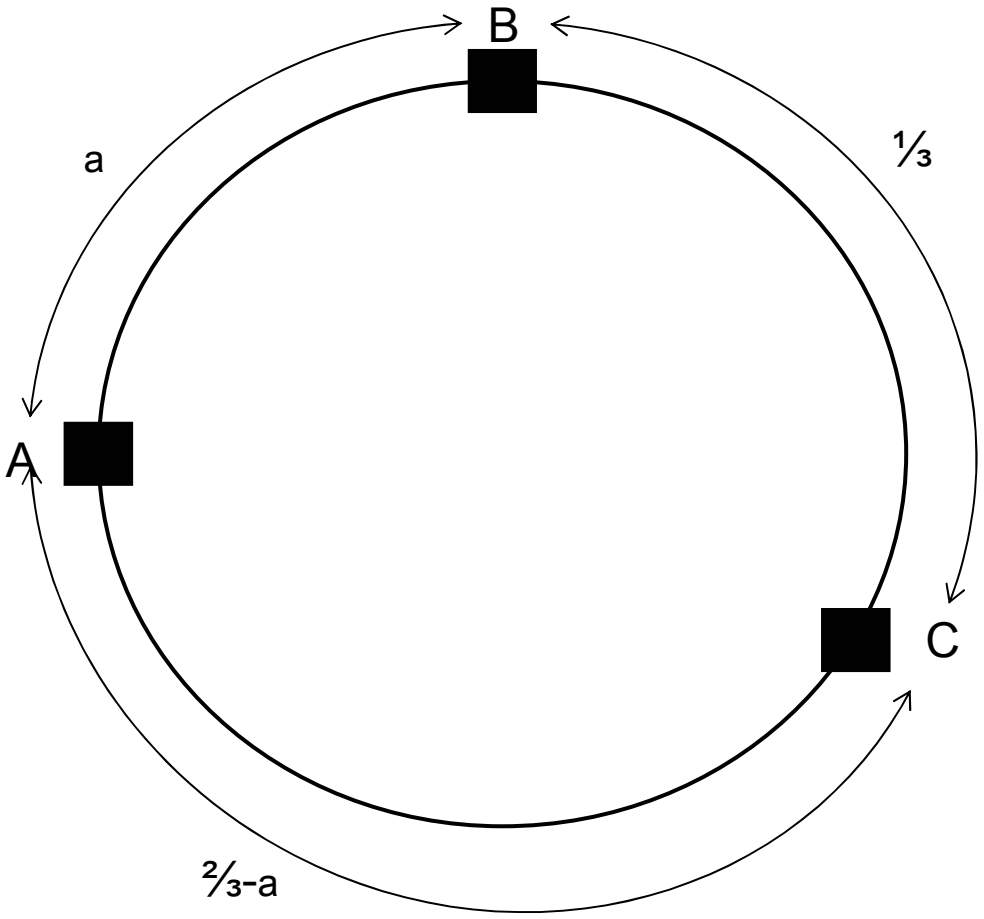

Figure 2(a): 30 Most Played Artists on Stations in the Adult Contemporary Category in the First Week of November 2001
Projected into a 2 Dimensional Music Product Space

Figure 2(b): Stations in the Adult Contemporary Category in 2 Dimensional Music Product Space Based on their Playlists in the First Week of November 2001

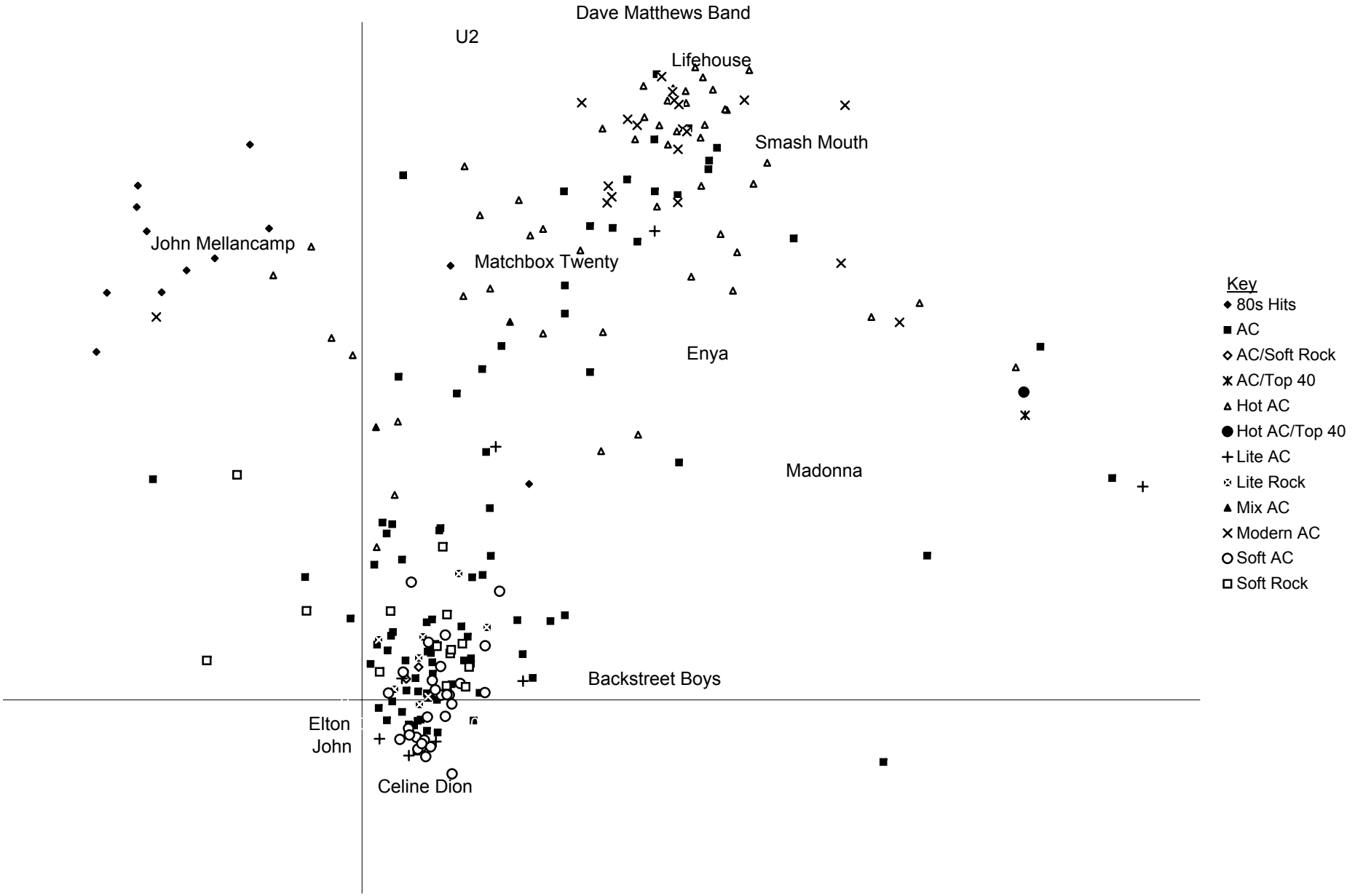

Table 2: Coverage of the Airplay Sample Based on Fall 2001 Station Categories and Ratings

Category	Number of Market Categories (MCs) with Home to Market Stations in the Airplay Sample	Number of Home to Market Rated Stations in MCs with at least one Airplay Station	Number of Home to Market Stations in Airplay Sample	Average % of Listening to Home to Market Stations Accounted for by the Airplay Stations
Arbitron Local Markets Ranked 1-70 (1 is New York City and 70 is Ft. Myers, FL)				
Adult Contemporary (AC)	66	221	162	89.2
Album Oriented Rock/Classic Rock (AOR)	65	111	98	95.9
Contemporary Hit Radio/Top 40 (CHR)	64	131	112	95.6
Country	64	141	94	92.1
Oldies	44	64	44	92.1
Rock	61	147	122	94.0
Urban	44	133	88	86.0
Arbitron Local Markets Ranked 71 and above (71 is Knoxville, TN)				
Adult Contemporary (AC)	56	135	78	78.7
Album Oriented Rock/Classic Rock (AOR)	34	66	45	82.5
Contemporary Hit Radio/Top 40 (CHR)	59	96	75	91.4
Country	60	137	76	85.7
Oldies	1	3	1	40.7
Rock	42	80	60	87.5
Urban	27	59	39	85.9

Table 3(a): Average Pair Distances Between Stations in the Same Category

	Stations in Same Category		Stations in Same Category and Format	
	Measure 1 Artists as Dimensions of Product Space	Measure 2 Proportion of Unique Artists	Measure 1 Artists as Dimensions of Product Space	Measure 2 Proportion of Unique Artists
Adult Contemporary	1.077 (0.316)	0.496 (0.247)	0.949 (0.290)	0.398 (0.219)
Album Oriented Rock/Classic Rock	0.997 (0.313)	0.423 (0.261)	0.849 (0.254)	0.293 (0.189)
Contemporary Hit Radio/Top 40	1.012 (0.283)	0.445 (0.233)	0.945 (0.263)	0.390 (0.208)
Country	0.513 (0.212)	0.108 (0.157)	0.513 (0.213)	0.108 (0.157)
Oldies	0.884 (0.431)	0.412 (0.340)	0.724 (0.334)	0.288 (0.264)
Rock	1.143 (0.314)	0.541 (0.275)	0.892 (0.258)	0.327 (0.192)
Urban	1.067 (0.278)	0.451 (0.235)	0.962 (0.241)	0.364 (0.183)

Distances are the average distance between pairs of stations in the same category in the same week. Standard deviations are in parentheses.
Measure 1 distance can vary between 0 (identical playlists) and 1.5708 (no artists in common). Measure 2 distance can vary between 0 (stations play only the same artists) and 1 (no artists in common). All Country category stations are also in the Country format.

Table 3(b): Pair Distances Between Stations in Different Categories

Average Measure 1 (*Measure 2*) distances between stations

	AC	AOR	CHR	Country	Oldies	Rock	Urban
Adult Contemporary	1.08	1.47	1.35	1.51	1.49	1.46	1.53
	0.50	*0.84*	*0.73*	*0.93*	*0.87*	*0.84*	*0.92*
Album Oriented Rock/Classic Rock		0.98	1.53	1.57	1.46	1.28	1.57
		0.42	*0.93*	*0.99*	*0.88*	*0.67*	*0.99*
Contemporary Hit Radio/Top 40			1.01	1.55	1.55	1.47	1.36
			0.45	*0.98*	*0.96*	*0.86*	*0.74*
Country				0.51	1.52	1.57	1.57
				0.11	*0.95*	*1.00*	*1.00*
Oldies					0.88	1.53	1.53
					0.41	*0.96*	*0.93*
Rock						1.14	1.56
						0.54	*0.99*
Urban							1.07
							0.45

Measure 1 distance can vary between 0 (identical playlists) and 1.5708 (no artists in common). Measure 2 distance can vary between 0 (stations play only the same artists) and 1 (no artists in common).

Table 4(a): Common Ownership and Differentiation Between Pairs of Stations in the Same Local Market

				Measure 1 Artists as Dimension of Product Space		Measure 2 Proportion of Unique Artists Played	
Pairs in the same category	Station-Pair Dummies	Category Dummies	Format-Pair Dummies	*SAME_OWNER*	*EVER_CLOSE *SAME_OWNER*	*SAME_OWNER*	*EVER_CLOSE *SAME_OWNER*
1. No pair fixed effects	No	Yes	No	0.1384 (0.0158)***	-	0.1208 (0.0136)***	-
2. Pair fixed effects	Yes	No	No	0.0837 (0.0200)***	-	0.0689 (0.0185)***	-
3. Use only observations from market-categories with at least 3 observed stations	Yes	No	No	0.1208 (0.0264)***	-	0.0901 (0.0204)***	-
4. Different effects for pairs which are ever close	Yes	No	No	-0.0139 (0.0087)	0.1280 (0.0257)***	-0.0080 (0.0223)	0.0984 (0.0302)***
5. Exclude 12 months following change in common ownership	Yes	No	No	-0.0084 (0.0130)	0.1524 (0.0393)***	0.0077 (0.0281)	0.1111 (0.0398)***
6. Format-pair dummies	Yes	No	Yes	-0.0057 (0.0159)	0.1276 (0.0355)***	0.0005 (0.0227)	0.1042 (0.0383)***
Pairs in any category							
7. No pair fixed effects	No	Yes	No	0.0328 (0.0040)***	-	0.0309 (0.0039)***	-
8. Pair fixed effects	Yes	No	No	0.0200 (0.0053)***	-	0.0185 (0.0054)***	-
9. Different effects for pairs which are ever close	Yes	No	No	0.0038 (0.0041)	0.0626 (0.0121)***	0.0023 (0.0028)	0.0462 (0.0122)***
10. Exclude 12 months following change in common ownership	Yes	No	No	0.0086 (0.0055)	0.0778 (0.0196)***	0.0059 (0.0041)	0.0644 (0.0183)***
11. Format-pair dummies	Yes	No	Yes	0.0073 (0.0046)	0.0750 (0.0178)***	0.0067 (0.0037)*	0.0559 (0.0148)***

Notes

Robust standard errors clustered on the market are in parentheses. ***, **, * denote statistical significance at the 1, 5 and 10% levels respectively.
The number of observations for pairs in the same category is 15,792 (15,273 dropping the 12 months following changes in common ownership).
The number of observations for pairs in market-categories with at least three observed stations is 9,286.
The number of observations for pairs from any category is 134,611 (131,656 dropping the 12 months following changes in common ownership).
Adjusted R^2s in row 1 are 0.42 (Measure 1) and 0.35 (2) and in row 7 0.51 (1) and 0.52 (2). The adjusted R^2s in the remaining rows are all between 0.90 and 0.93.
The *EVER_CLOSE* dummy equals 1 if the Measure 1 (2) distance between the pair is ever less than 1.2 (0.7).
All regressions include week dummies and dummies for the number of home market stations and the number of airplay stations in each station's market-category.

Table 4(b): Common Ownership and Differentiation Between Pairs of Stations in the Same Local Market by Category

					Measure 1		**Measure 2**	
	Average Pair Distance		Number of Pairs in Same Market		(1)	(2)	(3)	(4)
			Ever Commonly	Change Common	No Pair Dummies	Pair Dummies	No Pair Dummies	Pair Dummies
Category	Measure 1	Measure 2	Owned	Ownership	*SAME_OWNER*	*SAME_OWNER*	*SAME_OWNER*	*SAME_OWNER*
Adult Contemporary	1.2295	0.6220	46	13	0.1782 (0.0315)***	0.1305 (0.0689)*	0.1503 (0.0271)***	0.1139 (0.0493)**
Album Oriented Rock	1.236	0.6279	17	5	0.2128 (0.0395)***	0.1195 (0.0410)***	0.1968 (0.0395)***	0.0763 (0.0331)**
Contemporary Hit Radio	1.1645	0.5722	11	4	0.2052 (0.1003)**	0.1580 (0.0353)***	0.2096 (0.0833)**	0.1998 (0.0757)***
Country	0.5828	0.1729	16	6	0.0095 (0.0499)	0.0197 (0.0195)	0.0124 (0.0349)	0.0094 (0.0150)
Rock	1.3245	0.7004	32	12	0.1017 (0.0270)***	0.0453 (0.0183)**	0.0827 (0.0277)***	0.0339 (0.0152)**
Urban	1.2035	0.5753	32	6	0.1440 (0.0374)***	0.1301 (0.0568)**	0.1231 (0.0329)***	0.0977 (0.0490)**

Notes

Robust standard errors clustered on the market are in parentheses. Coefficients in each column and row are from separate regressions.

***, **, * denote statistical significance at the 1, 5 and 10% levels respectively.

All regressions include week dummies and dummies for the number of home market stations and the number of airplay stations in each station's market-category.

Table 5: Differentiation Between Commonly Owned Stations and Other Stations in the Same Market-Category & Market-Category Variety

(a) Distance from a Station to Each Pair of Other Stations in the Same Market-Category

	Measure 1		Measure 2	
	(1) No Station-Pair Dummies	(2) Station-Pair Dummies	(3) No Station-Pair Dummies	(4) Station-Pair Dummies
PAIR_SAMEOWNER	-0.0988 (0.0301)***	-0.0910 (0.0561)	-0.0772 (0.0242)***	-0.0643 (0.0388)*
Dummies	Week Category Number of Stations	Station-Pair Week Number of Stations	Week Category Number of Stations	Station-Pair Week Number of Stations
Adjusted R^2 (includes dummies)	0.2376	0.8983	0.2207	0.9076
Number of observations	14,475	14,475	14,475	14,475

Notes
Robust standard errors clustered on the market are in parentheses.
***, **, * denote statistical significance at the 1, 5 and 10% levels respectively.
See text for description of dependent variable.
Dummies for the number of home market stations in the market-category and the number of airplay stations in the market-category are included in all regressions.
Regressions use observation from market-category-weeks with at least three observed stations.

(b) Market-Category Variety

	Average Measure 1 Distance Between Station-Pairs		Average Proportion of Unique Artists on Each Station		Inverse Concentration of Combined Market-Category Playlist	
	(1) No Market-Category Dummies	(2) Market-Category-Observed Group Dummies	(3) No Market-Category Dummies	(4) Market-Category-Observed Group Dummies	(5) No Market-Category Dummies	(6) Market-Category-Observed Group Dummies
OWNERS	-0.0111 (0.0174)	-0.0107 (0.0095)	-0.0154 (0.0156)	-0.0122 (0.0119)	-0.0024 (0.0296)	-0.0063 (0.0265)
Dummies	Category Week Number of Stations	Station-Category -Observed Group Week Number of Stations	Category Week Number of Stations	Station-Category -Observed Group Week Number of Stations	Category Week Number of Stations	Station-Category -Observed Group Week Number of Stations
Adjusted R^2 (including dummies)	0.6310	0.9417	0.5309	0.9286	0.6194	0.8816
Observations	2,436	2,436	2,436	2,436	2,436	2,436

Notes (in addition to above)
Dummies for the number of observed stations in the market-category-week are also included in the regressions in columns (1), (3) and (5).

Table 6(a): Cross-Market Common Ownership and Playlist Homogenization

Pairs in the same category	Station-Pair Dummies	Category Dummies	Measure 1 Artists *SAME_OWNER*	Measure 1 Artists *SAME_FORMAT *SAME_OWNER*	Measure 2 Artists *SAME_OWNER*	Measure 2 Artists *SAME_FORMAT *SAME_OWNER*	Measure 1 Artist-Song Titles *SAME_OWNER*	Measure 1 Artist-Song Titles *SAME_FORMAT *SAME_OWNER*
1. No pair fixed effects	No	Yes	-0.0544 (0.0098)***	-	-0.0306 (0.0074)***	-	-0.0467 (0.0099)***	-
2. Pair fixed effects	Yes	No	-0.0105 (0.0057)*	-	-0.0050 (0.0039)	-	-0.0145 (0.0062)**	-
3. Different effects for same format	Yes	No	0.0001 (0.0097)	-0.0216 (0.0119)*	-0.0002 (0.0079)	-0.0098 (0.0112)	0.0000 (0.0073)	-0.0295 (0.0100)***
4. Drop 12 months following change in common ownership	Yes	No	0.0034 (0.0126)	-0.0334 (0.0178)*	0.0077 (0.0112)	-0.0215 (0.0153)	0.0008 (0.0091)	-0.0376 (0.0138)***

Notes

Regressions use all station-pairs from the same category and the same geographic region with different home markets.

Robust standard errors clustered on the region-category are in parentheses. ***, **, * denote statistical significance at the 1, 5 and 10% levels respectively.

All regressions include week dummies and dummies for the number of home market stations and the number of airplay stations in each station's market-category.

The number of observations is 300,839 (291,508 dropping the 12 months following changes in common ownership).

Adjusted R^2s in row 1 are between 0.30 and 0.37 and in rows 2-4 the R^2s are all above 0.89.

P-values for F-tests that the sum of the coefficients in row 3 are equal to zero are 0.0013 for Measure 1 Artists, 0.0835 for Measure 2 and 0.0000 for Measure 1 Artist-Song Titles.

P-values for F-tests that the sum of the coefficients in row 4 are equal to zero are 0.0026 for Measure 1 Artists, 0.0683 for Measure 2 and 0.0001 for Measure 1 Artist-Song Titles.

Table 6(b): Common Ownership and Playlist Length

	(1) Number of Artists	(2) Proportion of Plays of 20 Most Played Artists	(3) Number of Artists	(4) Proportion of Plays of 20 Most Played Artists	(3) Number of Artists per 1,000 songs
			Station-Category Fixed Effects	Station-Category Fixed Effects	Station-Category Fixed Effects
COMMONLY_OWNED_STATIONS	-1.8375 (2.9970)	-0.0020 (0.0048)	0.0308 (3.3504)	-0.0016 (0.0041)	0.0422 (2.5975)
LARGE_OWNER	-9.4372 (2.4991)***	0.0158 (0.0039)***	-5.9270 (2.6971)**	0.0144 (0.0041)***	-4.2438 (2.0687)**
TIME TREND (annual)	-0.3195 (0.7737)	0.0009 (0.0011)	-2.4450 (0.6351)***	0.0056 (0.0010)***	-2.0688 (0.4832)***
Dummies	Category Month Number of Stations	Category Month Number of Stations	Station-Category Month Number of Stations	Station-Category Month Number of Stations	Station-Category Month Number of Stations
Adjusted R^2 (includes dummies)	0.4084	0.3859	0.8681	0.8667	0.8665
Number of observations	21,095	21,095	21,095	21,095	21,095

Note

Robust standard errors clustered on the market are in parentheses. ***, **, * denote statistical significance at the 1, 5 and 10% levels respectively.
COMMONLY_OWNED_STATIONS is a count of the number of airplay stations which the owner of the station owns in the station's market-category.
LARGE_OWNER is a dummy variable which is equal to 1 if the station's owner has at least 30 stations in the category in all Arbitron markets.
The number of station dummies include dummies for the number of home market stations in the market-category and the number of airplay stations in the market-category.

Table 7: Common Ownership and Commercial Loads

	(1) Number of minutes of commercials in hour No station dummies	(2) Number of minutes of commercials in hour Station-category-hour dummies	(3) Number of breaks in hour Station-category-hour conditional fixed effects Poisson model
Year			
1999	0.4849 (0.1186) ***	0.5168 (0.1052) ***	0.0076 (0.0123)
2000	0.9764 (0.1633) ***	1.3095 (0.1551) ***	0.0566 (0.0138) ***
2001	0.9062 (0.1709) ***	1.6341 (0.1636) ***	0.0683 (0.0146) ***
Day of Week			
Tuesday	0.1463 (0.0231) ***	0.1064 (0.0217) ***	0.0011 (0.0014)
Wednesday	0.7048 (0.0301) ***	0.6728 (0.0288) ***	0.0239 (0.0018) ***
Thursday	0.7497 (0.0396) ***	0.6992 (0.0378) ***	0.0241 (0.0023) ***
Friday	0.7075 (0.0459) ***	0.7227 (0.0449) ***	0.0239 (0.0024) ***
Month			
February	2.4808 (0.0733) ***	2.5958 (0.0710) ***	0.1316 (0.0054) ***
March	2.2017 (0.0991) ***	2.4541 (0.0972) ***	0.1262 (0.0056) ***
April	2.9037 (0.0793) ***	2.9202 (0.0781) ***	0.1296 (0.0054) ***
May	3.2786 (0.0912) ***	3.6898 (0.0806) ***	0.1657 (0.0068) ***
June	2.9134 (0.0970) ***	3.0665 (0.0892) ***	0.1407 (0.0068) ***
July	2.7453 (0.0796) ***	2.9086 (0.0746) ***	0.1359 (0.0059) ***
August	2.8594 (0.0815) ***	3.0169 (0.0785) ***	0.1355 (0.0064) ***
September	2.4646 (0.0801) ***	2.7166 (0.0728) ***	0.1243 (0.0061) ***
October	2.9587 (0.0761) ***	3.2439 (0.0726) ***	0.1372 (0.0059) ***
November	3.1503 (0.0839) ***	3.4053 (0.0791) ***	0.1446 (0.0066) ***
December	3.5559 (0.1005) ***	3.8752 (0.0925) ***	0.1586 (0.0068) ***
COMMONLY_OWNED_STATIONS	0.4979 (0.1932) **	-0.0370 (0.1692)	-0.0026 (0.0168)
OTHER_STATIONS COMMONLY_OWNED	-0.4442 (0.3876)	-0.2042 (0.3126)	-0.0018 (0.0238)
LARGE_OWNER	0.4952 (0.1412) ***	0.6148 (0.1527) ***	0.0383 (0.0150) **
Additional dummies	Hour Category Number of Stations	Number of Stations Station-Category-Hour	Number of Stations
Adjusted R^2 (including dummies)	0.1003	0.4159	-
Log likelihood	-	-	-1,318,634.2
Number of observations	960,634	960,634	960,634

Notes

Robust standard errors clustered on the market are in parentheses. The standard errors in column (3) are calculated using a resampling bootstrap procedure with 50 replications. ***, **, * denote statistical significance at the 1, 5 and 10% levels respectively.

COMMONLY_OWNED_STATIONS is a count of the number of airplay stations which the owner of the station owns in the station's market-category. *OTHER_STATIONS_COMMONLY_OWNED* is a dummy variable which is equal to 1 if other airplay stations in the market-category are commonly owned by a different firm. *LARGE_OWNER* is a dummy variable which is equal to 1 if the station's owner has at least 30 stations in the category in all Arbitron markets.

The number of station dummies include dummies for the number of home market stations in the market-category and the number of airplay stations in the market-category.

Table 8: Common Ownership of Station-Pairs in the Same Market-Category and Station Listenership and Category Exit

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		Drop 12 months following change in common ownership	Drop 12 months following change in common ownership	Drop 12 months following change in common ownership	Drop 12 months following change in common ownership	Drop 12 months following change in common ownership	Drop 12 months following change in common ownership	Drop 12 months following change in common ownership	Drop 12 months following change in common ownership
			Different effect for ever close pairs			Observations where observe 3 or more airplay stations	Observations where observe 3 or more airplay stations	Conditional station-pair fixed effects Poisson model	Conditional station-pair fixed effects Poisson model
Dependent variable	Log of pair's combined share	Log of pair's combined share	Log of pair's combined share	Pair's combined share	Combined share of all other stations in market-category	Pair's combined share	Combined share of all other stations in market-category	Number of other stations in market-category	Number of other airplay stations in market-category
SAME_OWNER	0.0271 (0.0201)	0.0769 (0.0233)***	0.0485 (0.0501)	0.00098 (0.00038)***	-0.00100 (0.00046)**	0.00115 (0.00033)***	-0.00111 (0.00039)***	-0.2844 (0.1651)*	-0.3701 (0.1142)***
EVER_CLOSE SAME_OWNER*	-	-	0.0390 (0.0566)	-	-	-	-	-	-
Dummies	Station-Pair Number of Stations Ratings Quarter	Station-Pair Number of Stations Ratings Quarter	Station-Pair Number of Stations Ratings Quarter	Station-Pair Ratings Quarter	Station-Pair Ratings Quarter	Station-Pair Ratings Quarter	Station-Pair Ratings Quarter	Ratings Quarter	Ratings Quarter
Adjusted R^2 (including dummies)	0.9110	0.9121	0.9121	0.8945	0.8895	0.8962	0.8399	-	-
Number of Observations	3,023	2,947	2,947	2,947	2,947	1,767	1,767	2,947	2,947

Notes
Robust standard errors clustered on the market are in parentheses. The standard errors in columns (8) and (9) are calculated using a resampling bootstrap procedure with 50 replications.
EVER_CLOSE dummy equals 1 if the Measure 1 distance between the stations is ever less than 1.2.
***, **, * denote statistical significance at the 1, 5 and 10% levels respectively.

Table 9: Station Ownership and Station Listenership

	(1) No station-category dummies	(2) Station-category dummies Drop observations from 12 months following changes in any of the ownership variables
COMMONLY_OWNED_STATIONS	0.0881 (0.0298)***	0.0584 (0.0239)**
OTHER_STATIONS_COMMONLY_OWNED	-0.0020 (0.0543)	-0.0309 (0.0393)
LARGE_OWNER	0.0520 (0.0224)**	0.0038 (0.0183)
Dummies	Number of Stations Ratings Quarter	Station-Category Number of Stations Ratings Quarter
Adjusted R^2 (includes dummies)	0.2727	0.8872
Number of Observations	6,758	5,991

Notes

Robust standard errors clustered on the market are in parentheses.

***, **, * denote statistical significance at the 1, 5 and 10% levels respectively.

The dependent variable is the natural logarithm of the station's listenership share in its home market.

COMMONLY_OWNED_STATIONS is a count of the number of airplay stations which the owner of the station owns in the station's market-category. *OTHER_STATIONS_COMMONLY_OWNED* is a dummy variable which is equal to 1 if other airplay stations in the market-category are commonly owned by a different firm. *LARGE_OWNER* is a dummy variable which is equal to 1 if the station's owner owns at least 30 stations in the category in Arbitron markets.

The number of station dummies include dummies for the number of home market stations in the market-category and the number of airplay stations in the market-category.