Preliminary Draft

Comments Welcome

Please Do Not Cite

Too Much Rock and Roll? : Business Stealing Effects in Radio Station Format Choice

by Severin Borenstein*

Prepared for Presentation at the 1986 Winter meetings of the

Econometric Society, December 28-30, in New Orleans, LA

* Assistant Professor of Economics and Public Policy, The University of Michigan, Ann Arbor, MI 48109. Bruce Schillo, Dan Immergluck and Jon Western provided excellent research assistance. Funding from the University of Michigan's Rackham Research Fund is gratefully acknowledged.

Section 1: Introduction

A number of theoretical works in the last decade have investigated the potential for competitive or non-cooperative markets to generate an inefficient number of sellers (see Spence (1977), Dixit & Stiglitz (1977), Koenker & Perry (1981), Mankiw & Whinston (1986), and Borenstein (1986)). There are essentially two reasons that the profit motive might attract too many or too few sellers into a market. First, entry of an additional firm in the market generates some benefits that the entrant cannot capture, *e.g.,* lower price and/or greater variety that increase consumer surplus. These effects would tend to cause the equilibrium number of firms to be less than the efficient number. Second, some of the surplus earned by a new entrant may not be newly created, but rather just transferred from incumbent firms. To the extent that an entrant will be motivated in part by profits that are transfers, the equilibrium number of firms is more likely to exceed the efficient level. This has been called a "business stealing" effect by Mankiw & Whinston (1986) among others.

Borenstein (1986) examines these effects in the context of markets in which operating licenses, a scarce commodity, are necessary to enter. He shows that when a fixed number of licenses can be applied to any one of a number of different markets, there is little reason to believe that a competitive allocation will result in the efficient use of the licenses. Obvious applications of this principle include the market for a restricted number of landing slots at some airports, each of which can be used in a number of different city-pair markets, and the allocation of radio licenses, where each of the limited number available in a city can be used to operate in one of many different format-markets (*e.g.,* a broadcast license in Dallas can be used to play classical music, news, or rock.)

This paper takes an empirical look at the efficiency of radio broadcasting license allocation. In most metropolitan areas, the number of broadcasting licenses available restricts entry. The licenses are freely transferable and the Federal Communications Commission exercises very little influence over a license holder's format choice. In this context, we would like to surmise whether licenses are distributed efficiently among the different format-markets in which they could be used. Do licensees choose which format to enter

so as to maximize total surplus? Unfortunately, the data available do not allow us to consider the full question. The fact that radio broadcasting is financed by advertisers rather than listeners makes estimation of demand functions and, therefore, consumers' surplus extremely difficult.

A potentially significant aspect of the inefficiency, however, is the transfer of profits among firms in a market. The profit-maximizing use of a license may fail to correspond to the surplus-maximizing use, because some of the entrant's profits do not represent new surplus, but are the result of a transfer of listenership from incumbent stations in a format-market. Though the listeners who switch may be experiencing higher surplus with the new station, and though the new firm may be able to capture some of that surplus, a part of the new firm's profits may be offset by a decline in the profits of the incumbent stations. This paper attempts to measure such "listener stealing effects" and to formulate a model that will indicate situations in which they are of greater or lesser importance.

Though the formal literature on incentives for excessive or insufficient entry is relatively recent, the general reasoning is much older. Chamberlin (1931), of course, recognized that competition among imperfectly competitive firms may lead to excessive entry and inefficient underutilization of each firm's productions capabilities. In a more applied work, Steiner (1952) examines the efficiency of radio programming choice. He points out explicitly that, "increased duplication may be the result of rational program decisions of stations." The paper then demonstrates that excessive duplication is more likely to occur when the audience of incumbent stations in a format can be more easily persuaded to switch to a new entrant.

The following section presents a model of competition among radio stations within a format market. Stations produce programming, but intersperse advertisements, which listeners dislike. Listening to ads is the "price" that a consumer must pay to hear the programming. Firms compete by, among other things, lowering the number of ads they run. Within a given format, stations offer differentiated products, so entry increases variety, which is valuable to consumers. Competition pushes down "prices", the number of ads run, but profits are not driven to zero due to the restriction on the total number of licenses

in the area.

The model indicates that as the number of incumbents in a format-market increases, the increase in total surplus from entry declines relative to the profits that the potential entrant can expect to earn.[1] Due to the difficulty in measuring consumer surplus, this result is not directly testable. Still, the model also indicates that when there are many incumbents in a market, a higher proportion of the entrant's listeners will be switching from incumbents in the market, rather than coming into the market as new listeners. In other words, the business stealing effect becomes a relatively more important incentive for entry as the number of incumbents in a market increases. This is the primary reason that the change in total surplus falls in relation to the entrant's profits when there are more incumbents in the market.

The empirical study in the following sections seeks to test this hypothesis. We look at the change in audience size of incumbents when entry occurs. Because the model is symmetric in its view of entry and exit, and because the sample would otherwise be very small, we also examine events of exit from a format-market. We look at the change in audience size of remaining firms when exit occurs. We find weak (significant at the 10% level) evidence that a business stealing effect exists. Though the measure of the relationship between this effect and the number of firms in the market is in all specifications right-signed, in no case is it significantly different from zero. Thus, we cannot reject the hypothesis that the importance of the business stealing effect is independent of the number of firms in the market. It is quite possible that the weak results stem from the large degree of noise in measures of the change in audience sizes. With the relatively small sample, no attempt has been made to correct for these measurement errors. We plan to increase the size of the sample, more than doubling it, so that more sophisticated methods can be supported.

II: A Model of Station Competition Within a Format-Market

In most metropolitan areas, there is more than one station providing programming

[1] The lengthy derivation of this result is omitted from this draft.

within most of the major format designations.[2] Although the stations within each format-market are differentiated, they view as their primary competition other stations offering programming of the same format. Stations compete for listeners primarily in two ways: decreasing the number of advertisements they broadcast and changing certain characteristics of the programming, by means such as entertaining disc jockeys, contests and giveaways, frequency (or infrequency) of interruptions for up-to-the-minute news, weather and traffic reports, etc.

This description of radio format markets leads naturally to analysis in a characteristic-space model. We assume that a format-market can be viewed as a circular space of circumference S. Stations locate around this circle through adjustments to their programming. Consumers' "locations", their most preferred points, are distributed uniformly around the circle. A consumer listens to some station in the format-market if and only if at least one station offers her positive net utility

$$U = R_i - \beta d_i - \alpha a_x > 0 \qquad [1]$$

where

R_i is the gross utility that person i would derive from listening to a station at her most preferred point on the circle;

β is the disutility, per unit distance, of moving away from one's most preferred point;

d_i is the distance from the person i's most preferred point in characteristic space to station X;

α is the disutility of advertisements to the listener;

a_x is the number of ads that station X runs per unit time.

Thus, we assume that consumers differ in the gross utility they derive from listening to their "ideal" station, but that they have identical dislikes for ads and for moving away

[2] For the purpose of this study, we limit our attention to the standard format designations Rock, Beautiful Music, Middle of the Road, Country, News/Talk, Urban/Black, Spanish, Classical, Nostalgia/Big Band and Religion.

from their ideal stations.[3] If a consumer could get positive surplus from more than one station, she listens to the one that offers the highest surplus. Each consumer makes a binary decision to listen or not.[4]

The details of the demand function from such a model are laid out in Borenstein (1985), so it is only summarized here. A "type" of consumer is the group who all share the same value of R. It is assumed that the members of each type are distributed uniformly around the circle. Looking at the demand faced by firm X, we note that given the "prices" and locations of X and its neighbors, a type will either be served competitively or monopolistically. Competitive service occurs if all members of the type located between X and its neighbors receive positive utility from more than one station. Thus, the marginal listener to station X is choosing between X and its neighbor. Monopolistic service refers to the types for whom there are some members between X and its neighbors who receive negative surplus from all stations. Thus, the marginal listener to X is choosing between X and not listening to this any station in this format.

For types served monopolistically, the marginal X listener from type R_i is found by calculating the distance from X at which listener's surplus goes to 0.

$$R_i - \beta d - \alpha a_x = 0 \quad \Longrightarrow \quad d_m = \frac{R_i - \alpha a_x}{\beta}. \qquad [2]$$

Firm X serves all individuals of this type who are less than d distance from x, on both sides of x. Thus, the firm X receives listeners from type R_i

$$q_{x_i} = 2d = \frac{2(R_i - \alpha a_x)}{\beta}. \qquad [3]$$

the density of type R_i has been normalized to be one per unit distance.[5]

---

[3] The basic results can also be proven for the case in which consumers differ in their dislike of ads, but have identical R's. Closed-form solutions are much more difficult when more than one of R,β, and α are allowed to vary. See Borenstein (1985), for a detailed discussion of the more general model. Simulations of the model with a bivariate normal distribution of R and β as in Borenstein (1985), have yielded results in all cases consistent with those proven for this simplified version.

[4] This is not as restrictive as it may at first appear. One can think of many "consumers" as representing the decisions of a single person at different times of the day.

[5] This normalization presents no difficulties in the following analysis, because we will later assume a uniform distribution of R's.

For types served competitively, the marginal X listener from type R_i is found by calculating the point at which a listener would be indifferent between X and its neighbor. Since we look below for a symmetric Nash equilibrium, we here impose that all competitors of X charge the same "price", *i.e.,* run the same number of ads. We also assume that N firms will space themselves evenly, S/N apart from one another. In that case, the distance from X at which a listener's surplus from X is equal to her surplus from the neighboring station is

$$R_i - \alpha a_x - \beta d = R_i - \alpha a_j - \beta(S/N - d) \quad [4.1]$$

$$\Longrightarrow \quad d = \frac{S/N + \alpha(a_j - a_x)/\beta}{2}. \quad [4.2]$$

Thus,

$$q_{x_i} = 2d = \frac{S}{N} + \frac{\alpha(a_j - a_x)}{\beta}. \quad [5]$$

Note that the number of listeners to X is the same for all types that are served competitively.

A type will go from being served monopolistically to competitively at the point that the boundaries of two adjacent firm's monopoly markets for the type fill the entire space between the firms. The boundary R value, $R*$ can be determined for a given market size, number of firms and "prices" by

$$\frac{R - \alpha a_x}{\beta} + \frac{R - \alpha a_j}{\beta} = \frac{S}{N} \quad [6.1]$$

$$\Longrightarrow \quad R* = \frac{S\beta}{2N} + \frac{\alpha(a_x + a_j)}{2}. \quad [6.2]$$

For simplicity and analytic tractability, we assume that the reservation utilities are distributed uniformly with support $[0, \bar{R}]$. The number of listeners to station X is then

$$\frac{q_x}{L} = \int_{\alpha a_x}^{R*} \frac{2(R - \alpha a_x)}{\beta} dR + (\bar{R} - R*)(\frac{S}{N} + \frac{\alpha(a_j - a_x)}{\beta}) \quad [7.1]$$

where L is the number of listeners per unit distance along the circle. Listener density has no effect of the following equilibrium calculations and is suppressed for the remainder of the analysis. Integrating, substituting for $R*$, and simplifying this yields

$$q_x = -\frac{\beta S^2}{4N^2} + \frac{\alpha^2(3a_x^2 - a_j^2)}{4\beta} - \frac{\alpha^2 a_x a_j}{2\beta} - \frac{S\alpha(a_x + a_j)}{2N} + \frac{\bar{R}\alpha(a_j - a_x)}{\beta} + \frac{\bar{R}S}{4N}. \quad [7.2]$$

The radio station sells listener-minutes to advertisers. For brevity of presentation, I discuss here only the case in which each station is a price taker is the listener-minute market. That is, each station takes as given the price it is paid for each listener-minute it provides.[6] Station X's profits are then

$$\pi_x = q_x a_x P - F \qquad [8]$$

where F is fixed costs and P is the price that advertisers will pay for one listener-minute of station X's audience. This simple formulation assumes that a firm's costs are independent of the number of listeners they have. There is no causality in either direction.

Station X chooses the number of ads it runs in order to maximize profits, but more ads induce fewer listeners. Assuming Nash ad-number setting and recognizing that the price of ads will not affect the marginal condition for profit-maximization

$$d\pi/da_x = q_x + a_x \frac{dq_x}{da_x} = 0. \qquad [9.1]$$

Calculating the quantity derivative and substituting,

$$d\pi/da_x = -\frac{\beta S^2}{4N^2} + \frac{9\alpha^2 a_x^2 - \alpha^2 a_j^2}{4\beta} - \frac{\alpha^2 a_x a_j}{\beta} - \frac{S\alpha(2a_x + a_j)}{2N} + \frac{\bar{R}S}{N} + \frac{\bar{R}\alpha(a_j - 2a_x)}{\beta} = 0 \qquad [9.2]$$

and imposing symmetry ($a_x = a_j$)

$$d\pi/da_x = -\frac{\beta S^2}{4N^2} + \frac{\alpha^2 a^2}{\beta} - \frac{3S\alpha a}{2N} + \frac{\bar{R}S}{N} - \frac{\bar{R}\alpha a}{\beta} = 0. \qquad [9.3]$$

Equation [9.3] describes implicitly the relationship between the number of stations in a format-market and the number of ads each station will run in a Nash equilibrium. A business stealing effect occurs if the number of additional listeners in a market after entry is less than the audience of the new entrant. In a symmetric equilibrium after entry, the entrant receives Q/N listeners, where Q is the total listeners for the format-market. The

[6] The important results also hold for the case in which a station has market power in the listener-minute market and faces a linear demand function in selling to advertisers.

increase in format listenership due to entry is dQ/dN, so the proportion of the entrant's listeners that are stolen is

$$\text{proportion stolen} = \frac{Q/N - dQ/dN}{Q/N} = 1 - \frac{N}{Q}\frac{dQ}{dN} \qquad [10]$$

Thus, if the elasticity of total listeners with respect to N declines as N increases, then the business stealing effect is a proportionally larger part of the incentive to enter a market with many incumbents than one with few incumbents. It is mathematically tedious, but conceptually straightforward to show that this is the case. After a few pages of algebra, one can show that

$$\frac{dq}{dN} = \frac{\partial q}{\partial N} + \frac{\partial q}{\partial a}\frac{da}{dN} = \frac{-3\beta^2}{8N^3(\alpha a - \bar{R}) - 4N^2\beta}. \qquad [11]$$

So the elasticity of total listeners with respect to the number of stations in the format is

$$\frac{N}{Q}\frac{dQ}{dN} = \frac{-3\beta}{12N^2\bar{R}\alpha a - 4N^2\alpha^2 a^2 - 4N^2\bar{R}^2 - 2N\bar{R}\beta - \beta^2}. \qquad [12]$$

The derivative of this expression with respect to N is

$$\frac{d}{dN}\left(\frac{N}{Q}\frac{dQ}{dN}\right) = \frac{3\beta(24N\bar{R}\alpha a - 8N\alpha^2 a^2 - 16N\bar{R}^2 - 2\beta\bar{R})}{(12N^2\bar{R}\alpha a - 4N^2\alpha^2 a^2 - 4N^2\bar{R}^2 - 2N\bar{R}\beta - \beta^2)^2}. \qquad [13]$$

The denominator is, of course, positive and the numerator can be shown to be negative so long as $R > \alpha a$; the equilibrium number of ads must not be so high that no one listens to any station in the market.

The model predicts that the decline in the number of listeners to incumbent firms will be a larger proportion of the listeners to an entering firm if there are already many incumbents in the market than if there are few incumbents. The model is also completely symmetric in its treatment of entry and exit. Thus, with exit, the increase in the number of listeners to remaining stations will be a larger proportion of the former listeners to an exiting station if there are many remaining stations than if there are few. This symmetry justifies use of both entry and exit events in the following empirical analysis.

Section 3: Empirical Implementation of the Model

The model presented above gives some intuition for why entry in crowded markets is more likely to be motivated by "business stealing" than entry into less well served markets. If the model accurately described radio format markets, then direct implementation would be straightforward. Equation [11] gives an estimable description of the effect of entry on total listenership as a function of N, a, and exogenous parameters $\bar{R}$, α, β, and S. The first-order condition for a profit-maximizing symmetric equilibrium, equation [9.3], is quadratic in a (of which the larger root is always a profit minimum with no sales). It can be solved for a and substituted into [11], yielding an equation for dQ/dN as a complex function of N and the 4 parameters.

I have not estimated this equation. There are many reasons to think that the model presented in section 2 deviates from the true model substantially. This is true with almost any tractable model, and as with most, there are some changes that can be made to take into account some of the deviations.

First, in the model as it is spelled out above, there would never be any entry or exit, except in the case of new licenses becoming available or existing licenses being withdrawn. In fact, only a few of the 118 observation in our sample are due to changes in the number of available licenses. Otherwise, stations choose to change formats, exiting one format-market and entering another, primarily for one of two reasons. Either the change results from a change in the relative costs of providing service in different markets, or it is a reaction to a change in the demand for different formats of radio broadcasting. Levin (1971) and descriptions from my discussions with industry analysts indicate that the technology for operating a radio station has actually been very stable. More importantly, the advances that occurred between 1975 and 1984, the sample period, have not had significant impacts on the *relative* costs of different programming formats.

The primary motivation for entry and exit among radio formats is probably the change in listener tastes. Station changes tend to follow the trends reported in the trade press regarding which formats are growing. In the model, these taste changes can be viewed as an increase in the density of listeners in a format-market. The density, however, is

suppressed in the model. This is because the density has no effect on the N-firm equilibrium number of ads and, thus, no effect on the proportion of the total number of potential customers in the market who listen. Still, if one wants to distinguish the change due to entry or exit from the effect of taste changes, one must control for the latter effect. To do this, we have used changes in format listenership from out-of-sample cities as a proxy for changes in the tastes of individuals in the sample cities. This is described more fully in the data section. This allows us to compare the listenership after entry to some estimate of the listenership that would have occurred in the absence of entry, rather than to the previous year's listenership.

Whereas the taste variable is excluded from the model, but included in the regressions, the size-of-market variable is included in the model, but no data for it are available. What is meant by the size variable is the degree of diversity that exists within a format-market. This is, of course, a question of taste, but some quantification should be possible. Since we assume that the disutility of "travel" from one's most preferred point in characteristic space is the same across formats, the size variable is the only control for the fact that, for instance, a beautiful music fan might listen to any station of the format, but a jazz fan might listen only to a station that plays the particular type of jazz that the listener prefers. Though no data on these differences exist, there is likely to be such variation across formats. To control for such differences, we use dummy variables to scale the effect of entry on listenership differently for each format. Unfortunately, we have not yet gotten the regressions with format dummies to converge. So, in the regressions reported there is no control for these "size" differences.

The assumption of symmetry between entrant and incumbents in the model is not due to lack of data, but results from the pursuit of tractability. In fact, the firms in these markets are almost never symmetric in size. As in most real-world markets, entry and exit tend to occur primarily among the smaller firms. One could think of small entry and exit as N changing by less than one. The only available measure of the size of entry, however, would be the listenership that the entrant receives. If this is to be used, it makes more sense to estimate directly the effect of entry (exit) on the incumbent (remaining) firms than

to artificially impose a size of entrant. The result that the elasticity of listenership with respect to number of firms declines with N is equivalent to a result that the effect of the size of the entrants (exiters) audience should have a proportionally larger negative (positive) effect on incumbent (remaining) firms if N is large. Thus, rather than examining the effect of entry (exit) on total listenership, we look directly at the business stealing effect.

Finally, in the model, it is assumed that the reservation utility values are uniformly distributed. The "price" equivalent assumption would be linear demand curves. At the same time, all consumers are assumed to have the same α and β values. The result that the business stealing effect increases proportionally with N depends entirely on these assumptions. It is somewhat challenging, but possible, to find counterexamples in which the proportional business stealing effect declines with N. This is essentially what we want to test with the empirical analysis. We seek to find out whether the nature of demand and competitive interactions in the radio market do, in fact, cause the business stealing effect to grow with N. If this is the case, then Borenstein (1986) describes restrictions on the market allocation of licenses that may increase social welfare.

Section 4: Description of the Data and the Observations

The unit of observation for the study is the entry or exit of one or more firms in a format-market. The data are collected for the years 1975-1984 for the top five radio markets in the country, New York, Los Angeles, Chicago, Philadelphia, and San Francisco. For these years and cities we have assembled a panel of format and audience size for every station appearing in Arbitron's survey in each year.[7]

Information on a station's format is somewhat subjective. They report their format to services that compile advertising rates and demographic data for potential advertisers. Our data come from *Spot Radio Rates and Data* and *Broadcasting Yearbook*. Stations use

[7] Stations with a share of less than 0.1% of all listeners in a city in all quarters of a year are not shown in the Arbitron numbers. To avoid problems of counting one station's change from, say, 0.07% to 0.13% as entry into a format-market, entry (exit) required that a station not be listed in a format in the first (second) year and have at least a 5% share of the format-market's listeners in the second (first) year.

many different terms to describe their programming. To avoid counting as a change what is actually a renaming of a station's format by its owners, we have grouped stations into a relatively small number of broad format categories. Changes among these categories are, for the most part, distinct decisions to alter the programming and audience of a station. Those changes that might still be due to vague phrasing of the firm's format statement were dropped from the sample. The majority of changes for which we found a specified date occurred in the fall. Some occurred in the summer and winter, and only a very few occurred in the spring. For this reason we chose to use spring share data to determine the audience of each station.

The audience-size estimates were obtained from the Arbitron Ratings Service, the largest of the market surveyors in radio. For each quarter, Arbitron publishes the estimated proportion of the population in a city that listens to radio during an average quarter-hour period and the estimated proportion of those people who listen to each station. Multiplying share numbers by the proportion of radio listeners yields the estimated average proportion of the population in the listening area that was listening to a given station during an average quarter-hour period of the week.

We examined the change from the Spring of one year to the next when the number of stations reporting that they broadcasted a specified format changed during that period. As yet, we have not controlled for the actual point in time during the intervening nine months that the change occurred. We have those dates for only a small subset of the observations. By ignoring the time since change, we are assuming that the proportion of the audience of an entering (exiting) firm that is stolen from (switches to) incumbent firms is independent of the length of time since the firm has entered (exited). Though we have no strong priors about the derivative of this proportion over time, there is neither a strong argument for its constancy. Tests of this hypothesis can be made, though a somewhat larger set of observations with change dates will be necessary.

In many cases, more than one firm entered or exited a format-market during the same year. In this case, we examined the net change from all exit and entry in the market. If, for instance, one station that had 25 listeners (in the first year) exited that market and

another that had 40 listeners (in the second year) entered, the entrant share was measured as +15.

Finally, all entries into and exits from markets that had no stations before entry or after exit have been removed from the sample. In those events, there is by definition no business stealing effect. Though this certainly reflects lower business stealing in these cases, the definitions of market boundaries are to some extent arbitrary. To the extent that listeners are stolen from stations outside of the format, the calculation using just stations in the same format-market will understate the business stealing effect. This omission is probably most troublesome in the cases of no incumbent or no remaining firms. Omitting those cases lessens this bias which would tend to overstate the effect of N on the business stealing effect.

Section 5: Estimation and Regression Results

The data set that has been assembled thus far is rather small, including only 118 events in the top five markets from 1977 to 1984.[8] Eventually, we plan to expand the sample to the top 10 markets and to include 1975 through 1986. The model and following discussion indicate that the change in incumbent's audience should be a positive function of taste changes, as measured by the proportionate change in format listenership from out-of-sample, but similar sized, cities. Entry of a new firm is expected to decrease the listenership to incumbent stations. We would like to test the hypothesis that the negative relationship between the audience of the entrant (exiter) and the audience of the incumbents is stronger when there are more incumbents.

To do this and control for differences in the "size" of different format-markets we had planned to present the β and γ parameter estimates from

$$QINC_t - QINC_{t-1} = \beta_1 \cdot QINC_{t-1} \cdot TREND_t + \beta_2 \cdot QENX_t \cdot N_t^{\beta_3 \cdot (\sum_{i=1}^{10} \gamma_i \cdot D_i)} \quad [14]$$

[8] The data to calculate the format audience changes in out-of-sample markets have not yet been found for 1975 and 1976.

where

$QINC_t$ is the audience in period t of all stations that were in the market in both period t and period $t-1$.

$TREND_t$ is the proportional change in the listeners to the format in out-of-sample cities between period $t-1$ and t.

$QENX_t$ is the audience of entering stations in period t minus the audience of exiting stations in period $t-1$.

N_t is the number of stations in the format-market in both period t and period $t-1$.

D_i is a dummy variable equal to one when the market is of format i and equal to 0 otherwise.

Unfortunately, we have been unable as yet to get the nonlinear least-squares estimation of this equation to converge. The estimation of all 13 parameters seems to be more than the 118 observations can support. For this reason, we present only the results of estimates without the format dummy variables.

Estimating equation [14] without the format dummies by nonlinear least squares yields

$$QINC_t - QINC_{t-1} = \underset{(0.113)}{0.300} \cdot QINC_{t-1} \cdot TREND_t - \underset{(0.032)}{0.007} \cdot QENX_t \cdot N_t^{\overset{1.460}{(2.223)}} \quad [15]$$

where asymptotic standard errors are in parentheses.[9] Though all parameters are of the sign that the model predicted, only the trend variable is significantly different from zero.[10] The trend variable significantly predicts some of the change in format listenership. The estimate of β_1 is significantly different from one, however, the value one would expect if

[9] Equation [15] explains about 0.08 more of the variation in the dependent variable than the mean.

[10] The results are virtually unchanged by inclusion of a constant term. Because there are both exits and entries in the data, the mean of the dependent variable is very close to zero.

the change in tastes in other cities occurred in exactly the same proportion in the observed cities.

The estimates of β_2 and β_3 are of the sign that the model would predict. Greater net entry into a market drives down the listenership of the incumbent stations. If this effect were independent of N, then the true β_3 would be zero. In fact, the parameter estimate indicates that the business stealing effect increases with N more than linearly, but the estimate is not statistically different from 0. Furthermore, a likelihood ratio test of the joint hypothesis that β_2 and β_3 are both zero fails to reject. Thus, though the signs of the estimates are consistent with theory the data do not give strong support to the existence of a business stealing effect or the hypothesis that the effect is stronger when there are many incumbents.

These results might lead one to question whether the data show any signs of a business stealing effect. To answer that question, we restricted α_3 to be zero and ran ordinary least squares, finding

$$QINC_t - QINC_{t-1} = \underset{(0.112)}{0.314} \cdot QINC_{t-1} \cdot TREND_t - \underset{(0.052)}{0.082} \cdot QENX_t \qquad [16]$$

where the standard errors are in parenthesis. There is some evidence of a business stealing effect, but it is only weakly statistically significant. Furthermore, the parameter estimate indicates that only about 8% of an entrants customers are stolen from another station in the market.[11]

The results of this exercise are somewhat improved when α_3 is restricted to one instead of zero, imposing a linear effect of N on the business stealing effect. In that case

$$QINC_t - QINC_{t-1} = \underset{(0.116)}{0.317} \cdot QINC_{t-1} \cdot TREND_t - \underset{(0.009)}{0.017} \cdot QENX_t \cdot N_t \qquad [17]$$

[11] The regression is virtually unchanged when run with a constant term, which is insignificant and small. The $R^2 = 0.08$.

The significance of the business stealing term rises slightly in comparison to [16] and the proportion of the variation in the dependent variable explained in the regression rises from 0.08 to 0.10.

There are many indications, and it widely believed in the industry, that the Arbitron data are very noisy. To some extent, this is inherent in the medium. The only way to estimate audience size is with some form of polling. The extent of the information that each respondent must provide is great enough that firms must pay people to participate. Even then, participants receive their payment regardless of whether they are diligent in their reporting or only occasionally remember to fill in the log books with which they are provided. These reporting problems may explain some of the weakness of the empirical results. Still, until better data collection is possible, the actual size and cause of a business stealing effect may be difficult to analyze.

Section 6: Conclusion

This paper is a very preliminary report on an investigation of audience stealing effects in the radio industry. The questions raised here are important in determining whether a market allocation of broadcasting licenses over different uses is likely to offer more benefits to society than a government directed allocation. As stated in Borenstein (1986), the question of which system will yield a better product set is inherently empirical, as microeconomic theory does not support the common belief that market allocation of such licenses will yield first-best resource uses.

Unfortunately, the data collected and analyzed here do not appear to be sufficient to answer the interesting questions. Though there does appear to be some business stealing effect in the data, the effect seems to be small and the relationship to the number of incumbents has not been estimated with any accuracy. Perhaps an expanded sample will improve the estimates, however the noise in the data might be too great even then to yield much insight.

REFERENCES

Borenstein, S., "Price Discrimination in Free-Entry Markets," *Rand Journal of Economics*, **16**(Autumn 1985).

Borenstein, S., "On the Efficiency of Competitive Markets for Operating Licenses," Institute of Public Policy Studies Discussion Paper, University of Michigan, June, 1986.

Broadcasting Publishing, Inc., "Broadcasting Yearbook," 1975-1985.

Chamberlin, E.H., *The Theory of Monopolistic Competition.* Cambridge: Harvard University Press, 1931.

Dixit, A.K. and Stiglitz J.E., "Monopolistic Competition and Optimum Product Diversity," *American Economic Review*, **67**(June 1977), 297-308.

Duncan, J.H., Jr., *American Radio: Tenth Anniversary Issue, 1976-1986*, Kalamazoo, MI: Duncan's American Radio, Inc., 1986.

Koenker, R.W. and Perry, M.K., "Product Differentiation, Monopolistic Competition, and Public Policy," *Bell Journal of Economics*, **12**(Spring 1981), 217-231.

Kwerel, E. and Felker, A.D., "Using Auctions to Select FCC Licensees," Office of Plans and Policy Working Paper #16, Federal Communications Commission, May 1985.

Levin, H.J., "Federal Control of Entry in the Broadcast Industry," *Journal of Law and Economics*, **5** (October 1962).

Levin, H.J., *The Invisible Resource: Use and Regulation of the Radio Spectrum*, Washington D.C.: Resources For the Future, 1971.

Mankiw, N.G. and Whinston, M.. "Free Entry and Social Inefficiency," *Rand Journal of Economics*, **17**(Winter 1986), 48-58.

Mueller, M., "Spectrum Fees Vs. Spectrum Liberation," *Regulation*, **7** (May/June 1983).

Robinson, K., "Some Thoughts on Broadcast Reform," *Regulation*, **7** (May/June 1983).

Salop, S., "Monopolistic Competition with Outside Goods," *Bell Journal of Economics*, **10**(Spring 1979).

Spence, M., "Product Differentiation and Welfare," *American Economic Review*, **66**(May 1976), 407-414.

Spence, M., "Product Selection, Fixed Costs, and Monopolistic Competition," *Review of Economic Studies*, **43**(June 1976), 217-235.

_____ and Owen, B., "Television Programming, Monopolistic Competition and Welfare," *Quarterly Journal of Economics*, **91**(February 1977), 103-126.

Standard Rate & Data Service, Inc., "Spot Radio Rates and Data," December 1974 -

December 1985.

Steiner, P., "Program Patterns and Preferences, and the Workability of Competition in Radio Broadcasting," *Quarterly Journal of Economics*, **66**(May 1952), 194-223.

Steiner, P., "Monopoly and Competition in Television: Some Policy Issues," *The Manchester School*, (May 1961), 107-131.