Preliminary and Incomplete

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Broadcasting Competition and Programming Costs

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May 4 2007 (Initial Draft)

This work is incomplete in many ways, not least of which is the data set, which is missing about half of the stations for any given year, as well as years 1942, 1943 and 1948. Hopefully, that will be remedied in future drafts.

ABSTRACT

An increase in the number of advertising-financed broadcasting stations has two distinct effects on programming expenditures. The direct effect reflects the dependence of the fraction of listeners gained by a given increase in the quality of programming, while the indirect effect reflects that of per-capita advertising revenue, on firm concentration. These effects are estimated by an empirical examination of AM radio stations' programming expenditure and local advertising revenue during both the `freeze' years of World War II and the period of massive expansion of radio station numbers in the latter part of the 1940s.

The effect of competition on product quality ought to be a central concern of Industrial Organization, but outside a few industries it is rarely studied empirically. It is, however, a matter of increasing relevance in media markets, given the steady increase in the number of outlets for audio and visual content over the last number of years. This paper explores the effect of competition on quality in media markets, first theoretically and then empirically, the latter by studying radio broadcasting in the United States in the 1940s. The freeze on construction of new stations for nearly three years following the U.S. entry into World War II, and then the dramatic doubling of the number of stations in as many years after the war's end provides a useful environment to examine the issue at hand.

A priori, it is unclear what effect enhanced competition is likely to have on quality. The incentive to increase programming quality is the advertising revenue that accompanies the listeners thus attracted. Both the number of new listeners and the per-capita advertising revenue can be expected to be a function of the degree of competition in the market.

An economist's most basic intuition is likely to be that competition must be good for quality, and one certainly hears that in the U.K. Office of Communications report (2005) which writes of "competition for quality" and envisagns "[a] competitive broadcasting marketplace" as "encourage[ing] broadcasters to provided quality, innovation" as well as diversity "as they seek viewers and advertisers". An opposing view is that the reduction in per firm advertising revenue from competition will reduce the incentive to offer quality programming. This argument may be behind the statement in *The Economist* (2007) that “Fragmenting audience make it harder of commercial media firms to invest in expensive, high-quality original content.”

A recent paper by Armstrong and Weeds[1] (2006) provides a formal argument for that second view. It argues that increases in the number of advertising-funded broadcasting firms will decrease the quality of broadcast content. The mechanism relies on the effect of competition on advertising: as shown previously by Choi (2006), in this model, when listeners dislike advertising, an increase in the number of stations will lead stations to broadcast fewer ads, much in the same way that in a consumer-revenue funded market, firms price lower when there are more firms. With lower per-listener ad revenue, stations have a smaller incentive to increase their number of listeners, and so quality declines.

This result, however, depends on linear transportation costs. Under the linearity assumption, the number of broadcasting firms does not directly affect quality. Since the share of listeners gained from increased quality is independent of the number of firms, so is the gross incentive to add listeners at a given rate of advertising, and thus so is quality. In contrast, if transportation costs are a super-unitary power function of distance, so that the marginal disutility of listening to a broadcast is increasing in content distance, then the direct incentive to increase quality will be increasing in firm numbers. Advertising will also be more responsive to firm numbers than under linear transportation costs, but, if the power parameter is sufficiently great, the direct effect will nonetheless predominant under non-decreasing marginal disutility of advertising and a concave advertising revenue function. Thus the Armstrong-Weeds result can be overturned.

[1] Armstrong and Weeds are primarily concerned with the comparison of advertising to subscription-based funding.

A related issue is the relationship between market size and quality. Shaked and Sutton (1983, 1987) and Sutton (1991) have demonstrated how crucial this relationship is to understanding industry concentration. Understanding the long run process requires us to know how much of increases in market size are translated into increases in fixed costs and how much into the entry of new firms. Yet the effect of market size on quality expenditure has not been much studied empirically. Sutton (1991) and many others since (e.g., Robinson and Chiang, 1996) have explored the bivariate distribution of sales and concentration, but the direct effect of market size on fixed cost expenditures has not been tested, and certainly not measured. Sutton (1991) describes a number of industries in which increasing concentration accompanied a growth in demand, but these histories are potentially interpretable by the heterogenous capabilities theories of shakeouts that Klepper and his co-authors have offered.[2] So there is the need for a measurement of the effect of market size on quality expenditure.

Estimating the relationship between quality, here programming, expenditure and both competition and size runs into a serious identification problem. It is not the lack of a credible instrument, for measures of economic activity will provide that. Rather, it is the lack of two instruments. Both concentration and advertising revenue are endogenous, and in either cross-sectional or long-differenced data they are likely to be functions of the same economic activity. Thus in equations that include both of them on the right hand side, we are likely to be one instrument short. Nor does it help to estimate only reduced form regressions where the left hand side variable is a function of concentration only, since, as we will see, there economic activity measures will be needed to be included as regressor as proxies of market size.

[2] For example, Graddy and Klepper, 1990, Klepper, 1997.

The solution offered in this paper is to exploit the lagged relationship between changes in concentration and changes in economic activity. The dramatic post-war expansion of AM radio is a particularly attractive time period to do this in. Three factors made entry in this period large: the war-time freeze on radio station construction, the post-war consumer spending boom, and a more hands-off FCC approach to station licensing. Entry varied across cities accordingly - because both wartime and post-war relative demand changes were large and because pre-war allocations were driven in part by non-economic factors.

This sequence of events allows me to handle the endogeneity problem in a number of ways. The first approach is to use the concurrent and lagged changes in the level of economic activity as instruments for the two regressors. This strategy is likely to be more successful than under normal circumstances and with less frequent data, where revenue and firm numbers are arguably functions of a common level of economic activity, so that the econometric rank condition necessary for identifying a separate effect for each of these two variables fails. Here, the freeze in station entry makes it reasonable for us to expect post-war entry to be a function not only of changes in post-war economic activity, but of the earlier war time changes as well. In contrast, one would expect revenue growth to reflect the current and not lagged growth of economic activity.

The war-time freeze is useful in another way. With the number of stations frozen over a number of years, the effect of concentration can be differenced out, and the relationship between programming costs and revenue can be estimated, with the use of the contemporaneous change in economic activity as an instrument. Based on that estimate, one can then estimate the effect of concentration on programming costs in the post-war period with the use of one instrument only. [NOT IN THIS DRAFT]

A third approach uses the first stage analysis of post-war entry, which shows it to be determined only by war-time and not concurrent economic growth rates, to argue that entry can be regarded as exogenous in the regression determining programming costs.

Section 1. Theory

The model is a generalization of the adaptation of the Salop circle model to broadcasting markets, due first to Choi (2006) and then, with endogenous quality added, to Armstrong and Weeds (2006). The Salop circle model has also been used for broadcasting media by Dukes and Gal-Or (2006). Both Motta and Polo (2003) and Waterman (1992) also present a model of broadcasting with endogenous quality, but it focuses on long term effects and, for our purposes here it is less tractable, or is less suited.

Listeners' ideal type of content (the 'horizontal' attribute) is distributed uniformly on the circumference of a circle. There are S consumers, and the market is always covered. Stations' content is located exogenously at equal distances along the circumference of the same circle. Stations choose advertising levels and quality.

Listeners like quality (v) and dislike advertising (a) and content different from their ideal content type. Quality here is meant to denote the 'vertical' aspect of content. Thus individuals will differ according to whether, at any particular time or day, they prefer to listen to comedy or drama, but all will prefer to listen to Jack Benny over some second rate comic, and to the same degree. A listener chooses to listen to the station that provides him or her with the greatest utility, which is comprised of a common component, $u \equiv v - a^m$ minus a power function of the distance along the circumference of the listener's ideal content from that offered by the station, i.e.,

$$(1) \qquad u - t(\text{distance})^{\phi} \equiv v - a^m - t(\text{distance})^{\phi}, \qquad t\phi > 0$$

This generalizes the Choi and Armstrong-Weeds models, which assumed $\phi = m = 1$.

The increase in listenership share D from a small increase in the common component of utility, u , when the differences in u across firms are small, is

$$(2) \qquad \frac{dD}{du} = \frac{1}{t\phi} \sum_{i \in L,R} 1/[x_i^{\phi-1} + (N^{-1} - x_i)^{\phi-1}]$$

where x_L (x_R) is the distance to the firm of the marginal listener with respect to the neighbouring firm on the left (right), and the differences in u across firms is not too great. At the symmetric equilibrium, this is equal to

$$(3) \qquad \frac{dD}{du} = \frac{1}{t\phi}(2N)^{\phi-1}$$

which also provides a first order approximation to (2).

Figure 1 shows why the gain in listenership depends on the number of stations in this way. The black line is the utility a listener obtains from the station located at zero, while the green line is the utility a listener obtains from the station located at 0.5, when both stations offer the same common utility. When $N = 2$, these are the only two stations and the marginal listener is located at 0.25. When the 0-station increases its offered common utility by .05, utility from that station shifts up to the brown line. The marginal consumer is now at 0.3, so that the station increases its market share by 10 percentage points. When $N = 4$, the neighbouring station is located at 0.25, so that the marginal listener is at 0.125. The upwards shift in the utility shifts the marginal listener twice as much, to 0.225, so that station-0's market share increases by 20 percentage point.

The reason for this result is simply that there is an increasing disutility of distance from ideal content, so that increases in the common component of quality is more effective in increasing market share when stations are more closely located to each other. In contrast, when $\phi < 1$ (which can be thought of as the case in which listeners are relatively indifferent among content that is not close to their ideal point), as in Figure 2, crowding in more stations makes utility increases less effective in generating market share gains.

As in Choi and Armstrong and Weeds (2006), I will also assume that the station earns $r(a)$ per listener when it broadcasts a ads, where r is a concave function, with a maximum point, a^M. Thus a firm's profit is $SD(u,\bar{u};N)r(a) - F(v)$, where $F(v)$ is the cost to the station of broadcasting programs of quality v, and $F', F'' > 0$.

In the discussion that follows, I will characterize the symmetric equilibrium. Issues of existence and uniqueness are relegated to an appendix. [NOT INCLUDED IN THIS DRAFT]

Stations' choice of advertising level will trade-off the gain in per-capita revenue by advertising more against the loss of listeners to other stations. The first order condition is

$$\text{(4)} \qquad \left|\frac{\partial D}{\partial a}\right| r(a) = Dr'(a) \qquad \Rightarrow \qquad \frac{m}{t\phi}(2N)^{\phi-1} a^{m-1} r(a) = \frac{1}{N} r'(a)$$

As Choi (2006) and Armstrong and Weed (2006) point out, since the left hand side is positive, so is the right, so that advertising minutes and per-capita advertising revenue must be less than what a monopolist broadcaster would set. Stations broadcast fewer ads than a monopolist broadcaster would, in order to gain market share. In the linear specification of these models, ϕ equals one, so competition affects the choice of advertising minutes only through decreasing the firm's share of listeners in equilibrium. More generally, competition also determines the fraction of listeners lost with increased advertising, in the manner described above and in Figures 1 and 2. When $\phi > 1$, this second effect strengthens the first, while if $0 < \phi < 1$, the second counteracts the first, but is dominated by it, so that the previous authors' qualitative result that advertising is decreasing in the number of firms continues to hold so long as $\phi > 0$. If $\phi < 0$, increases in the number of firms actually increases advertising minutes and per-capita advertising revenue.

Firms' choice of quality trades-off the increase in listenership from greater quality, multiplied by per-listener ad-revenue, against the increase in fixed cost of quality, thus

(5) $Sr(a)(dD/du) = F'(v)$

or using (3),

(6) $S\frac{1}{t\phi}(2N)^{\phi-1}r(a) = F'(v)$

Thus, conditional on per-capita advertising revenue, an increase in the number of firms increases (decreases) the quality of programming if and only if $\phi > (<)1$.

To determine the net effect of competition on the quality of programming, in parametric form, we need a specification for the per-capita advertising revenue function. Assume, therefore, that, below a^M, $r(a)$ is well approximated by a^η with $0 < \eta < 1$ to ensure concavity[3]. Then the first order condition for per-capita advertising reduces to

(7) $r = \{\frac{m}{\eta t\phi}2^{\phi-1}N^{\phi}\}^{-\eta/m}$

Substituting (7) into (6), we see that the sign of the net effect of competition on quality is that of $(\phi-1)-\phi\eta/m$. Thus so long as the marginal disutility of advertising is increasing, the net effect is guaranteed to be negative if $0 < \phi \leq 1$, which of course includes the linear transportation case of Armstrong and Weeds. It is positive if and only if $\phi > [1-(\eta/m)]^{-1}$.

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[3] Equivalently, the inverse demand for advertising of $p(a) = a^{\eta-1}$.

To obtain a closed-form solution, suitable for estimation, assume either that $F(v) = \frac{1}{\beta}\delta v^{\beta}, \beta > 1$ or $F(v) = \frac{1}{|\beta|}\delta(\alpha - v)^{\beta}, \beta < 0, v < \alpha$. (The parameter $\delta > 0$ will prove useful later for assessing biases.) Substituting this into equation (6), we obtain

$$\text{(8)} \qquad F(v) = \delta^{1/(\beta-1)}\{\frac{1}{t\phi}(2N)^{\phi} R\}^{\beta/\beta-1}$$

where $R = Sr(a)/N$ is per-firm revenue.

Taking logs of both sides, we obtain our first regression equation:

$$\text{(9)} \qquad \ln F = const + \frac{\beta}{\beta-1}\ln R + \frac{\beta}{\beta-1}\phi \ln N$$

which stems from the first order condition for the choice of quality. Taking logs of equation (6), we obtain

$$\text{(10)} \qquad \ln R = const + \ln S - [(\eta/m)\phi + 1]\ln N$$

which is both a reduced form and structural representation of advertising revenue choice. Combining the two, we obtain our third regression equation

$$\text{(11)} \qquad \ln F = const + \frac{\beta}{\beta-1}\ln S + \frac{\beta}{\beta-1}[(\phi-1) - \phi\eta/m]\ln N$$

which expresses programming cost as a reduced form function of the number of firms. Clearly, if the coefficients on the variables in the first two equations can be estimated, we can obtain consistent estimates of β, ϕ and η/m. Although no new parameters are estimated by equation (11), it may be preferred as it involves one less potentially endogenous variable.

An Aside

Note that the above analysis assumes that a local radio market is a small part of the labour market that it draws upon, either because talent is a dime a dozen, or because talent is highly mobile (or importable as pre-recorded material on records – what was known as 'transcription services'). To the extent that this is not the case, it is necessary to take into account any increase in the wage of talent when firms increase quality. Assume, then, that there is an increasing supply curve for talent. Let z be the number of efficiency units of that the station employs, assume $v = z^{\omega}$, and let δ be the wage-rate of talent, with $\delta(z) = (Nz)^{\alpha} = (Nv^{1/\omega})^{\alpha}$. I will assume that radio stations have no market power in the market for talent, so that in making its quality decision, firms see $F(v) = \delta v^{1/\omega}$; however a Cournot assumption would yield the same result, up to a constant in the log-linear forms. Firms choose v so that

$$(12) \qquad \delta v^{1/\omega - 1}/\omega = Sr(a)\partial D/\partial u \quad \Rightarrow \qquad v = [(\omega/\delta)RN^{\phi-1}]^{\omega/(1-\omega)}$$

This implies that

$$\text{(13)} \qquad \ln F = const + \frac{(1+\alpha)\beta}{(1+\alpha)\beta - 1}\ln R + \frac{\phi(1+\alpha)\beta - \alpha}{(1+\alpha)\beta - 1}\ln N$$

Clearly, the parameters are now identifiable only conditional on one of the three. Data on wages or employment are necessary to identify all three. Such data are available for a subset of the years, and I intend to gather it and incorporate it into future drafts. In the meantime, I will proceed as if $\alpha = 0$. The biases in the inferred values of $\frac{\beta}{\beta - 1}$ and ϕ from doing so are likely to be small when the estimate coefficient on log revenue in (13) is near one, as will be seen to be the case. In particular, letting the coefficient on log revenue (log number of firms) be denoted as ψ_R (ψ_N), we have: $\frac{\beta}{\beta - 1} = \frac{\psi_R}{1 + (1 - \psi_R)\alpha}$, while $\phi = \frac{\psi_N}{\psi_R} + \frac{1 - \psi_R}{\psi_R}\alpha$. Finally, for many purposes, including the long run analysis discussed in the next section, what part is α and what part β, i.e., what part of the increase in fixed costs derives from increased quality, and what from the bidding up of the price of quality, is immaterial.

Section 2. Free Entry Equilibrium

Although the empirical analysis estimates relationships that are conditional on the number of firms, it is nonetheless useful to analyze the free entry equilibrium. The extent to which the radio broadcasting industry in the late 1940s is well described by the free entry model is an open question given the licensing process and the capacity constraints inherent in the limited radio frequencies. That, however, should not in itself be an impediment to inferring the long run nature of other media industries at other times, on the basis of the empirical findings in this paper.

The analysis in Chapter 3 of Sutton (1991) is useful here. Figure 3 shows a set of iso-profit curves, showing variable profits, here, advertising revenue, as a function of the number of firms. Each curve corresponds to a different market levels (S). As S increases, the curve shifts out. The red curve is the locus of long run equilibrium pairs of the number of firms N and total fixed costs (F and an exogenous fixed cost, σ) that are traced out by the intersection of an iso-profit curve as market size increases. In the case of no endogenous fixed costs, the long run locus would be horizontal, and the number of stations would increase without end as market size increased. More generally, we expect the curve to be at least initially upward sloping: increases in market size induce firms to expend more on programming, thus limiting the attractiveness of the industry so that N increases less than it would otherwise. Sutton notes that there is the possibility that the red curve could bend back upon itself – if the induced increase in quality expenditure is so large that at some point increases in market size actually reduce firm profits and so induce exit.

In the current model, clearly the response of fixed costs and concentration to market size is governed by the parameters ϕ and $\beta / \beta - 1$. The locus of long run equilibrium $(N, F+\sigma)$ here is $(w[\sigma + F]N^{\phi})^{\beta/\beta-1} = F$, and its slope is

(14) $$\frac{dF}{dN} = \frac{F}{N}\phi \frac{\beta / \beta - 1}{1 - (\beta / \beta - 1)(F / [\sigma + F])}$$

so that the backward bending case can only occur if $\beta / \beta - 1$ is greater than one. A sufficient condition for the case to occur is this condition along with $(\phi - 1) - \phi\eta / m > 0$, i.e., that the net effect of the number of firms on programming cost is positive.

Section 3. Empirical Methodology

Biases in the OLS estimation of equations (9), (10), (11) can arise for any number of reasons: differences in unobserved market size, talent costs, listener heterogeneity, incomplete reports and local revenue shares.

The most obvious bias can be seen in the reduced form equations (10) and (11). Both advertising revenue and programming cost depend on the size of the market (S); there being no exact exogenous measure of that, proxies must be employed. Those proxies being imperfect, the estimated coefficient on the number of firms will pick up part of the market size effect, so long as the FCC approval reflects to some degree the potential profitability of stations. The coefficient will be biased upwards so long as the red curve is sloping upwards in the relevant area. Equation (9), on the other hand, should be immune to that bias, as revenue is an included variable and it is, by definition, proportional to market size.

The cost of talent (δ) may be especially high in some cities, because of other, national level industries that draw on the same labour pool, coupled with limited labour mobility, or because of relative disamenities in the area for those individuals, coupled with unlimited labour mobility. The direction of this bias depends on the sign of β. Rewriting equation (9) explicitly as a function of δ:

(15) $$\ln F = const + \frac{\beta}{\beta-1}\ln R + \frac{\beta}{\beta-1}\phi \ln N - \frac{1}{\beta-1}\ln\delta$$

For $\beta > 1$ ($\beta < 0$), a high cost of talent will lead to lower (greater) programming expenditures, and so greater (less) per-station profits (as advertising revenue is independent of δ), given the number of firms, and so more (less) firms. This will tend to lead to a downward (upward) bias on the coefficient on the number of firms in equation (11) and in the post-war analysis of equation (9) (unless the change in revenue is sufficiently correlated with the growth in the number of firms).

Cross market differences in listeners' sensitivity to horizontal content differences (i.e., t, which can represent differing degrees of listener heterogeneity) can also be a source of the regression error. By decreasing the number of listeners lost when ads increase, a greater sensitivity increases equilibrium ad revenue; in the war-time regression, where there is no change in the number of firms, this will upwardly bias the coefficient on ad-revenue in equation (9). In the post-war regression, matters are complicated since the prospect of greater ad revenue will induce greater entry so that the percentage change in the number of firms will also be positively correlated with the error term. Since the changes in competition and revenue are positively correlated, the direction of the bias on the coefficients is unclear in this regression.

A greater sensitivity to horizontal content will also reduce the returns from increasing quality (see equation (8)) and so reduce the expenditure on it, and increase per station profits and so the number of firms, leading to biases in the estimation of equations (9) (in the post-war period only) and (11). [4]

A fourth source of bias arises from incomplete reports. Consider the 1945 report of WBIR of Knoxville, Tennessee. All the reported revenues and expenses are about a tenth lower than the same items in both the previous and following years. Needless to say, the Knoxville economy did not undergo a corresponding collapse and recovery over those couple of years.[5] What is more likely, although I have no evidence of it, is that either the station only operated for a month or so during 1945 (perhaps there was a fire at the antenna location) or there was a change in ownership that was not recorded in the reports (or that my normally diligent research assistant missed). With expenses and revenues distributed more or less uniformly over the year, incomplete reports of this type will bias the coefficient in the regression of the first on the second variable towards one.

A fifth type of bias can arise if there is a large variation across stations in the share of broadcasting devoted to network programs. Otherwise identical stations that use more network shows will have correspondingly smaller local broadcasting revenue and programming. This, too, will bias the coefficient towards one.

I deal with these biases in a number of ways. The first step is to time difference the data. This should go some way in handling differences among stations in the propensity to use local rather than network programs. It also (approximately[6]) eliminates the effect of competition during the period of the 'freeze', thus eliminating those biases

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[4] NOTE: the net effect on log profits is $(1+\frac{\beta}{\beta-1})\frac{\eta}{m}-\frac{\beta}{\beta-1}$

[5] Bank debt to demand deposits in Knoxville …

[6] Approximately, to the extent that firms are equal sized. Based on the data gathered to this point, the mean variance of market share of local programming revenue in 1944 is .03. The mean standard deviation of the absolute deviation of market share from the inverse number of firms is .002, which may be a more appropriate measure, given (2).

discussed earlier that arise from the correlation of the error term with the number of firms. Such biases will also be mitigated in the post-war period, to the extent that entry is driven by war time growth and the auto-correlation in, say, changes in $\ln\delta$ is low. Of course, any biases arising from permanent differences in the parameters across markets will be eliminated as well.

The second element in the identification strategy is the use of concurrent and lagged measures of economic activity as instruments. This exploits the history of FCC licensing of AM radio stations. From about 900 stations at the end of the war, the FCC licensed about as many more by 1948. Figure 4 shows the time series of the number of radio stations in this period. The freeze on the construction of new broadcast stations is evident in the flat portion of the curve. This dramatic expansion that followed it is also clear from the figure.

So long as there are differences in the growth rate of economic activity during the war year and during the post-war years, we can instrument both log-revenue and the log-number of firms in the post-war regressions. The growth in the number of radio station in the post-war period should reflect the growth in economic activity not only during those years but also, and perhaps primarily (if there are substantial lags), during the war years.

The post-war growth in the number of radio stations also reflects a policy change in the FCC. Licensing policy in the previous decade had been a mix of economic and social forces. On the one hand, the vast majority of stations were commercial; potential licensees needed to expect to be profitable to enter. On the other hand, the FCC was subject to the Davis Amendment, which mandated that the number of stations (or quota units) be equalized across five zones of the continental U.S., and that the number of stations in each state be proportional to the state's share of the zone population. There was also some degree of pressure from existing stations to thwart new entrants.

In contrast, the post-war policy was very clearly one of laissez-faire. The only economic concern was that potential licensees demonstrate the ability to finance the radio station. Edelman (1950, p. 103) writes that "[s]ince the end of the war, the Commission has been particularly liberal in authorizing new stations without regard to economic injury." He quotes the FCC Chairman as saying, in 1947: "We shall not attempt to fashion an umbrella with which artificially to shelter this industry from the consequences of free competitive enterprise." Or as an anonymous letter to the editor in Broadcasting put it, the new policy was that of "survival of the fittest" or "dog eat dog", in which "the FCC has little interest in whether or not a station operates profitably." (*Broadcasting*, July 29, 1946,page 52). This change in policy followed the U.S. Supreme Court's *Sanders Brothers* decision of 1940 that made clear that FCC licensing decisions need not take the financial effect on incumbents into consideration, as well as the 1936 repeal of the Davis Amendment. (Sunk costs and the Depression would have delayed the effect of that repeal to the boom years of the post war period.)

The use of the change in economic activity as an instrument may, unfortunately, introduce (or exacerbate) an additional bias. Growth in economic activity may be associated with growth in local wages; indeed, I will show that this is the case from 1940 to 1950. Note that this problem will arise only for equation (9) where the log of revenue is included as a regressor, as only there is there a need to employ the contemporaneous change in economic activity as an instrument (and we will see that changes in economic activity are not correlated across time in the relevant periods). The direction of the bias depends on the sign of β, or equivalently, on whether $\frac{\beta}{\beta-1}$ is greater or less than one. As equation (15) clearly indicates, if $\beta < (>) 1$ the coefficient on log revenue will be upwards (downwards) biased.

Section 4: Issues in Applying the Model to Radio in 1940s

A number of issues arise in applying the model to the radio markets of the 1940s. The first is that the model assumes a symmetric model, so that N is the correct indicator of concentration. Clearly, this is not the case. Firms differed in their transmitters' wattage and so in their potential reach, although for those located in metropolitan areas, this was much less important than suggested by the wattage. They would have differed also in their capability to provide quality programming (which may be thought of differences in their δ s). For the war-time analysis, this is not much of a problem, as dD/du will be differenced out; only to the extent that changes in market size lead different firms to expand at different rates (and so change their dD/du), which admittedly the model implies, should this prove a problem.[7]

In estimating the relationships in the post-war period, one faces the additional problem that newer firms would presumably be less capable initially than existing firms. I handle this by restricting the sample to firms that existed in 1944 only. This does not solve the problem entirely, since with existing firms larger than the entrants, changes in $\ln N$ will overstate the change in concentration. Ideally, one would use a measure of

[7] Note, however, that equation (2) shows dD/du to be not only non-monotonic in market share, but also symmetric around 1/N.

concentration based on listening shares; that being unavailable, one based on advertising shares might be used instead. Constructing the latter requires information on all the stations in a market, and so must wait until the data from all the stations are at hand; meanwhile, I will simply use the number of firms, the coefficient on which should be downwards biased in magnitude.

It is worth noting, however, that the difference in revenue is not as large as one might think. Table 1, taken from FCC (1947), shows revenue by class of station and expansion status. The figures can only be suggestive, since the revenue of the existing firms is taken from 1945, and that of the new stations from two years later; also, there is no control for the market, and new firms were disproportionately established in smaller markets. It is clear, however, that revenue is of a similar magnitude. In one of the four classifications, the new firms actually earned more than the existing firms (granted, two years previously), and the lowest ratio of new stations' revenue to existing stations' revenue is forty percent.

The station level data that I have collected does permit a comparison of revenues for the same year and market. The ratio of local advertising revenue in 1947 of new to existing firms, averaged across the 58 markets in which I have managed to collect data with at least one of each type in 1947 is .39, with a standard error of .04. The mean of the ratio of total advertising revenue (i.e., local plus network) across 48 markets is also .39, with a standard error of .06). This suggests that our estimates for the coefficient on the log number of firms ought to be multiplied by 2.5, to correct for this difference.

Network broadcasting also complicates the analysis. When a station broadcasts a network show, it does not incur the programming costs; it 'pays' the network through receiving only a share of the advertising revenue. Thus all programming costs are for non-network shows. Furthermore, per-capita advertising rates on network shows should be insensitive to local competition, since the uniformity of the network show means that the amount of time given to advertising must be constant among all stations broadcasting the show. For this reason, I restrict the analysis to non-network advertising revenue.

The model also assumes that each station in a market was owned by a single firm. That was very nearly the case in the post-war period, after the FCC's break-up of the so-called 'duopoly' stations in 1944. We drop those stations for the war-time analysis.

As for television, it was not yet a serious competitor. In 1947, the last year used in this draft, there were but 12 television stations (and only 8 in the markets considered here). 1948 (data for which will be used in the next draft) ended with 58 stations on the air, but, still, over the year television advertising revenue was barely two percent that of radio advertising revenue (Sterling, 1984).

Section 5. Data

The data come from a number of different sources. Revenue and programming costs are taken from stations' 1944, 1945, 1946 and 1947 annual financial reports to the FCC, which are on file at the National Archives and Research Administration. Revenue is stations' reported "Total sale of station nonnetwork time". Programming costs is the reported "Total programming expenses". The latter includes such items as program department wages and salaries, talent expenditures, royalties and license fees, transcription services, wire and teletype services and news services.[8]

[8] Ryan (1946) writes, "Under production expenses we carry salaries of program director and announcers, salaries of production manager and the production staff, any charge for freight cartage and express that is

Lists of radio stations, published in spring 1946 by the Broadcasting Measurement Bureau, and on January 1 of 1947 and 1948 in the trade weekly *Broadcasting*, are used to construct the number of stations in each market. For annual economic activity, I use bank debits to demand deposits (essentially the dollar value of cheques writing on demand deposits at banks reporting to federal reserve banks) , from Federal Reserve Board (19xx), as well as census population figures, aggregated up from the county level to the market level.

The sample consists of stations in the 137 metropolitan districts, as defined in 1943, as well as 41 other markets identified in the FCC summary for 1948. Two overlapping sets of districts are dropped: New York-Northeastern New Jersey, Chicago and Los Angeles, since these three locations were the source of most programs and it might be difficult to disentangle the national production activity from the local activity, and all cities in which there were network owned affiliates, for accounting reasons. Those markets for which bank debit data for any year from 1942 through 1947 is missing were dropped. This results in 149 markets.

The sample is further restricted in this draft to those stations (and therefore those markets with at least one of those stations) for which I have succeeded gathering NARA data to this date. That consists of stations with call letters KABC to KRUX, WAAB to WDHL,[9] and an additional set of stations in relatively large markets, data on which were gathered for a different project. A further restriction eliminates those stations for which no 1944 records were found; the vast majority of these stations, of course, were not

incurred for the program department, music copyright including license fees paid to ASCAP, BMI, SESAC and other holders of music copyright, amounts spent for news wire services and expenses of news gathering and the charge for al talent that appears on the station."

[9] All radio stations are labelled by three or four letters, beginning with K or W.

operating in that year. These conditions yield us 196 station in 89 cities for the war-time period, and 153 stations in 79 cities for the post-war period.

Section 6. War-time Analysis

Table 2 reports the summary statistics. From 1944 to 1945, non-network revenue increases, on average, by 13 percent, while programming costs increase by 24 percent. Both have a standard deviation of about .24. Growth in this year averages at 7 percent; over the three years from 1942 to 1945 it is .34, with a standard deviation somewhat less than half of that. Importantly, as Table 2a shows, annual growth is uncorrelated from year to year.

Table 3 presents the regression analysis. (Standard errors are clustered by market.) Columns (1) and (3) regress revenue growth and programming expenditure growth on concurrent economic growth, the past year's economic growth and economic growth in the year before. Although the individual coefficients are noisy and jointly significant at the .11 and .20 level, respectively, one cannot reject the hypothesis that the set of three coefficients are equal within each regression. Restricting the coefficients to be equal, as in columns (2) and (4), one obtains that that revenue growth increases by 0.7 percent and programming costs for 0.6 percent for every one percent increase in economic growth over the three year period; each of those estimates is significantly different from zero, but not from one. The last three columns present the regression of programming costs on revenue growth, corresponding to equation (9), with the log number of stations differenced out to zero, because of the freeze. Whether instrumented by the three separate annual growth terms, or the total wartime growth, or estimated by

OLS, the estimated coefficient, which is an estimate of $\beta/1-\beta$, is always close to .85, and significantly less than one under the first and last estimation method.

As noted earlier, even the IV estimate can be biased if the change in economic activity is correlated with the change in local wages. From equation (15), one obtains (dropping the 'plim's):

$$
\begin{aligned}
(16) \quad & IVEstimate = \frac{\beta}{\beta-1} - \frac{1}{\beta-1}\frac{Cov(\Delta z, \Delta \ln \delta)}{Cov(\Delta z, \Delta \ln R)} \\
& = \frac{\beta}{\beta-1} - \frac{1}{\beta-1}\frac{Cov(\Delta z, \Delta \ln \delta)}{Var(\Delta z)}\frac{Var(\Delta z)}{Cov(\Delta z, \Delta \ln R)} = \frac{\beta}{\beta-1} - \frac{1}{\beta-1}(b_\delta / b_R)
\end{aligned}
$$

where b_x is the regression of $\Delta \ln x$ on Δz, the instrument . Manipulating the above, we obtain

$$
(17) \quad \frac{\beta}{\beta-1} = \frac{(b_\delta / b_R) - \Psi_R^{IV}}{(b_\delta / b_R) - 1} = \frac{b_\delta - b_F}{b_\delta - b_R}
$$

where ψ_R^{IV} is the IV estimate of the coefficient on log revenue. As local wages are unavailable at annual frequencies, I estimate b_δ from the regression of the change in the mean log wage from 1940 to 1950 on the growth in economic activity from 1941 to 1949, using micro Census of Housing and Population data.[10] This yields a coefficient of .22,

[10] The data were downloaded from www.ipums.org. The mean log wage was calculated as the coefficient on the corresponding metropolitan district dummy in the regression of ln{income/(hours*weeks)} on a set of such dummies, as well as sex and white/non-white dummies, and a cubic function of age, w here income denotes "wage and salary income", hours is "hours worked last week" and weeks is "Weeks worked last year", where class of workers was employed by a private firm.

with a standard error of .04.[11][12] Plugging the data into the formula in equation (17) yields $\frac{.22-.6}{.22-.7}=.79$ as an estimate of $\frac{\beta}{\beta-1}$.[13]

A number of additional points can be made about this table. First, both revenue and programming costs are clearly more dependent on the previous than current year's growth. Presumably this arises because there is a lag between economic growth and product firms' advertising behaviour, whether because of a lag in recognition or the need to commit to advertising levels (at least for program sponsorship) some time in advance. Second, the dependence of programming costs on revenue can not, of itself, explain the large differences in their growth rate over the period. Revenue growth causes programming growth by some amount less than proportionally, while programming costs increased twice as much. Of course, a country level increase in the cost of talent could explain it. Third, a Hausman test can not reject the exogeneity of revenue growth, as is plainly clear from the OLS and IV estimates in the table. This suggests that, in the absence of changing levels of competition, differencing substantially eliminates the biases discussed earlier.

An alternative approach to estimating $\frac{\beta}{\beta-1}$ is to use a cross-firm, within market comparison. Here the natural instrument to use is the log of the station's power. Not surprisingly, stations with higher power reached more listeners and so generated greater revenue. The last panel of Table 3a shows that the elasticity of local ad revenue with

[11] The intercept is .69 (standard error .05), while the R-squared is .17.
[12] Note that including the decennial log wage change as a regressor would be inadequate, as given the low correlation in growth rates across years, a ten year average would be a very noisy proxy of the annual or bi-annual change that is actually required.
[13] An alternative approach would be to add the decennial change in wages, but that would be a noisy proxy, given what we know about the low correlation of annual growth rates over time in this period.

respect to power is about 1/3, and precisely estimated. Estimating the relationship between programming costs and log revenue should eliminate the effect of an increasing supply curve for talent, as well as the econometrically endogenous local wage, but at the cost of introducing a new bias: more capable managers/owners (lower δ) within a given market, will generate higher quality programming and so a higher market share, and higher revenue; they are also to end up with the higher wattage stations through assortative matching. This will generate a positive (negative) bias when β is positive (negative). The first two panels of Table 3a shows the OLS and IV estimates of the within market regression of log programming expenditure on log revenue. Interestingly, the OLS estimates for 1944 and 1945 are .85 and .89, very nearly the same as those obtained from time differencing; those for the expansion years, however, are noticeably smaller. The IV estimates of $\frac{\beta}{\beta-1}$ are about 1.1, with standard errors between .07 and .10.

Section 7: Expansion Years Analysis

As a preliminary step to estimating the dependence of programming costs on revenue and station concentration, we first consider the first stage regression of the number of stations on various instruments. Summary statistics for this analysis are shown in table 4. Average population growth in our sample of markets was 11 percent in the 1930s and 23 percent in the 1940s. Economic growth is large between 1942 and 43, then is cut in half before returning to its previous level in the post-war period. Table 4a shows, as before, that growth rates are generally uncorrelated from year to year. The exception is 1945 and 1946: markets that grew strongly in the first year tended to grow strongly in the second year as well. Likewise, markets with large population growth in the 1930s also grew strongly in the 1940s; these markets tended to have large war time economic growth as well.

Table 5 presents the regression of the change in the log number of stations from 1946 to 1948 on these various measures of economic activity or growth. As expected, war-time growth increases the growth in the number of stations in the post-war period. Concurrent growth, in contrast, has no significant effect at all, and its coefficient is negative. Similarly, 1940s population growth is highly insignificant, while population growth in the previous decade has a large although only weakly (and that only if the concurrent growth variables are dropped) significant.

By far, the most significant variable, and that responsible for most of the variation in predicted growth, is economic activity in 1942. Note that were the number of stations determined by a free entry condition both before and after the war, (and were station numbers sufficiently large that integer constraints could be ignored) we would expect only growth variables and not the level of economic activity, to determine the growth in firm numbers. Notwithstanding the large predictive power of this variable, the wartime growth, which explains only a quarter of the variation in the predictive value, has a t-statistic of nearly three.

These regressions point to another empirical strategy. That the entry of radio stations between 1946 and 1948 reflects economic growth in the war years but not over 1946 to 1948 itself strongly suggests that the entry in those years does not reflect changes in any of the factors identified in the model over that period, viz., changes in t, β and so on, and so justifies treating entry as exogenous. It is hard to imagine that potential entrants' decisions reflected, say, changes in heterogeneity over the period while not reflecting economic growth. Entry was determined not only by firms' decisions, but by the FCC as well; but all the indications are that the FCC's sole concern was the entrants ability to finance the construction.

The next table provides a finer look at the determination of the growth in firm numbers by breaking that down into growth over 1946 and over 1947. We see that although 1942 economic level of activity predicts firm growth in both years, population growth predicts firm growth, and significantly so, only in 1946, while wartime growth predicts firm growth in the next year only. It is unclear why that is.

Tables 7 and 8 consider the net effect of the number of stations on programming costs. In the terms of the model, this is $(\phi-1)-(\phi\eta/m)$. The first of these two tables shows the regression of the growth in programming costs from 1946 to 1948 on the growth in the number of stations. The bivariate regression shows an insignificant regression of .07. That barely changes when the concurrent economic growth is added, the coefficient on which is estimated at .36, insignificant and less than half the estimated coefficient in the analogous OLS regression for the wartime period (column (3) in table (3)). Breaking the concurrent growth into its constituent parts (column (3)) and adding the growth rate for the preceding year (column (4)) do not qualitatively change the results.

Table 8 presents the instrument variables estimation of this equation, using the three variables identified as determinants of the growth in the number of firms in table 5 Doing so increases the coefficient on the log number of firms in the bivariate regression dramatically to .53, which has a t-value of about 2.5. Adding concurrent growth to the regression decreases that coefficient to only .39 (column (2)), while adding 1940s population growth yields three individually insignificant coefficients. The remaining three columns present that regression using each of the three instruments separately (or perhaps should do the bivariate only). We see that the positive coefficient on the log number of firms is due to the 1942 economic activity.

Table 9 shows the empirical counterpart to equation (9): the regression of programming costs growth on revenue growth ($\beta/1-\beta$) and numbers growth ($\phi\beta/1-\beta$). In the first column, the OLS regression is shown. The coefficient on revenue growth is .75, not far from the estimates in table 3. The coefficient on station number growth is essentially zero, but with a large standard error – but not so large that one can not confidently reject a concave distance function. The standard errors balloon when the two regressors are instrumented, by the three determinants of firm growth and concurrent growth (for revenue growth), and both coefficients are insignificant. In columns (4) and (5), firm growth is treated as exogenous, as suggested by the insignificance of concurrent economic and population growth in the firm growth regressions of Table 6, with revenue growth instrumented by concurrent growth and its component parts. Although the coefficients vary widely, the implied estimate of ϕ (assuming $\alpha = 0$) is quite stable, and ranges from -.06 to .03. Applying the factor of 2.5 to account for the lower revenues of the expansion firms will change this range to -.15 to .075. It is, in any case, very clearly less than one.

Table 10 presents the OLS regression of advertising revenue growth on firm growth, the empirical counterpart of equation (10). (Recall that the results of Table 6 argue for the exogeneity of the growth in firm numbers.) The OLS estimate of

$-[(\eta / m)\phi + 1]$ is a mere .02, statistically indistinguishable from zero. Although ϕ is not identifiable from this regression alone, under the assumption that $0 \leq \eta/m \leq 1$ (increasing disutility from ads and a downward sloping demand for advertisements), the 95% symmetric confidence interval of ϕ lies beneath -0.9.

The IV estimate is consistent under weaker assumption, but the results are much noisier. It shows a one percent increase in the number of firms leading to a .48 percent increase in ad revenue, but this effect is insignificant. As for ϕ, it is at least five standard deviations beneath zero.

Applying the factor of 2.5 to account for the lower revenues of the expansion firms, will, of course, make these results even more extreme.

How to reconcile the results in table 9, which imply a value of ϕ around zero, which those in Table 10, which imply a much lower value? One possible explanation, not encompassed by the model, is that with more stations, advertisers are better matched to the listener, as in Chandra (2005). One could model this by having per-capita advertising revenue depend directly and positively on the number of stations.

A second alternative explanation is that more stations increase the variety on offer to consumers, which increases their expected utility from buying a radio set, or turning on the set they already own, and so increases stations' ad-revenue. Given the FCC's ban on owning more than one station in a given market, neither of these externalities could be internalized by a firm.

Section 8. Conclusion

[INCOMPLETE]

This paper has shown, theoretically, that competition affects quality/programming costs not only indirectly through the change in advertising revenue, but also directly through the change in the sensitivity of the marginal listener to the common component of utility. When the marginal disutility from listening to other than one's favoured type of show falls with the distance in content types, increases in competition will lead broadcasters to decrease their expenditures on programming.

The empirical analysis exploits the timing of station entry in the 1940s. Preliminary results are mixed. OLS estimates of both the net effect of concentration, and its effect conditional on ad-revenue, on programming expenditure are near zero. IV estimates of the latter are also small. IV estimates of the net effect are large, but at insignificant. The effect of competition on per-firm advertising revenue is zero under OLS estimation, and positive, although at best weakly significant, under IV. These estimated effects of competition on programming costs, given ad-revenue, and on ad-revenue all imply a convex distance function, i.e., a decreasing marginal disutility from non-ideal content type, but they are quantitatively inconsistent with each other, given the framework of the model. Possible explanations for this inconsistency are variety effects and advertiser-listener externalities. Hopefully, more exact statements will be possible when all the data are collected.

The paper also shows that programming expenditures are very sensitive to market size. Although it can not be established that the effect is so large so that increases in demand will actually lead to firm exits, the relationship is such that it is reasonable to infer that most of the long run response to increases in advertising demand in such a market will be met by existing firms' increasing their endogenous fixed costs and not by the entry of new firms.

To what extent can we take empirical regularities during the expansion of AM radio station and infer policy recommendations from them to the current situation? Radio in the 1940s was very much like television is today. There were news shows in the morning, soap operas in the early afternoon, news at 8 o'clock, dramas and comedy shows in the evenings. Radio differed only in the greater fraction of musical programs. A somewhat bolder statement would be that radio in the pre-war and war periods was like television up until fifteen twenty years ago, while radio in the immediate post-war period was like television is today.

One might also ask how relevant advertising funded broadcasting is in a world in which more and more content is being offered for payment. I would answer that, first, many new goods, typically information goods, are being offered with advertising, where exclusivity is difficult or impossible to impose; and second, even with the possibility of exclusivity and so a payment based revenue model, it may yet be an equilibrium to rely on the advertising financing mechanism only, as Armstrong (2006) and Armstrong and Wright have noted.

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Table 1: Yearly Revenue

	Local Unlimited	Local Part Time	Regular Unlimited	Regular Part Time
Existing 1945	94.3	52.3	328.5	164.4
New: October1945 - April1947	68.4	65.7	129.5	92.9

Source, FCC, 1947 Tables 5 and 20.

Table 1a: Ratio of New to Existing Firms' Revenue, 1947

	Local Advertising	Total Advertising
Mean	.39	.39
Standard Deviation	(.04)	(.06)
Number of Markets	58	48

Table 2: Summary Statistics, Freeze Period

Variable	Mean	S.D.	Min	Max
Revenue Growth	.13	.23	-0.55	1.62
Programming Cost Growth	.24	.24	-0.44	1.51
Growth in Economic Activity				
1942-1943 (gr43)	.18	.10	-0.08	0.56
1943-1944 (gr44)	.09	.07	-0.10	0.46
1944-1945 (gr45)	.07	.07	-0.14	0.29
War Years (1942-1945)	.34	.15	0.08	1.00

Table 2a: Correlation of Growth in Economic Activity

	1943-1944 (gr43)	1943-1944 (gr44)	1944-1945 (gr45)
1942-1943 (gr43)			
1943-1944 (gr44)	0.07		
1944-1945 (gr45)	-0.11	0.16	

Table 3: Revenue and Programming Costs Growth: Freeze Period

N=196, 89 cities	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent Variable:	**Revenue Growth**			**Programming Costs Growth**			
Revenue Growth					.83	.86	.84
					(.08)	(.10)	(.05)
1944-45 Growth	.43		.66		Inst.		
	(.28)		(.45)				
1943-44 Growth	.99		.80		Inst.		
	(.78)		(.68)				
1942-43 Growth	.64		.42		Inst.		
	(.28)		(.32)				
War Growth		.70		.60		Inst.	
		(.37)		(.32)			
p-value: coefs=0	.11		.20				
(p-value: equal coefs	.78		.76				
Est. Method	OLS	OLS	OLS	OLS	IV	IV	OLS

Table 3a: Within Market Regressions

	1944	1945	1946	1947
	Dep Var: Log Programming Costs (OLS)			
lnRevenue	.89	.84	.71	.79
	(.05)	(.04)	(.05)	(.03)
	Dep Var: Log Programming Costs (IV)			
lnRevenue	1.14	1.16	1.07	1.12
	(.07)	(.07)	(.10)	(.07)
	Dep. Var.: Log Revenue (OLS)			
lnPower	.36	.32	.32	.32
	(.03)	(.02)	(.03)	(.03)
No. of Obs.	195	192	181	175

First Panel: OLS Estimation of the regression of log Programming Costs on log Revenue.

Second Panel: Instrumental Variables Estimation of the regression of log Programming Costs on log Revenue, with the log of the station's power as instrument.

Third panel: First stage regressions: OLS regression of log revenue on lnpower.

Metropolitan district dummies included in all regressions.

Table 4: Summary Statistics, Post-War Period

	Mean	S.D.	Min	Number =0	Max
Ln of Bank Debit to Demand Deposits in 1942	6.78	1.16	4.37		10.00
ECONOMIC GROWTH:					
War	0.33	0.16	-.17		1.00
gr43 (1942-43)	0.17	0.12	-.08		0.72
gr44	0.09	0.08	-.21		0.46
gr45	0.07	0.08	-.17		0.41
gr46	0.17	0.11	-.17		0.45
gr47	0.14	0.06	.005		0.41
POPULATION GROWTH:					
1930s	0.11	0.11	-.07		0.63
1940s	0.23	0.16	-0.13		0.75
CHANGE IN LOG NUMBER OF STATIONS					
1946 to 1948	0.51	.40	0		1.79
1946 to 1947	0.19	.35	-.69		1.37
1947 to 1948	0.32	.32	0		1.79
NUMBER OF STATIONS					
1946	2.99	2.06	1	(35)	13
1947	3.52	2.22	1	(20)	13
1948	4.71	2.75	1	(5)	17

Table 4a: Correlations, Post-War Period

		War	Conc.	lnbd42	dpop30	
War growth		1.00				
Conc. growth	-0.02	1.00				
lnbd42		-0.16	-0.43	1.00		
dpop30		0.29	0.14	-0.07	1.00	
dpop40		0.29	0.09	0.04	0.76	1.00

	gr43	gr44	gr45	gr46	gr47	lnbd42
gr43	1.00					
gr44	-0.04	1.00				
gr45	-0.24	0.17	1.00			
gr46	-0.27	0.01	0.52	1.00		
gr47	-0.21	0.04	-0.04	0.14	1.00	
lnbd42	0.10	-0.12	-0.33	-0.49	-0.08	1.00

Table 5: First Stage Regression of Number of Firms on Determinants

<u>**Y=DlnN 46-48**</u>	(1)	(2)	(3)	(4)	(5)
Conc Growth	-.29	-.29			
	(.29)	(.29)			
War Growth	.42	.41	.44	.53	.58
	(.20)	(.20)	(.19)	(.19)	(.20)
Pop Gr. (`40s)	-.05				
	(.29)				
Pop Gr. (`30s)	.56	.52	.47		
	(.42)	(.28)	(.28)		
1942 BDDD	-.13	-.13	-.12	-.12	
	(.03)	(.03)	(.02)	(.02)	
R-2	.22	.22	.21	.20	.05
P-value	*pop: .22*				
N=149					

Table 6: First Stage Regression of Number of Firms on Determinants

	(1)	(2)	(3)	(4)	(5)	(6)
			Growth in Number of Stations			
Period	1946-1947		1947-1948		1946-1948	
Conc. Growth	-.13		-.36		-.29	
	(.30)		(.41)		(.29)	
War Growth	-.12	-.11	**.53**	**.56**	.41	.44
	(.18)	(.18)	(.17)	(.17)	(.20)	(.19)
Pop Gr. (`30s)	**.71**	**.68**	-.25	-.24	.52	.47
	(.27)	(.26)	(.24)	(.23)	(.28)	(.28)
1942 BDDD	**-.06**	**-.05**	**-.06**	**-.06**	-.13	-.12
	(.03)	(.02)	(.02)	(.02)	(.03)	(.02)
R-2	.08	.08	.14	.13	.22	.21

N=149

Table 7

N=153, 79 Cities	(1)	(2)	(3)	(4)
NET EFFECT: Growth in Prog. Costs (1945-1947): OLS				
N Growth (46/8)	.07	.06	.06	.06
	(.09)	(.09)	(.09)	(.09)
Conc. Growth		.36		
		(.21)		
Growth 46-47			.09	.10
			(.40)	(.44)
Growth 45-46			.44	.42
			(.25)	(.22)
Growth 44-45				.06
				(.49)

Table 8

N=153, 79 Cities	(1)	(2)	(3)	(4)	(5)	(6)
	NET EFFECT: Growth in Programming Costs (1945-1947): IV					
N Growth (46/8)	.53	.39	.26	-.42	-.13	.33
	(.20)	(.19)	(.20)	(1.2)	(.52)	(.21)
Conc. Growth		.39	.26	.33	.30	.26
		(.19)	(.23)	(.24)	(.21)	(.24)
Pop Growth (`40s)			.36	.50	.44	.35
			(.27)	(.32)	(.22)	(.28)
Instruments	war growth, 30’s pop growth, BDDD42			war growth	30`s pop growth	BDDD42

Table 9

N=153, 79 Cities	(1)	(2)	(3)	(4)	(5)
STRUCTURAL: Growth in Programming Costs (1945-1947)					
N Growth (46/8)	.02	-.07	-.05	-.14	-.001
	(.09)	(.58)	(.51)	(.42)	(.11)
Revenue Growth	.75	1.18	1.11	4.95	1.35
	(.26)	(1.19)	(1.04)	(7.94)	(.98)
Inferred value of ϕ	.03	-.06	-.05	-.03	-.01
		W, 30, gr42, con	W, 30, 42, 46 47	con	46, 47
Endogenous Var.		N, R	N, R	R	R
	OLS	IV	IV	IV	IV

Instruments: W: war-time growth, 30: 1930s population growth, 42: BDDD42, con: concurrent growth (i.e, gr46+gr47), 46: gr46, gr47: gr47.

Table 0

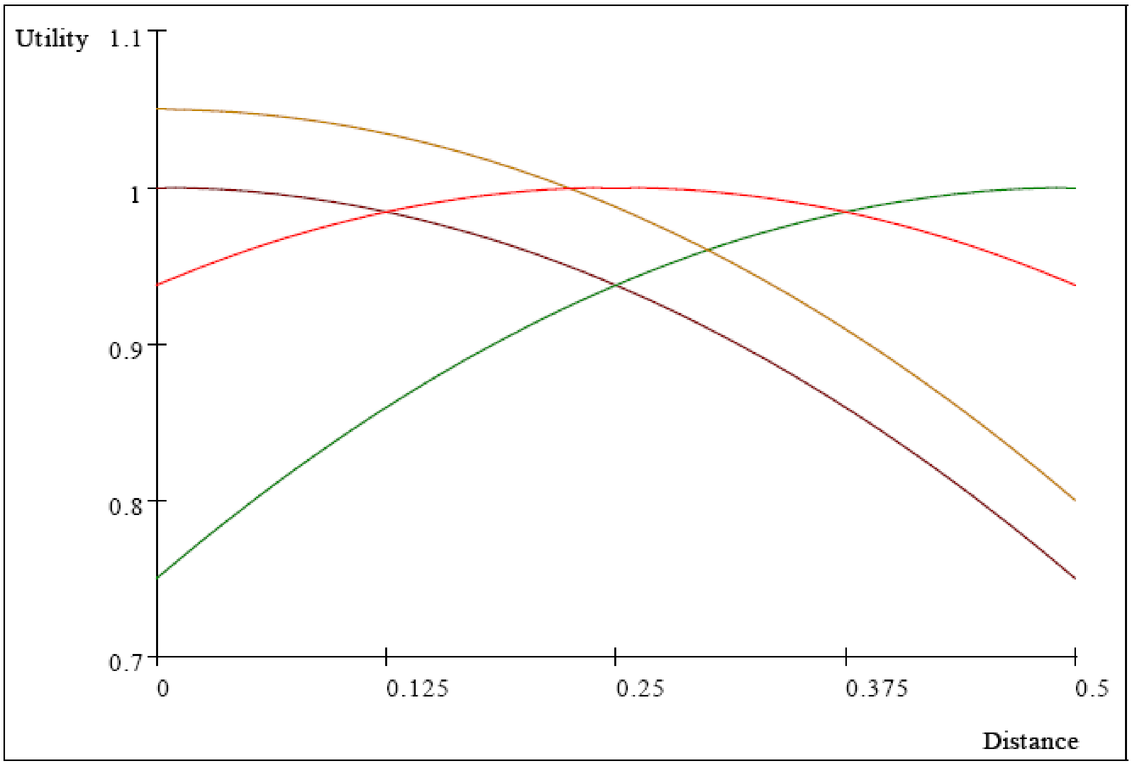
STRUCTURAL, Cross Section, OLS: Ln Programming Costs

N=153, 79 Cities	(1)	(2)	(3)	(4)
	1944	1945	1946	1947
Ln Revenue	.95	.98	.91	.96
	(.07)	(.07)	(.11)	(.05)
Ln Number of Stations	-.01	.04	.03	.08
	(.08)	(.07)	(.06)	(.06)
R-squared	.67	.71	.55	.76
Number of Observations`	153	153	153	153

Note: not referenced in paper.

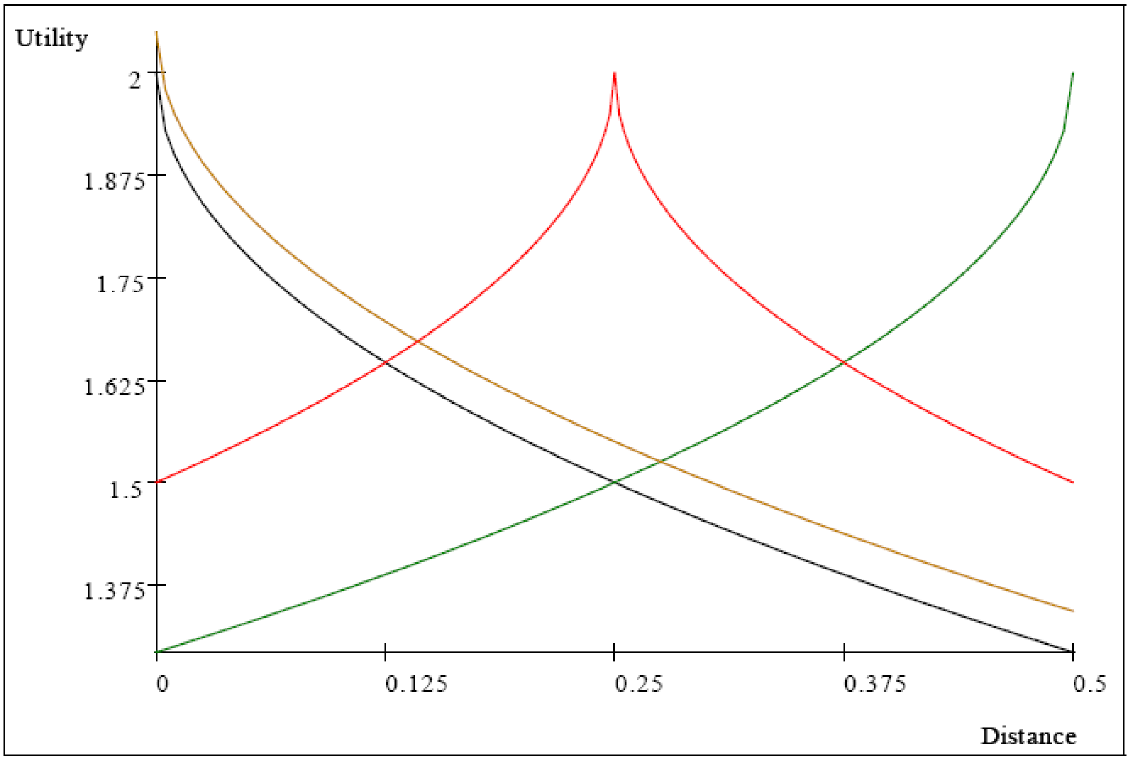
Table 10

N=153, 79 Cities	(1)	(2)	(3)	(4)
Growth in Revenue (1945-1947)				
N Growth (46/8)	.02	.48	.01	.41
	(.06)	(.29)	(.05)	(.26)
1946-47 Growth	-.45	-.10	.24	-.15
	(.35)	(.47)	(.15)	(.46)
1945-46 Growth	.23	.13	-.42	.13
	(.17)	(.24)	(.33)	(.23)
1944-45 Growth	-.05	-.19	.16	-.27
	(.32)	(.47)	(.16)	(.44)
1940s pop. Growth				.19
Estimation Method	OLS	IV	OLS	IV



The black, green and red curves show the utility from listening to a station located at positions 0, 0.5 and 0.25, respectively, that offers a common component of utility equal to one, $t = 1$ and $\phi = 2$. The brown curve shows the utility from listening to a station located at 0 that offers utility equal to 1.05.

Figure 1



The black, green and red curves show the utility from listening to a station located at positions 0, 0.5 and 0.25, respectively, that offers a common component of utility equal to two, $t = 1$ and $\phi = 0.5$. The brown curve shows the utility from listening to a station located at 0 that offers utility equal to 2.05.

Figure 2

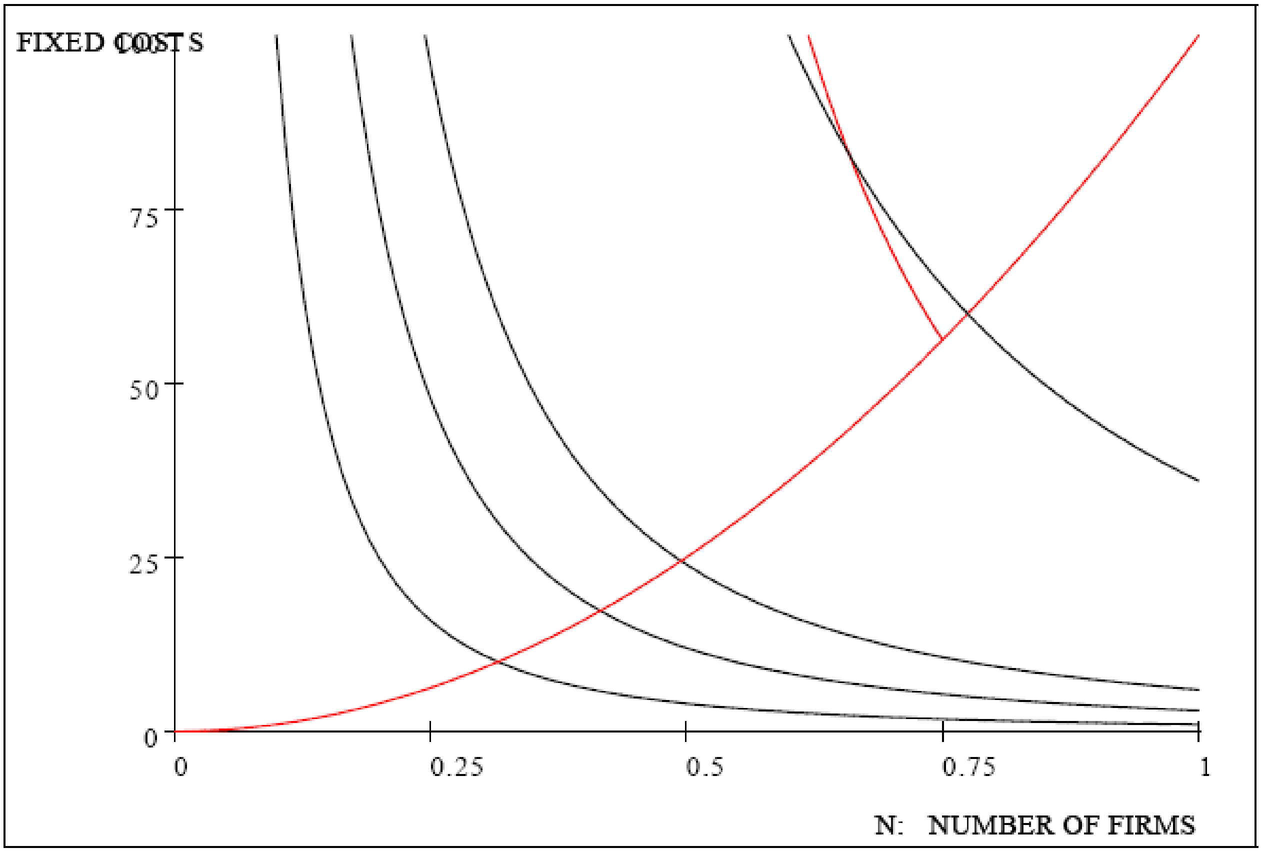


Figure 3

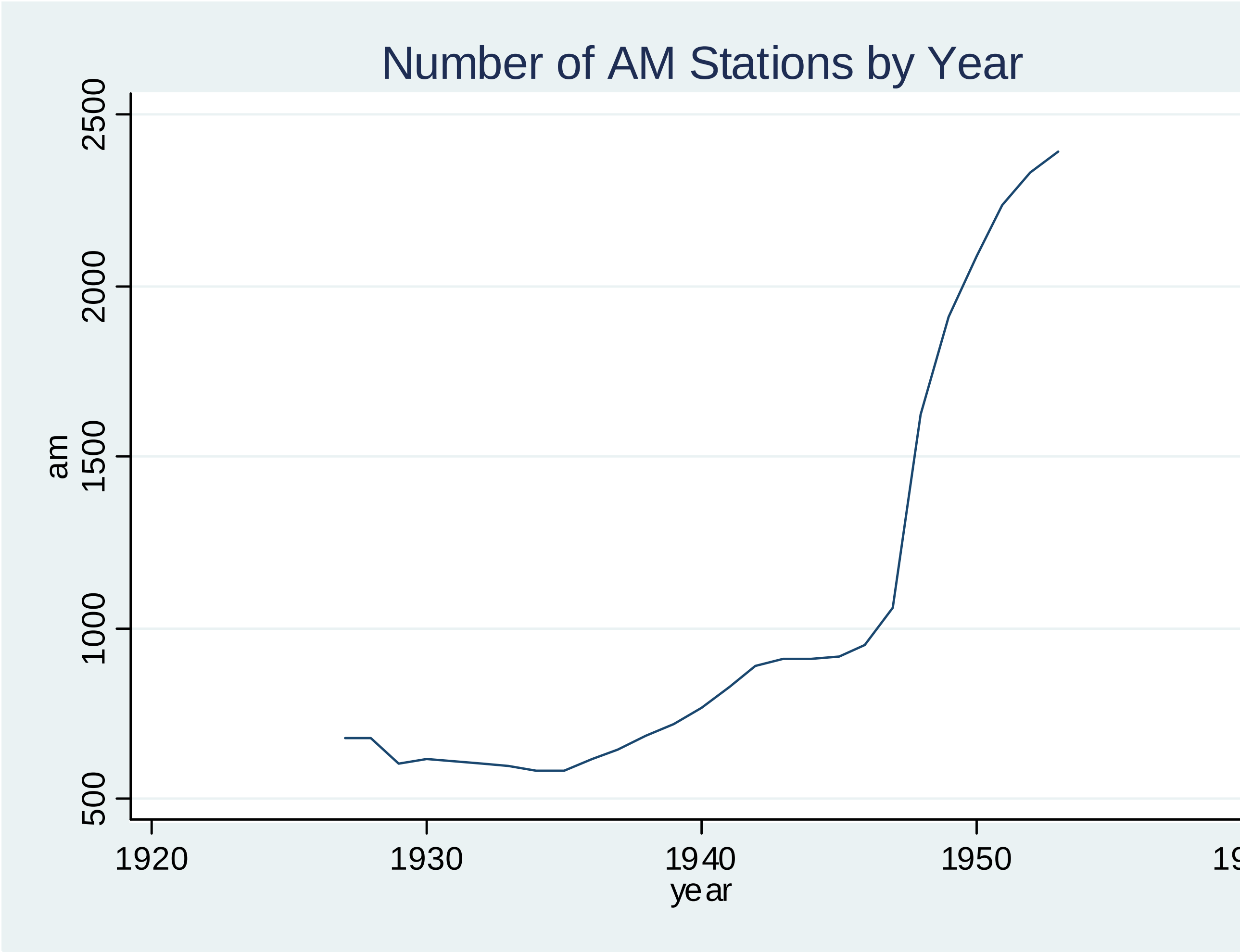


Figure 4

Source: Sterling, 1984, Table 170-A, taken from Department of Commerce, Federal Radio Commission and Federal Communications Commission.