THE NEWS HOUR: ESTIMATING THE VALUE OF TELEVISION NEWS

Matthew J. Baker[1]
Hunter College and the Graduate Center, CUNY

Lisa M. George[2]
Hunter College and the Graduate Center, CUNY

October 1, 2010
This version: March 14, 2011

**** Preliminary and Incomplete ****
**** Comments Welcome ****

Abstract

We estimate a two-sided structural model of television news to measure the relationship between viewing, advertising and station format choice. The model extends the approach of Berry & Waldfogel (1999) to introduce heterogeneity in the value of programming to viewers and advertisers, and to include the station's choice of programming format. In this way, the model represents a first attempt to measure inefficiencies in the product mix in differentiated product markets. Using program-level data on television viewing and advertising prices during the 5-7pm news hour over one week in 2010, we find that television news programs are close substitutes from the perspective of viewers. Advertiser demand for local news viewers is lower and more elastic than for viewers of non-news programs. Welfare simulations indicate that local news is oversupplied to a small degree in most markets from the perspective of viewers and advertisers, while some under-provision exists for stations. We illustrate how these inefficiencies arise from business stealing effects, indicating that stations systematically overlap programming when differentiation would improve welfare.

---

[1] Matthew J. Baker, Department of Economics, Hunter College, 695 Park Ave., New York, NY 10065. *Email:* mjbaker@hunter.cuny.edu.

[2] Lisa M. George, Department of Economics, Hunter College, 695 Park Ave., New York, NY 10065. *Email:* lisa.george@hunter.cuny.edu.

I. Introduction

An expansive theoretical literature documents potential inefficiencies in differentiated product markets, which can arise in both the number and mix of products. Excess entry can occur if products offered by entrants are close substitutes for existing varieties so that new entrants divert consumers from existing options. When entry costs are fixed, the marginal revenue to entrants can exceed fixed costs even if the total surplus gain to consumers does not. Models of entry and competition in this spirit begin with Chamberlin (1933) and are extended in important contributions by Spence (1976a, 1976b), Dixit and Stiglitz (1977) and Sutton (1991).

Inefficiencies in the product mix can arise when firms face incentives to cluster in regions of product space with high demand, or to excessively differentiate in order to sustain high prices. A large literature starting with Hotelling (1929) and developed by d'Apermont, Gabszewicz and Thisse (1979) documents inefficiencies in the location choices of firms. Taken together, this literature demonstrates that under a range of consumer preference distributions (Anderson, Goeree and Ramer (1997); Loeschter, 2010) and timing assumptions (Prescott and Visscher, 1977) product location choices can fall well short of first-best. Location models without prices, such as the median voter result of Downs (1957) and others reviewed in Osborne (1995), can produce even more pronounced distortions.

An important class of differentiated product markets, namely advertiser-funded media, are also two-sided markets. Divergence between the marginal value of differentiated products to consumers and to advertisers potentially introduces further distortions in the number and mix of products. Product positioning in two-sided markets is not well understood, though recent theoretical advances suggest important welfare effects.[3]

Despite this rich theoretical literature, very few attempts have been made to measure potential inefficiencies in differentiated product markets. An exception is Berry's and Waldfogel's (1999) analysis of free entry and inefficiency in radio broadcasting. They estimate the welfare loss to advertisers and broadcasters from excess entry to be 45% of revenue compared to the socially optimal number of firms. This dramatic result is driven by estimates of station substitutability, which indicate that additional stations largely divert listeners from existing options rather than bring new consumers into the market. With few additional consumers, total advertiser revenues increase only modestly with entry and do not cover the fixed cost of the last entrant in equilibrium.

Berry and Waldfogel estimate a symmetric model in which profits depend only on the number of firms. Their model thus cannot speak to surplus generated from the distribution of formats. This paper makes a first attempt to measure the value of differentiated products and estimate inefficiency in the product mix. To do this, we study the market for local television news. We extend the symmetric model of Berry and Waldfogel to incorporate multiple product types with distinct demands. We allow both viewer utility and advertiser revenue to depend on the program type, then model the broadcasters' program choice as a simultaneous static game of complete information. We estimate the model using program-level data on format, viewership and advertising revenue during the 5-7 p.m. evening news hours over one week in February 2010.

---

[3] Most of the product location literature on the media of two-sided markets concerns product position in a left-right political framework. See, for example, Gal-Or and Ylidrin (2009). An exception is Anderson (2010).

We study television for several reasons. First, the potential tradeoff between inefficient duplication and inefficient program choice in television has long interested economists. Theoretical efforts to understand inefficiencies in media markets date to Steiner (1952), who outlined cases where inefficient duplication might arise in competitive markets for television. Beebe (1977) extended Steiner's framework to consider tradeoffs between excess entry for "mass market" programming and under-provision of niche formats using a richer set of consumer preferences. In general, efficiency in both the product mix and total number of stations depends critically on substitutability of products from the perspective of viewers, especially consumer willingness to consume less-preferred products compared to outside options. The substitutability of local television news for non-news programming and the option of not viewing is an empirical question that we tackle in this paper.

Second, concern with under-provision of local programming, especially local news, has motivated long-standing communications policies in the US. Localism is one of the three principles governing FCC ownership rules, and the supply of local content is subjected to regular policy study. More recently, declining local news viewership along with lower newspaper readership has triggered interest in public subsidies and public provision. Our structural model allows us to estimate the positive and normative effects of station closure as well as the expected effects of policy intervention to stimulate supply.

Finally, television offers a convenient environment for estimation. Both viewing and advertising data are available at the program level, which allows for precise estimation of the value of differentiated programs. Program categories of interest are well-defined. Entry costs for new local stations are high, which allows us to abstract from station entry and focus on program choice.

Our viewership and advertising price models closely follow Berry and Waldfogel (1999). To study viewership, we formulate a nested multinomial logit model of television viewing. Our advertising price model it is based upon a log-linear demand for viewer impressions that changes functional form with the nature of programming. This specification allows the possibility that advertisers value impressions on viewers differently for different types of programs.[4]

We examine television stations' programming decisions from a game-theoretic perspective. Following the large and growing literature that applies the tools of game theory to estimate models of market structure and product variety, we view stations' decisions to air local news broadcasts as the outcome of a static, non-cooperative game of complete information played between local stations across times, days, and markets.[5] Estimates from the viewership and advertising price models allow us to form simple counterfactuals for the revenues stations would derive from offering alternative programs. We use these counterfactual returns to recover estimates of program-specific effects from alternative broadcasting

---

[4] Our approach can be viewed as a model of advertising context. The notion that the same individual might be more or less valuable in different program environments is well studied in psychology but warrants formal treatment in economics. Most of the psychology literature considers affective environments, for example Goldber and Gorn's (1987) treatment of "mood congruence," which studies advertisement recollection of "happy" and "sad" advertisements on programs with similar or opposing emotional tone. Most relevant to this research is Furnham, Gunter and Walsh (1998), who find that advertisement recall was stronger in news relative than comedy environments. Furnham, Gunter and Richardson (2002) offer a useful summary of the literature.

[5] Our estimation strategy is most closely related to Zhu, Singh, and Manuszak (2009) and Ellickson and Misra (2010).

options. We construct unobserved program quality terms implied by the complete-information Nash equilibrium of the programming choice game, then use these estimates to study the nature of equilibrium in programming markets.

Our reliance on a specific model of viewership and advertiser demand allows us to assess the welfare properties of programming choices. Our results suggest that from the perspective of viewers, local news broadcasts are close substitutes for each other and other programs types. Advertiser demand for local news viewers is lower and more elastic than for viewers of non-news programs. Welfare simulations indicate that local news is oversupplied to a small degree in most markets from the perspective of viewers and advertisers, while some under-provision exists for stations. More generally, the inefficiencies in our model most often arise from excess duplication of local news or non-news programming in a timeslot, but this is not true in many cases. We offer examples of how these inefficiencies arise from business stealing effects.

[To be Written: Policy Simulations]

The paper proceeds as follows. Section 2 relates our research to the literature and provides background on local television news markets. Section 3 outlines our model and basic estimation approach. Section 4 describes the data and explores relationships in the data in a non-structural framework. Section 5 presents results of our viewer, advertiser and program choice specifications and studies welfare. Section 6 considers policy experiments, and section 7 concludes the paper. We provide detail on our estimation methods in an appendix to the main text.

II. Background & Literature

A. Literature

Our study is informed by a well-developed literature on variety and consumption in media markets. Much of this literature explicitly or implicitly considers the relationship between product variety and market size. Overall, the positive relationship between market size, available variety and consumption has been demonstrated in radio (Waldfogel 2003), newspapers (George and Waldfogel 2003) and entertainment television (Waldfogel 2004). This literature suggests that the welfare implications of variety are particularly important for minority taste groups, as larger minority populations are generally found to increase per capita consumption among these groups. We might expect similar effects to operate in local television news markets, and one contribution of this paper is to document the effect of market size and the distribution of tastes on the supply of local news programs and local news viewing.

Our paper also informs the debate on localism, which constitutes one of the three principles of media regulation in the US and is the subject of an interesting literature on the competition between national and local media products. George and Waldfogel (2006) documents that the national expansion of the *New York Times* attracted highly educated readers away from local media, triggering repositioning in local newspapers. George (2008) documents the effect of the spread of the internet on the composition of the local newspaper audience. Anderson (2005) offer a theoretical framework for thinking about competition and welfare when national and local media compete. This literature is driven by the intuition that firms producing national products can spread fixed quality investments over a larger market than local producers. Since most of the expansion in both news and entertainment programming associated with improvements in television technology has been national, this mechanism might be expected to operate in television markets. Our estimates of the substitutability of national and local television news speak to this point.

From a welfare perspective, the substitutability of local for outside products matters most when local media generate positive behavioral externalities that are lost when outside media are privately preferred. Demand-side externalities are now well documented: George and Waldfogel (2008) show that the *New York Times* expansion differentially reduced turnout in local elections among readers targeted by the Times. Gentzkow (2006) documents significant changes in local political participation during the expansion of television in the 1950's. Oberholzer-Gee and Waldfogel (2009) show a relationship between Spanish-language news programming and voter turnout. Evidence suggests that spillovers are not limited to voting. Stromberg (2004) shows a relationship between public spending and radio access in the 1920's, and Snyder and Stromberg (2010) describe effects of local media markets on political competition. In the context of this paper, we would like to know, for example, whether public affairs programming on cable networks is a strong substitute for local news. If so, we might expect to see associated changes in local engagement and local policy.

The paper also offers unique evidence of how advertising shapes media markets through station programming choice. Most theoretical and empirical research in this area follows the contribution of Anderson and Coate (2005) in emphasizing the role of advertising minutes and associated viewer disutility. In television, long-term contracts and fixed program length limit the role of advertising time as a strategic variable. We focus instead on the imperfect substitutability of programming from the perspective of advertisers. The potential importance of advertiser heterogeneity in television markets is documented in George (2009), which measures the role of television in the decline of local beer. The model developed here demonstrates how scale parameters of an advertiser profit function can impact program choice by stations, offering a new perspective on location choice in two sided markets.

From a methodological perspective, our empirical approach builds upon the large and growing literature that applies the tools of game theory to estimate models of market structure and product variety, beginning with the work of Reiss and Spiller (1989), Bresnahan and Reiss (1990,1991), and Bjorn and Vuong (1985) and recently reviewed in Berry and Reiss (2007), Ackerberg, Benkard, Berry, and Pakes (2005), Bajari, Hong, Krainer, and Nekilipov (2010), and Bajari, Hong, and Ryan (2010). A central focus of this literature on estimation of discrete games is using market outcomes to estimate profit functions in the absence of information about profits. Our data, however, has detailed post-outcome information in the form of viewership and advertising prices, which constitute the bulk of station revenue. In this regard, our methods more closely follow the work of Zhu, Singh, and Manuszak (2009) and Ellickson and Misra (2010) in adapting control-function techniques to control for equilibrium selection effects. The basic idea behind this research is to estimate a reduced-form predictive model of market structure, and use the results of this estimation to control for equilibrium selection in estimating revenue and/or demand equations. Along these lines, we adopt a semi-parametric approach in which we flexibly model the probability of observing a configuration of programming options across stations in a market, and then use predicted probabilities deriving from this model to control for selectivity in estimating parametric viewership and advertising revenue functions for each stations. One difficulty that must be confronted in executing this agenda is the variability in the identity and number of stations across markets.

The following section reviews pertinent background on the market for television news. We then turn to the data.

B. Local Television Background

There has never been truly free entry in local television. Since the start of the broadcast era, television stations have been licensed by the FCC to broadcast programming over specific portions of the frequency spectrum. Because broadcast signals can interfere with each other, the number of stations in any particular region was limited by the technology available to utilize spectrum. The FCC's initial allocation allowed three stations in the largest markets, fewer in smaller cities, setting the stage for the three-network regime that dominated television through the 1980's. The number of broadcast stations licensed in very large markets was thus not much larger than the number in small markets, leading to a wide disparity in the number of stations per capita across the US.

Entry barriers for local stations, however, do not necessarily translate into restricted entry for local news, as stations have many scheduling options to satisfy demand. However, in practice, the limited number of station licenses in each market did likely indirectly limit local news programming. Local station license-holders negotiate contracts with national networks to carry network programs. Station scarcity meant substantial rents paid by networks to local license holders for airing national programs. The opportunity cost of forgoing national programming in favor of additional local news broadcasts has thus always been very high. These opportunity costs were highest in the largest, most constrained markets with the greatest number of viewers per station. As a result, the amount of local news programming during the broadcast era did not vary substantially across markets.

The spread of cable television dramatically lowered entry barriers for national programming. By offering both an alternative outlet for network entertainment and diverting viewers from local stations, the spread of cable reduced the networks willingness to pay for placement on local stations. This effectively lowered the opportunity cost of airing local news, and is likely the reason that more local news programming is broadcast today than in the broadcast and early cable eras.. Cable expansion has led to entry of some stations carrying local and regional news, and we will consider the effect of these stations in our analysis. But limits to "must carry" rules combined with cable system maps that do not fully coincide with broadcast geography have limited these local stations to the largest market.

What is important for our analysis is that the number of stations in each market be fixed. Our program choice model in this context can thus be seen as the second stage of an entry-location game. Our modeling assumptions appear to be consistent with the data.

It is also worth noting that contracts between networks and local stations include not only compensation for airing network programming, but also an allocation of advertising minutes. The number of minutes of advertising per hour has increased over time and is generally higher on cable programs. It has become standard in the literature on media markets to consider advertising minutes as a measure of quality and to model it explicitly. Our model treats advertising minutes as fixed, consistent with what we observe in our advertising data for broadcast stations. From a modeling standpoint, this allows us to make stronger welfare conclusions from advertising prices. More generally, advertising minutes are not a strategic variable in television station competition the way they might be in, say, radio markets. The inability to compete on quantity comes from two sources. The first is constraints from programming: *Friends* is 22 minutes long and *Law & Order* is 44 minute long. Program times cannot be readily lengthened or shortened after production. The second constraint comes from the allocation of advertising slots among networks and stations in long-term contracts. As a result, the allocation of television advertising is done through price competition, with unsold minutes allocated to promotional spots.

With this background, we turn to our model of viewing, advertising and program choice.

III. Econometric Specification

This section describes our models of viewership, advertising prices, and program choice. The empirical model is comprised of a viewership equation and an advertising price equation. The viewership equation and the advertising price equation allow prediction of expected revenues to stations from alternative programming decisions. We specify an equilibrium condition: expected revenues from stations' observed choices must be greater than the revenues from alternatives in a way that is consistent with a complete-information Nash equilibrium. From the expected revenues and equilibrium condition, we deduce unobserved parameters dictating the returns stations would derive from choosing alternative unobserved programming options.

Our model of viewership is based on a simple nested-logit formulation. Our model of advertising prices is based upon a log-linear demand function for viewers that changes functional form with programming. This feature of the advertising price equation allows for advertisers' valuation of viewership to vary with the program format. In a fashion described by Ellickson and Misra (2010), we adapt control-function techniques to account for equilibrium selection effects in both the advertising price and the viewership demand functions.

In what follows, we use the usual notation to denote the actions available stations in programming choices. We denote the programming chosen by station *i* as a_i, where $C = \{1,2,3,..,K)$ denotes a set of alternative programming options available to stations. The actions of all other stations excepting station *i* are denoted a_{-i}.

A. Viewership Share Functions

The viewing decision is based upon a standard discrete-choice random utility model. The utility enjoyed by viewer *n* when watching station i in market *m* at time *t* on day *d* can be written as:

$$u_{ni,dmt} = \delta_{i,dmt}(a_i) + \xi_{i,dmt}(a_i) + e_{ni,dmt}. \tag{1}$$

To economize on notation, we suppress the day-market-time subscripts in (1) when there is minimal possibility of confusion, and write the viewership equation as:

$$u_{ni} = \delta_i(a_i) + \xi_i(a_i) + e_{ni}. \tag{2}$$

Equation (2) indicates that utility depends upon a deterministic, station-specific term $\delta_i(a_i)$, an idiosyncratic component $\xi_i(a_i)$ that is unobserved by the econometrician but known to the station, and a viewer-specific error term $e_{ni,dmt}$. This formulation closely follows the classic random utility framework described by Berry (1994), excepting the dependence of both deterministic and unobserved terms on programming choice a_i.

The implication of the dependence of idiosyncratic and deterministic terms on programming choice is that the situation of each station in (a market at a given time) is characterized by a set of terms

$\delta_i(a_i)$, $\xi_i(a_i)$, *i=1,2,…,C*. While the deterministic components $\delta_i(a_i)$ can be recovered using estimated coefficients as described in Berry (1994), estimating the full set of unobserved terms $\xi_i(a_i)$ presents some specific challenges. Below, we detail how conditions deriving from the Nash equilibrium of the programming choice game can be used to extract information about these parameters.

We assume that the systematic component of viewer utility can be captured by sets of dummy variables, so that:

$$\delta_{i,dmt}(a_i) = 1_{ai}\beta_p + d_m\beta_m + d_t\beta_t + d_d\beta_d \tag{3}$$

Equation (3) expresses the systematic component of utility as dependent upon programming type dummies, market-level dummies, time dummies, and day dummies. We allow the type of programming to be local news, national news, or "other" sorts of programming in the exposition, but will discuss more detailed types of programming choices in the estimation section of the paper. We employ the usual assumption that there is an outside alternative available to the viewer (i.e., not watching television), the utility of which is normalized to zero, so $u_{n0} = e_{n0}$..

The idiosyncratic error term e_{ni} in equation (2) can be specified to allow for correlation across similar sorts of programming, and this forms the basis for a nested logit model. Following Berry (1994) and Berry and Waldfogel (1999), we specify the error term as:

$$e_{ni} = \nu_{a_i,a_{-i}\in k}(\sigma_k) + (1-\sigma_k)\varepsilon, k \in C\,, \tag{4}$$

where ε_{ni} is an IID type-one extreme value variate. In equation (4), *k* indexes program types, and therefore specification (4) of the error term results in a nested multinomial logit model of viewer choice, where the parameter σ_k measures the degree of similarity between programming options of the same type – the apparent substitutability between different local news broadcasts, for example. As σ approaches one, programming options are essentially identical from the perspective of the viewer. In this case, adding programming options does not change overall viewership, but instead reallocates existing viewership among stations. As σ goes to zero, programming is maximally differentiated and (4) collapses to a standard multinomial logit model. The notation in (4) indicates that from the perspective of viewers, the error term of station *i* is correlated with other stations that broadcast the same type of program.

Nested multinomial logit models are problematic for several well-documented reasons (as discussed, for example, in Berry, Levinsohn, and Pakes (1994) who also provide an oft-used alternative model). One objection to the use of a nested multinomial logit model in describing consumer choices is that rather restrictive assumptions about viewer decisions must be imposed.[6] The nesting structure sometimes presents practical problems in estimation, as there is no guarantee results will be consistent with utility-maximizing behavior. McFadden (1981) shows that consistency requires that the nesting parameters must lie between zero and one, i.e., $\sigma \in [0,1]$. We shall also describe and estimate some more

---

[6] Cardell (1997) takes exception with this viewpoint.

complex models of viewership in which there are multiple nesting levels. In these cases, it must be the case that as one moves down the decision-making tree, the values of σ increase.[7]

On the other hand, nested multinomial logit models allow for parameter estimation using linear estimation methods. More importantly for our work, the estimating equation implied by the nested multinomial logit, along with the implied market share expressions, allows for simple and intuitively appealing expressions describing the way stations' programming choices impact the viewership shares of other stations. The nested logit is therefore an ideal vehicle for characterizing competition between stations for viewers and for describing counterfactuals necessary for modeling programming choice as a complete-information noncooperative game.

With this,the probability that an individual chooses to watch a particular program can be written as:

$$p_{ni}(a_i) = p_{i|k,a_i\in k}\, p_{k,a_i\in k}\,,\ k\in C \tag{5}$$

That is, the probability that an individual *n* decides to view station *i* offering programming of type *k* is the conditional probability of picking station *i* multiplied by the probability of opting to watch a program of type *k*. McFadden (1981) and others have shown that the assumption on error terms in equation (4) imply that the above probability – also the market share of the station – can be written as (with a slight abuse of counters in the notation):

$$s_i(a_i,a_{-i}) = \frac{e^{\frac{\delta_i(a_i)+\xi_i(a_i)}{1-\sigma_k}}}{\sum_{j\in k} e^{\frac{\delta_j(a_j)+\xi_j(a_j)}{1-\sigma_k}}} \frac{\left(\sum_{j\in k} e^{\frac{\delta_j(a_j)+\xi_j(a_j)}{1-\sigma_k}}\right)^{1-\sigma_k}}{\sum_{h\in C}\left(\sum_{j\in h} e^{\frac{\delta_j(a_j)+\xi_j(a_j)}{1-\sigma_h}}\right)^{1-\sigma_h}}\,. \tag{6}$$

The share in equation (6) depends upon market-wide deterministic and unobserved terms in the market, the programming choice made by the station (*i*), and the programming choices of all other stations. While explicitly noting that the share of station *i* depends upon the choices of other stations in the market is not necessary for estimating equation (6) – indeed, this is one of its chief conveniences - the notation serves to accentuate some of the game-theoretic aspects of station programming choices, and also serves as a reminder that the market share of a station depends upon not only its own situation, but that of all other stations in the market. In the double summation appearing in the denominator of (6), there is one category for which utility is normalized to unity, describing the probability of not viewing. Then, the probability of not viewing is:

$$s_0(I) = \frac{1}{\sum_{h\in C}\left(\sum_{j\in h} e^{\frac{\delta_j(a_j)+\xi_j(a_j)}{1-\sigma_h}}\right)^{1-\sigma_h}} \tag{7}$$

---

[7] Some researchers have argued that global consistency is too high a standard to hold the model to, and have instead found conditions under which the model is locally consistent. See Borsch-Supan (1990) and Herriges and Kling (1996). Gil-Molto and Hole (2004) extend these sorts of results to the three-level nested multinomial logit.

With program-level viewing data, equations (6) and (7) can be used to formulate a model of market shares that can be estimated using standard linear instrumental-variables methods. The estimating equation associated with (6) and (7) can be written as (see Berry, 1994):

$$\ln s_i(a_i,a_{-i}) - \ln s_0 = \sigma_k \ln s_{i|i\in k}(a_i,a_{-i}) + \delta_i(a_i) + \xi_j(a_i) \qquad (8)$$

The conditional shares on the right-hand side of (8) are endogenous and therefore instruments are needed for estimation.. Moreover, selection effects are potentially important: those stations that broadcast local news might do so in part because they possess a large value of $\xi_i(a_i)$ for local news and/or a low value of $\xi_i(a_i)$ for non-news programs relative to other stations. We discuss estimation of selection terms in more detail below.

B. Advertising

Following Berry and Waldfogel (1999), a simple approach to modeling advertising prices is to assume that advertisers have a diminishing willingness to pay for additional viewers, and that this willingness to pay is described by a log-linear demand function. We use this formulation to model advertising demand at the station level, and also to allow advertisers' willingness to pay for viewers to vary with the program type.[8] Let $\tilde{q}_i(a_i,a_{-i})$ denote the price that an advertiser is willing to pay for viewers, and let viewership of station *i* be given by $x_i(a_i,a_{-i})$; total viewership can be readily computed using viewership shares by scaling shares up to the size of the market; i.e, total viewership is $x_i(a_i,a_{-i}) = Ms_i(a_i,a_{-i})$, where *M* denotes total market population. The willingness to pay for an additional viewer on the part of advertisers, given a total viewership of $x_j(a_i,a_{-i})$ is:

$$\tilde{q}_i(a_i,a_{-i}) = e^{\alpha_j(a_i)+\omega_j(a_i)} x_i(a_i,a_{-i})^{-\eta_k} \qquad (9)$$

Reintroducing time-day-and market subscripts for the moment, we specify α_j in equation (9) as the deterministic component of advertiser demand:

$$\alpha_{j,dmt}(a_i) = d_m\alpha_m^k + d_t\alpha_t^k + d_d\alpha_d^k \qquad (10)$$

Equation (10) characterizes the intercept term in the demand function (9) as a function of market, time, and day dummies. The coefficient η_k in equation (9) describes how the price per viewer an advertiser is willing to pay changes with total viewership on program type *k*.. In equation (9), we have referred to total viewership as $x_j(a_i,a_{-i})$, which indicates that total viewership of station *i* depends upon the programming choices that *i* makes, but also depends upon the programming choices that other stations have made, as these choices influence viewership share, and hence station viewership. The $\omega_j(a_i)$ term in equation (9) is an error term which we view as a "true" error term in the sense that it is unknown to stations and advertisers at the time programming decisions are made. This specification allows the

---

[8] The role of advertiser heterogeneity in media markets is under-researched. We hope to explore in future work the extent to which advertiser demand functions are interdependent, that is to capture imperfect substitutability between stations from the perspective of advertisers.

possibility that advertisers value impressions on viewers differently for different types of programs, which we interpret as a measure of advertising *context*.[9]

It will be convenient to estimate equation (9) as a price-per-unit-time, rather than its stated price-per-viewer form, so we multiply both sides of (9) by total viewership. This produces a log-linear equation describing advertising revenues per second: $q_i(a_i, a_{-i}) = x_i(a_i, a_{-i})\tilde{q}_i(a_i, a_{-i})$. Hence, our estimating equation is:

$$\ln[q_i(a_i, a_{-i})] = \alpha_i(a_i) + (1-\eta_k)\ln x_i(a_i, a_{-i}) + \omega_j(a_i) \qquad (11)$$

Equation (11) allows us to develop expressions for expected revenue that stations would derive from broadcasting different program types. Note that when stations change program types, this also changes viewership shares, and hence total viewership $x_i(a_i, a_{-i})$. As was the case with estimating viewership equations, equilibrium selection effects in estimating (11) have to be considered.

C. Program Choice

We model the program choice problem as a dichotomous choice between broadcasting local news or broadcasting an alternative type of programming, which we refer to as "other" or "non-news" programming. Therefore, the choice set of the local stations we study is given by $C' = \{l, o\}$, with *l* denoting a choice to broadcast local news, and *o* denoting the choice to broadcast "other" programming. Note that from the perspective of *viewers*, we allowed a choice set in which there are three different classes of programs available: local news, national news, and "other" programming, which might be denoted as $C = \{l, o, n\}$. We treat national news broadcasts as exogenously supplied and scheduled, so local stations make no choice in this regard but national news is included in the viewers' choice set, and therefore impacts station shares.

The point of departure for our model of programming choice is that programming decisions are a result of a simultaneous, static game of complete information among stations. This means that stations know their own programming demand parameters $\delta_i(a_i), \xi_i(a_i), i \in l, o$ and also know the programming demand parameters $\delta_k(a_k), \xi_k(a_k), k \in l, o$ of all other stations in the market. In words, firms know the characteristics of demand for each and every choice of programming they might make, and also know these parameters for all other firms in the market.

As a first step, denote the expected revenue obtained from a course of action, given the actions of all other players, as $E[q_i(a_i, a_{-i})], i \in \{l, o\}$, where $q_i(a_i, a_{-i})$ is given in equation (11). Since programming decisions are the result of a static noncooperative game of complete information, we expect that no station has an incentive to deviate from its observed programming choice, taking as given the

---

[9] The notion that the same individual might be more or less valuable in different program environments is well studied in psychology but warrants formal treatment in economics. Most of the psychology literature considers affective environments, for example Goldberg and Gorn's (1987) treatment of "mood congruence," which studies advertisement recollection of "happy" and "sad" advertisements on programs with similar or opposing emotional tone. Most relevant to this research is Furnham, Gunter and Walsh (1998), who find that advertisement recall was stronger in news relative than comedy environments. Furnham, Gunter and Richardson (2002) offer a useful summary of the literature.

programming choices of other stations. Consider a station that is currently broadcasting local news. For this decision to be consistent with a Nash equilibrium, it must be the case that:

$$E[q_i(a_i = l, a_{-i})] \geq E[q_i(a_i = o, a_{-i})] \qquad (12)$$

Equation (12) formalizes the idea that station *i* finds it most profitable to broadcast local news vis-à-vis other programming, given the (fixed, for the purposes of this exercise) broadcasting decisions of all other stations, denoted in (12). Using equation (11), we can rewrite equation (12) as:

$$E[e^{\omega_i(a_i=l)}]e^{\alpha_i(a_i=l)}x_i(a_i = l, a_{-i})^{1-\eta_l} \geq E[e^{\omega_i(a_i=o)}]e^{\alpha_i(a_i=o)}x_i(a_i = o, a_{-i})^{1-\eta_o} \qquad (13)$$

The first term on the left-hand side of (13) is *i*'s expected advertising price from broadcasting local news, which depends upon the expectation of an error term, the deterministic components of price relevant to *i*, and viewership. In the case in which station *i* is actually observed broadcasting local news, our viewership and advertising price models produce estimates of all the terms in (13) except for $x_i(a_i = o, a_{-i})$, which is the viewership that station *i* would get when broadcasting something other than local news. We will describe how this term may be intuited from an equation like (13) momentarily, but it is worth recounting how and where all the other terms in (13) come from, as equations of this form are the basis for modeling the station game. First, the (exponentiated) expected value of error terms may be estimated using the residuals deriving from equation (11). Typically, these expectations are estimated using an adjustment factor such as the average exponentiated value of the residuals:

$$E[e^{\omega_i(a_i=l)}] = \frac{1}{N_l}\sum_{a_k=l} e^{\omega_k(a_k=l)} \ ; \qquad E[e^{\omega_i(a_i=o)}] = \frac{1}{N_o}\sum_{a_k=o} e^{\omega_j(a_k=o)} \qquad (14)$$

In a regression with selection effects, two sets of equations generate two different sets of residuals. These residuals can then be used to compute the quantities in (14). The advertising equations furnish estimates of the parameters α and η directly. Furthermore, if station *i* is broadcasting local news, we observe total viewership; hence the term $x_i(a_i = l, a_{-i})$ is also known.

The term $x_i(a_i = o, a_{-i})$ in equation (13) is station viewership if non-news” programming were broadcast, holding the broadcast decisions of all other firms constant. This term has to be regarded as known (to stations) for a complete-information game. Estimation results do not produce an estimate of counterfactual viewership, or the unobserved viewership term $\xi_i(a_i = o)$, so these terms must be developed via other means.

A first point to note is that if the terms $\xi_i(a_i = o)$ were known, producing an estimate of counterfactual viewership for station *i* given other stations' actions would be straightforward. Using all known terms in the share equation (6), but switching station *i* from programming type *l* to programming type *o* results in a new share of:

$$s_i(a_i = o, a_{-i}) = \frac{e^{\frac{\delta_i(a_i=o)+\xi_i(a_i=o)}{1-\sigma_o}}}{\left(\sum_k e^{\frac{\delta_k(a_k=o)+\xi_k(a_k=o)}{1-\sigma_o}} + e^{\frac{\delta_i(a_i=o)+\xi_i(a_i=o)}{1-\sigma_o}}\right)^{\sigma_o}} \times$$

$$\frac{1}{1+\left(\sum_k e^{\frac{\delta_k(a_k=o)+\xi_k(a_k=o)}{1-\sigma_o}} + e^{\frac{\delta_i(a_i=o)+\xi_i(a_i=o)}{1-\sigma_o}}\right)^{1-\sigma_o} + \left(\sum_{k\in n} e^{\frac{\delta_k(a_k=n)+\xi_k(a_k=n)}{1-\sigma_n}}\right)^{1-\sigma_n} + \left(\sum_{k\in l} e^{\frac{\delta_k(a_k=l)+\xi_k(a_k=l)}{1-\sigma_l}} - e^{\frac{\delta_i(a_i=l)+\xi_j(a_i=l)}{1-\sigma_l}}\right)^{1-\sigma_l}} \qquad (15)$$

Equation (15) depends upon both the terms $\xi_i(a_i = o)$ and $\xi_i(a_i = l)$. The former term forms the basis for most of the share described in (15), but the latter also figures into the last part of the denominator in (15); it must be subtracted out of the local news group to get the new inclusive utility term for stations broadcasting local news. Once (15) has been computed, the counterfactual viewership can be obtained by simply scaling up the share to the size of the market by multiplying the share by total market population.

While the exposition so far has supposed the term to be known, it is not. But (15) can be calculated for *any* value of $\xi_i(a_i = o)$, and this allows recovery of critical information on its distribution. We proceed first by noting that there is some cutoff for $\xi_i(a_i = o)$ that renders equation (15) an equality:

$$E[e^{\omega_i(a_i=l)}]e^{\alpha_i(a_i=l)}x_i(a_i = l, a_{-i})^{1-\eta_l} = E[e^{\omega_i(a_i=o)}]e^{\alpha_i(a_i=o)}x_i(a_i = o, a_{-i})^{1-\eta_o} \qquad (16)$$

Given knowledge of everything else in (16), and expression (15), the "cutoff" value $\bar{\xi}_i(a_i = o)$ can be found using numerical solution methods. We use a simple fixed-point iteration algorithm to recover these terms, The algorithmconverges rapidly, aided by the fact that the shares in (16) are monotonically increasing in $\xi_i(a_i = o)$.

Given proper controls for equilibrium selection effects, estimation results also produce information on the distribution of the unobserved heterogeneity terms. If we assume that these terms are normally distributed with standard deviation τ , we infer that the unobserved heterogeneity terms will each be distributed according to a right-truncated normal distribution with mean zero, standard deviation τ, and right truncation point $\bar{\xi}_i(a_i = o)$ obtained from (16). The standard deviation of the idiosyncratic terms can be estimated from the residuals of the viewership equation. Given knowledge of the distribution, we may either simulate values for $\xi_i(a_i = o)$ or estimate it using the expectation of a truncated normal random variable:

$$E[\xi_i(a_i = o)] = -\tau \frac{\phi(\bar{\xi}_i(a_i = o)/\tau)}{\Phi(\bar{\xi}_i(a_i = o)/\tau)}. \qquad (17)$$

We now are able to construct a complete information Nash equilibrium around observed programming choices. Before turning to application of these estimates to questions of stability and uniqueness of equilibrium, welfare analysis, and policy experiments, we first delve into some of the details of estimation, most notably, how we deal with the selection effects underlying equations (8).

[To be written – inclusion of differential costs from alternative broadcasting decisions.]

D. Selection effects and modeling equilibrium outcomes

To control for selection effects, we use a control function approach. Put most simply, this involves estimating a flexible predictive model of different equilibria, and then using this model to form predicted probabilities. As Heckman and Robb (1985, 1986) and Ahn and Powell (1993) have shown, once such a probability model has been estimated, terms controlling for selection can, under certain assumptions, be developed through transformation of predicted probabilities.

[The rest to be written – in this version, Mills ratios are used to control for selection effects.

$$MR_l = \frac{\phi(\gamma Z_j)}{\Phi(\gamma Z_j)}; \qquad MR_o = \frac{\phi(\gamma Z_j)}{1-\Phi(\gamma Z_j)}.$$

Strictly speaking, this is more consistent with a game of incomplete information and a Bayes-Nash equilibrium, but is still not correct. A selection model for different Nash equilibria must be estimated.]

E. Welfare

We are interested in how changes in the nature of market equilibrium can be expected to impact viewers, advertisers and broadcasters. Such assessment is important in evaluating policy interventions, as there is no a priori reason to believe that programming choices – which reflect the valuation that advertisers attach to viewers of different types of programming – also maximize the utility earned by viewers of television. Alternatively, it could well be the case that viewers are not very strongly impacted by market changes, but that advertisers care a great deal about the menu of available programming choice. We also seek to measure how station entry and exit affects welfare. The paragraphs that follow first derive an expression for changes in viewer welfare, expressed in terms of changes in program viewing shares, then consider changes in station and advertiser profits.

1. Viewer Welfare

As is well-known, in the typical nested logit model, the expected maximum utility that a consumer of a good achieves can be written as:

$$U = \gamma_c + \ln\left[\sum_{k\in C}\left(\sum_k e^{\frac{\delta_i(a_i=k)+\xi_i(a_i=k)}{1-\sigma_k}}\right)^{1-\sigma_k}\right]. \qquad (21)$$

Where γ_c in (21) is Euler's constant. The viewership estimating equation (8) implies that parameters and observed shares obey the relationship:

$$e^{\frac{\delta_i(a_i=k)+\xi_i(a_i=k)}{1-\sigma_k}} = s_i(a_i = k, a_{-i})\left(\frac{s_k^{\sigma_k}}{s_0}\right)^{\frac{1}{1-\sigma_k}} \tag{22}$$

Inserting (22) into (21), remembering that the utility from not viewing is normalized at zero, and simplifying results in the expression for total expected maximum utility from viewers as:

$$U = \gamma_c - \ln s_0 . \tag{23}$$

Hence, utility to the typical viewer (up to a scale factor) can be calculated by observing how the change in the share of the population not watching television changes under alternative programming configurations. Moreover (23) suggests that expected viewer utility is increasing in the aggregate viewership share. Therefore, optimal programming mixes from the perspective of viewers are those mixes that maximize total viewership.

Equation (23) can also be used to produce dollar-value estimates of the change in viewership utility across two alternative programming offerings. The change in utility for the representative viewer at a particular time is the log-ratio of the new non-viewership share to old non-viewership share:

$$\Delta U_{dmt} = \ln\left[\frac{s'_{0,dmt}}{s_{0,dmt}}\right] \tag{24}$$

While (24) is a convenient formula for calculating changes in expected consumer utility, it does not translate into interpretable units. This can be accomplished by multiplying (24) by some appropriate monetary value to get the correct result. As a baseline, we use ½ of the going wage rate to measure the time value of an additional ½ hour of viewing time. We also consider the implied value of not viewing that would render the advertiser's optimal program choice optimal for viewers.

2. Advertiser and Station Welfare

Our pricing model implies that the demand function for advertising time on a particular station is a function of the form:

$$\tilde{q}_i(a_i = k, a_{-i}) = \kappa_i(a_i = k)x_i(a_i = k, a_{-i})^{-\eta_k} \tag{25}$$

where $\kappa_i(a_i = k) = e^{\alpha_i(a_i=k)+\omega_j(a_i=k)}$. The willingness to pay for viewers is consistent with a representative advertiser with a profit function of the form:

$$\pi^a = \sum_i \frac{\kappa_i(a_i)x_i(a_i, a_{-i})^{1-\eta_i}}{1-\eta_i} - \sum_j \tilde{q}_i(a_i, a_{-i})x_i(a_i, a_{-i}) \tag{26}$$

The last term on the right-hand side of (26) is also the price per second. Plugging this in gives advertiser profits as:

$$\pi^a = \sum_i \frac{\eta_i}{1-\eta_i}\kappa_i(a_i)x_i(a_i, a_{-i})^{1-\eta_i} \tag{27}$$

Station revenue from a particular time block derives strictly from the revenues derived from advertising, hence total advertiser profits are:

$$\pi_i(a_i,a_{-i}) = \sum_{jdmt} \kappa_i(a_i) x_j(a_i,a_{-i})^{1-\eta_i} \qquad (28)$$

The three expressions (24), (27), and (28), taken either separately or in tandem, form the basis for our welfare analysis in subsequent sections. Before getting to these results, we first describe the data and estimation.

IV. Data

A. Overview

The basic data for our estimation is a station-level cross-section of television viewing, television advertising prices, program characteristics and market demographics for broadcast and cable programs aired during the 5-7pm time period over one work week (Monday through Friday) in February 2010. We have complete station data for 178 of the 210 television DMA's in the US. We also observe weekend viewing and advertising as well as viewing and advertising from 7-8pm that we use as instruments in some specifications.

We build our working data from several sources. Viewing data are taken from the Viewers in Profile reports published by Nielsen Media Research. The viewing data combines records from diaries, people-meters and set-tuning meters. Nielsen reports data only for stations receiving cumulative daily viewership totaling 5% of the viewing market, so small cable stations are not included in our data. Nielsen measures the number of viewing "impressions" recorded by individuals during each 15 minute period during the 5-7pm time period that is the focus of our study. We aggregate viewing data to 30 minute timeslots that coincide with program times. The data record viewership at 1,707 stations.

We supplement the viewing data with station-level characteristics from the Warren Communications *TV & Cable Factbook* and BurrelleLuce *Burrelle's Media Director*y. From this data we identify the home market, owner, and network affiliation for local stations. Market-level demographics are aggregated from county level variables in the 2000 census and 2009 census estimates to the DMA level. In addition to population demographics, we include market characteristics such as retail expenditures, crime statistics and health characteristics from the City and County data book.

Advertising data comes from Kantar Media (formerly TNS). The Kantar data show advertisement length and advertising expenditure for each advertisement on local commercial stations during the week that coincides with our viewing data. We aggregate the advertisement-level data to half-hour program timeslots to link to viewership. With the aggregated data, we can identify prices per second for advertising in each timeslot for each station. When combined with viewing data, advertising expenditures allow calculation of a price per viewer. Our estimation procedures reflect that the viewing sample includes cable stations while the advertising sample does not.

Program names are taken from Nielsen. We identify local and national news programs individually using a variety of reference sources. We also rely on program genre's for local stations available from Kantar Media. Although our full structural model considers only the three program categories of local news, national news and "other" programming, we estimate our viewership model across a richer set of categories. To do this, we classify television programming into 13 broad genres, including a category for non-news public affairs programming. The genres are assembled from multiple sources, including Kantar and the Internet Movie Database (IMDB).

B. Summary Statistics

Table 1 summarizes station characteristics and market demographics for the data in our study. Our data include a total of 1707 stations, 1565 of which are local. There are an average of 65.1 stations in each market, of which 11 are traditional broadcast stations and 56 are cable stations. Markets have on average 12.8 local stations, of which 10.3 are broadcast from within the DMA. Most local stations are broadcast stations, but an average of 2.9 local cable stations is available in each market in our sample. We classify regional stations, such as the New England Sports Network or Northwest Cable News as local stations. The lower portion of the table summarizes population and market characteristics that function as controls in some specifications. These are constructed from county-level census measures and aggregated to the DMA level. In addition to demographics, we include market characteristics from the City and County Data Book that we expect may be related to the supply of or demand for local news, such as crime and business activity.

Table 2 summarizes information on programming across markets. The first two column blocks show averages across timeslots in the 5-7pm news hour period. An average of 3.2 local news programs and 3.4 national news programs are broadcast during each timeslot across markets. The average share of the market population viewing local news during thie period is 0.0461 and the average share viewing national news is 0.0264. The third and fourth column block show weekly totals. The average number of program ½ hours of local news broadcast per workweek across markets is 49.5. The standard deviation is 25.5, indicating substantial variation across markets. The average number of national news programs is very close to the number of local news timeslots at 55.7, but the variance is smaller because many of the national news programs are on cable stations available in many markets. Average weekly viewing is the sum of the timeslot viewing over the week. The total local news viewing share averages 0.655 over the workweek, while the national news share averages 0.327. While this number does not distinguish between unique viewers and repeat viewing, in a general sense the totals illustrate there is twice as much local news as national news viewing each week.

Table 3 summarizes advertising data for the sample. As noted above, we use advertising data for broadcast stations only. This sample represents the majority of local news programming. Advertising prices are reported per second and per viewer, both overall and for general categories. Prices per second average $12.20 per market overall, with local and national news prices at $10.84 and $11.56, respectively. The large standard deviations indicate substantial variation in prices per second across markets, days and times.

Prices per viewer are calculated as total station revenues for the timeslot divided by viewers. Prices average $.36 per viewer over all program types, with $.39 per viewer for local news and $.36 for national news viewers. Prices per second are $12.20 over all program types, $10.84 for local news broadcasts and $11.56 for national news broadcasts. Consistent with prices, total advertising revenues for each timeslot are on average about $5,000, with local and national news revenues at $4,206 and $4,626. Note that revenues and prices per viewer include revenues to both the local station and to the networks.

C. Basic Relationships

We now look to our data to establish some basic relationships between programming, viewing and advertising that we later examine formally in our model.

Figure 1 plots the fraction of the population viewing local news during the evening news hours as a function of the number of local news programs broadcast in each timeslot. The upward slope is apparent in the scatterplot, and a linear relationship indicates the slope is about 0.007. To evaluate this relationship in a regression context, we aggregate program half-hours and viewing each day to the DMA level. We regress the number of local news half-hours each day in each market on the number of stations (broadcast and cable) and other market characteristics. We repeat the process for local news viewing. Results are shown in table 4. We estimate the effects with OLS as well as an instrumental variables approach where the number of stations in a market is instrumented with market population and the number of outside stations.

The regression estimates are consistent with those in figure 1. An additional station is associated with 0.12-.27 more half hours of local news programming and .01-.06 percentage points higher news viewing. Instrumenting has a large effect on estimates. Larger markets support both more stations and more viewing, a result consistent with findings in radio listening and newspaper readership. We cannot infer causality from these estimates, as the amount of news programming is endogenously related to the demand for news and information in a market. But broadly construed, the results suggest a small but positive correlations between stations, programming and viewing of local news.

We also look to the data for basic information on the relationship between programming and advertising. Figure 2 reports the relationship between advertising revenues in local news and the number of programs. A linear trend line in the scatterplot indicates that the additional revenue produced by an additional half hour of local news programming produces a slope of $9,200. Again, because the amount of local news programming is endogenously related to the demand for advertising in a market, we cannot infer causality from the figure.

Our advertising model also specifies diminishing returns to viewers, so we consider the basic relationship between prices and viewing. Figure 3 plots the price per viewer (total program revenues divided by viewers) against the viewing share. The relationship is negative, with steep declines with higher viewership. Figure 3 combines viewership for all programming types, but the pattern holds for local news as well. The pattern is consistent with a model of diminishing returns to viewing.

The viewing data also offer evidence of program substitutability. Substitution patterns are interesting in their own right, but are also important to to inform the structure of our nested logit model. To investigate substitutability, we regress viewing by programming type (measured as impressions divided by market population) on the number of programs broadcast concurrently in each category, along with time, day and market fixed effects. For this analysis, since we are interested in a broad range of program categories, we use our extended sample of 5-8pm times over the full seven day week.

Results are shown in table 5. Each column represents viewing by category as the dependent variable, while the number of programs are the independent variables in each row. The diagonal elements in the table represent “own” effects, or the increase in viewing represented by one additional program of that type. All of the diagonal elements are positive and statistically significant, but many are small, suggesting that additional programs add few viewers in the category. The effect of additional programming on viewership is highest among the news categories, with estimates ranging from 0.021-

0.027. The estimate for local news is consistent with those in figure 1 and table 4, though the sample is different.

The off-diagonal elements provide an initial basis for evaluating substitutability. Focusing on the first three columns, additional sporting events and national news programs are associated with lower local news viewing. Movies and lifestyle programs are associated with higher local news viewings. Column (2) shows the effect of program lineups on national news viewing. More local news, sports, reality & lifestyle programs are all associated with lower national news viewing. The magnitudes of the coefficients suggest that news programs are usefully nested separately from other programming. For public affairs programming, local news, reality programming and infomercials appear to be substitutes, while additional national news programs increase public affairs viewership, though the effects are weaker than for news categories. Based on this, we will group public affairs programming with "other" non-news programming in our estimation but will consider the robustness to the nesting structure.

The estimates in table 5 include day, market and time fixed effects. The coefficients are therefore identified off of variation in program lineups in each of the day-timeslots across markets and should be robust to unobserved demand for news and other programming across markets. Nonetheless, they are subject to bias from unobservables of various sorts, especially factors that affect demand for local news viewing at different days and times across markets. But overall, the estimates in table 5 suggest that local news and national news are a closely related programming group that might sensibly be treated as a category in a nested logit framework. Public affairs programming appears to be a closer substitute for news than entertainment

With this overall context in our data, we turn to estimates of our models.

V. Estimation Results

This section presents results of the viewer, advertiser and program choice equations. As some of the estimation results are of interest in their own right, we begin with a discussion of the implications of our estimated viewership and advertising price equations.

A. Parameter Estimates

Results of the basic model are shown in table 6. The first two columns show ordinary and two-stage least squares estimates of a symmetric viewing model with a single substitution parameter σ. The third and forth columns show the category-specific estimation in equation 7. In columns two and four, the two stage least squares estimates use two periods of lead viewing as instruments for contemporaneous viewing in the timeslot. The local news dummy is instrumented with the share of programming on outside local stations devoted to local news.

The estimates of σ range from about 0.8 to 0.95, indicating that television programs are generally close substitutes from the perspective of viewers. The category-specific σ coefficient for local news are 0.883 in the OLS model and 0.968 in the TSLS specification. Estimates for national news are 0.816 and 0.805 in each specification. For perspective, it is useful to how the estimated parameters affect total viewership in a simple case of symmetric programs. Symmetry implies that the viewing share of the average program will follow:

$$s_j = \frac{1}{N} \frac{N^{1-\sigma}}{e^{-\delta} + N^{1-\sigma}} \qquad (29)$$

where δ captures the mean utility from not viewing television. Taking $\sigma = .9$ from table 6 and the number of stations $N=58$, each of which earn a share of s=0.0027 from table 2, the value of δ implied by (20) is -2. At this level, adding another station to the market increases total viewership from 0.1589 to 0.1591, or 0.0002, a small effect. With an estimate of $\sigma = .8$ at the lower estimate in the table, an additional station increases total viewership from 0.1589 to 0.1593, or 0.0004 viewers per capita.

The third and fourth columns in table 6 show the selection-adjusted estimation results for the advertising price equation, which recover the parameters for advertising demand for local news and non-news programming. (Recall that national news broadcasts are scheduled exogenously by networks, and hence do not figure into programming decisions). The constant terms reflect the scaling parameters α and indicate that impressions on local news viewers are lower on average than impressions on non-news viewers. The estimate of $1-\eta$ for local news is .598 and for non-news is .501, implying a price elasticity of demand for viewers at 2.5 for local news and 2.0 for non-news programming.[10] These parameter estimates offer some intuition on the welfare effects of program choice. Television programs are close substitutes from the perspective of viewers, indicating that program choice generally has small effects on the total number of viewers watching television. But advertising demand for local news programming is lower and more elastic than advertising demand for non-news programming, which means that station revenues in equilibrium will tend to increase more steeply with viewership when offering non-news programming than when offering local news. As a result, the marginal viewer is worth more to advertisers and stations on a local news program than on a non-news program. This effect might lead to some overprovision of local news relative to non-news programming from the perspective of viewers.

B. Simulation and Welfare

We explore the welfare implications of our estimates in a series of simulations. The objective of the simulations is to identify equilibria that might be preferred by viewers, advertisers and stations relative to the actual equilibrium outcome observed in the data. A preliminary question concerns uniqueness of equilibrium. Given that some of our markets contain relatively large numbers of competitors (from table 1, the average number of local stations in a market is around 12), it is computationally infeasible to test equilibrium conditions for all potential action profiles in each market; as an example, a market with 12 local stations has 4096 different possible programming configurations.

[To be written – exhaustive tests of all possible equilibrium configurations]

We instead adopt a simulation-based strategy, a typical run of which proceeds as follows. We first simulate the unobserved heterogeneity terms following equations (16) and (17). For each simulation we then randomly draw a large number of programming configurations from each market. These draws are designed to cover more or less fully the range of possible configurations. We then calculate the stations for which inequalities like (16) are violated, and allow these stations to change their broadcasting choices. We then repeat this algorithm until no station wishes to change its programming choice in any market.

We run these simulations over *[X]* different draws of the unobserved heterogeneity terms, each with *[Y]* simulated initial conditions. The basic finding is that equilibrium seems to be, by and large,

---

[10] For comparison, Berry and Waldfogel (1999) found substitutability across stations in radio σ=0.7, and demand elasticity of 1.8.

unique; it is hard to get the algorithm to converge to an equilibrium other than the one observed. One conclusion that one might reach from this is that programming decisions appear to be relatively stable. This would seem to rule out policy interventions that are simply designed to direct a viewership market to a potentially pareto-improving new equilibrium. This also suggests that if suboptimal outcomes can be found, they arise due to strategic, game-theoretic concerns which must be dealt with by the policy intervention.

From the perspective of viewers, we define the optimal outcome as the set of programming choices with the highest total viewing share, following equation (23). Summary data from a typical simulation run are shown in table 7. The first two rows show that the total fraction of the population viewing television during each timeslot in the news hour at the (observed) Nash equilibrium is 5.4%. The highest viewing equilibrium is 5.6%. Over the total population in the sample, this difference is equivalent to about 560,000 viewers. At the Nash equilibrium, there is an average of 2.26 local news broadcasts in each day and timeslot, while the viewer optimal is 2.13. Aggregating over all markets, the actual number of total local news broadcasts is 5,735 while the optimal is 5,380, an excess of 260 half-hour broadcasts, or 4.5% of the broadcasts. The number of timeslots and markets with excess supply is shown in the lower half of the table. The number observations timeslots with over-provision and under provision are similar, at 360 and 378, or about 11%. Aggregating to the market level, the number of markets with too much local news is 111 out of a total of 178 in the sample. Simple OLS regressions of the oversupply indicator on market demographics show the oversupply markets to be larger, more urban and less Hispanic than markets without oversupply. Similarly, undersupply markets are smaller and less urban.

We also find oversupply of local news from the advertiser perspective. The average advertising price per second in the data is $8.32, with revenues of $23,802 per timeslot. (Recall that we do not have advertising data for cable stations). Summed across all markets, the revenue difference from the actual to the optimal is $2 million. From the advertiser perspective, the number of excess local news broadcasts is 319, or 55, or 9%. The oversupply is broadly dispersed over 131 markets. From the advertiser perspective there is too little local news in 145 timeslots, or 4% spread over 41 markets. As with viewers, oversupplied markets are more urban.

The last welfare category is station welfare, which consists of aggregate revenue earned by all stations in a market. Because advertiser surplus depends on the relative elasticity across program types and station revenues depend only on price, the welfare tradeoffs for advertisers is not perfectly aligned with tradeoffs for stations. The optimal number of local news broadcasts from the perspective of stations is higher than the amount observed at the Nash equilibrium. Prices are $.03 per second too low, which translates into $2.2 million per week in reduced revenue. The simulations show under-provision in 236 timeslots (7%) across 54 markets Simple OLS regressions indicate that under-provision is associated with larger poor and Hispanic populations in less urban markets.

C. Explaining suboptimal programming outcomes

We are interested in whether inefficient provision of local news results from excessive duplication or inefficient differentiation. We study this in two ways. First we consider examples of inefficient provision in the data to illustrate the mechanisms by which inefficiencies can arise. We choose two markets with only two stations and suboptimal program choice to illustrate the station game. We then examine the characteristics of Equilibria in markets with more than two stations.

Figure 4 shows a two-by-two normal form game played by two stations (WCAV, WVIR) choosing local news or non-news ("other") programming. Each box contains the expected station revenue per second and expected viewership, along with market totals. Consider the first game depicted in figure 4. In this game, the Nash equilibrium (highlighted in red) is for both stations to broadcast local news, with WCAV earning $4.39 per second and WVIR earning $2.23. This is the outcome we observe in the data and have constructed unobserved heterogeneity terms to support. The simulation results, however, indicate that joint profit maximization outcome (highlighted in green) would dictate WCAV broadcast non-news programming. Note that the profit maximizing equilibrium in this case corresponds with the optimal programming configuration from the perspective of viewers, with an expected increase in viewer share of 0.003 from a switch. In terms of magnitudes, with each station broadcasting 540 seconds of advertising per timeslot the overall revenue difference is $.05 * 540 = $27. With approximately 200,000 viewers in this market, an increase in the viewing share of 0.003 translates into 600 additional television viewers. This might be called the result of a business-stealing effect.

The second panel in Figure 4 shows a second small market, this one with no local news broadcast on Fridays at 5:30. Again, this is the observed outcome in the data around which we have constructed our unobserved heterogeneity terms. The joint revenue-maximizing outcome would be for WJMN to switch to a local news broadcast, raising total revenues by $.05 per second or $27 per timeslot. Total viewership would drop with the switch, from 1.4% of the population to 1.1% or 600 viewers; in light of the lost viewership, advertisers would pay more to gain access to the new local news viewers.

To generalize these examples to markets with more than two stations, we ask whether the standard deviation between the optimal number of local news broadcasts and optimal number of non-news broadcasts in each timeslot is systematically higher or lower than the standard deviation between the actual number of local news and non-news broadcasts. For example, in a market with four stations where the optimal number of broadcasts in a timeslot was two of each type, the standard deviation at the optimum would be zero. If the distribution of programming at the Nash equilibrium was observed as 4 local news and no non-news broadcasts, the standard deviation would be 2. Because the standard deviation at the Nash equilibrium is higher than at the optimal, this timeslot would be characterized as having too much differentiation.

The Nash and optimal differentiation can be calculated for viewers, advertisers and stations at both the timeslot and day level. Our results indicate that in all cases, at the market level the standard deviation at the optimal is higher than what is observed at the Nash, suggesting that stations systematically select the same programming when differentiation would improve outcomes.

D. Market impact of exogenous changes

We consider three cases of exogenous market changes and their effect on viewers, advertisers and stations using our model estimates: The three types of simulations are: public provision of local news via PBS; cash subsidies to local stations for local news broadcasts; and expansion of non-news cable entertainment. In each case, we first identify markets in which at least one station's current programming decision becomes unstable according to the criterion in equation (23), and for these markets, we calculate a new Nash equilibrium, the welfare properties of which can be compared to the old equilibrium.

1. Public Provision [*To be written*]

3. Cable Proliferation [To be written]

VII. Robustness of results

In this section, we consider the robustness of results to alternative means of characterizing the interactions between stations. While we have assumed that stations play a non-cooperative game of complete information, it is interesting to see how the results of the model change when we employ alternative assumptions about how the underlying game is played. In this spirit, we might change either the solution concept used to solve the game, or the informational assumptions surrounding play. One possibility is that stations engage in some sort of collusive behavior, in which case, a more appropriate model of station interactions is a complete information cooperative game. A second possibility is that stations do not have complete information about one another, and instead engage in a noncooperative game of incomplete information. Both of these cases can be treated through suitable modification of equation (23).

[To be written]

VII. Conclusions

In this paper, we have modeled the programming decisions of local television stations as a noncooperative game of complete information. Some of the singular features of our work derive from the interesting nature of our data set, which contains information both on total viewership and advertising prices. This allows us to form a relatively complete picture of returns stations expect from alternative courses of action. Using counterfactuals deriving from the estimated viewership and advertising price equations, we form necessary conditions for a Nash equilibrium, and use these conditions to develop the distribution of unobserved components of station viewership from programming options not followed.

Our estimation method is semi-parametric in that we use a reduced-form model of the probability of observing particular sorts of equilibrium to develop selectivity controls for our parametric viewership and advertising price equations. In addition to allowing us to predict how particular changes might influence market outcomes, our use of specific functional forms allows us to characterize the welfare properties of market outcomes from the perspective of viewers, advertisers, and television stations. These welfare properties are interesting because of the two-sided nature of the market – there is in general no reason to suppose that what advertisers prefer people watch is the same as what people actually want to watch.

Simulations based on model estimates suggest that programing decisions are fairly close to the joint optimum in most markets. In roughly 5% of markets, both from the perspective of viewers and advertisers, there seems to be a slight tendency for provision of too many local news broadcasts. However, the indications are that these deviations are small relative to the optimum. Those deviations that do occur appear to be caused by business-stealing effects. Roughly put, stations choose programming to capture the most viewers and highest advertising prices for themselves; stations do not seek to maximize the surplus attained by viewers or advertisers. Still, these possible deviations from optimality seem to be, for the most part, small.

We also investigate the impact of certain exogenous changes on market structure…

We examine the robustness of results to alternative assumptions about the underlying structure of the game. In one experiment, we assume that stations play a cooperative game of complete information in determining programming, while in another, we assume that stations play a noncooperative game of incomplete information. Results from these alternative modeling strategies suggest that…

Directions for future research are several…

Table 1: Market & Station Characteristics

DMA Measures	**Obs**	**Mean**	**Std. Dev**
Station Characteristics			
Total Stations		1,707	
Total Local Stations		1,565	
All Stations	178	65.123	32.7
Broadcast Stations	178	11.2	4.3
Cable Stations	178	56.3	28.9
Local Cable Stations	178	2.9	1.5
Inside Local Stations	178	10.3	5.4
All Local Stations	178	12.8	5.4
Population Characteristics			
Population (Census 2009)	178	1,588,288	2,578,130
Population Growth 2000-2009	178	0.072	0.087
DMA Fraction Urban	178	0.665	0.169
DMA Fraction Black	178	0.112	0.119
DMA Fraction Hispanic	178	0.089	0.152
DMA Fraction College	178	0.171	0.065
DMA Fraction Less than HS	178	0.155	0.08
DMA Fraction Low Income	178	0.097	0.023
DMA Fraction Rich (Income 75k+)	178	0.062	0.023
DMA Fraction Very Rich (Income 200k+)	178	0.006	0.003
Market Characteristics			
DMA Per Capita Banks	178	0.0003	0.0001
DMA Per Capita Bank Deposits $	178	0.015	0.0062
DMA Per Capita Retail Establishments	178	0.004	0.0007
DMA Per Capita Retail $	178	9.7441	1.165
DMA Per Capita Hotel & Food $	178	1.2854	0.7207
DMA Per Capita Hotel & Food Establishments	178	0.0019	0.0005
DMA Per Capita Number of Physicians	178	0.0025	0.0011
DMA Per Capita Number Hospital Beds	178	0.0031	0.0013
DMA Per Capita Violent Crime	178	0.0037	0.0018
DMA Per Capita Property Crime	178	0.0315	0.0099

Table 2: Program & Viewing Characteristics

		Program 1/2 Hours/Timeslot		*Average Viewing Share/Timeslot*		*Total Program 1/2 Hours/Workweek*		*Average Viewing/Workweek*	
	Markets	Mean	SD	Mean	SD	Mean	SD	Mean	SD
All Stations All Categories	178	57.89	33.11	0.0027	0.0014	1154.612	662.59	2.404	0.528
Local Stations All Categories	178	9.57	5.47	0.0091	0.0060	190.34	109.3	1.310	0.293
All Stations, by Category									
Local News	178	3.20	1.51	0.0461	0.0223	49.51	25.47	0.655	0.200
National News	178	3.44	1.53	0.0264	0.0284	55.79	17.05	0.327	0.089
Public Affairs	178	2.58	0.67	0.0078	0.0041	48.92	12.41	0.150	0.067
Documentary	178	7.74	4.29	0.0061	0.0032	149.74	86.57	0.118	0.056
Entertainment	178	20.13	13.16	0.0288	0.0170	397.51	260.08	0.563	0.201
Infomercials	178	1.15	0.36	0.0009	0.0016	11.79	7.82	0.007	0.006
Information	178	1.01	0.10	0.0007	0.0009	15.74	5.75	0.010	0.008
Kids & Family	178	6.84	2.58	0.0143	0.0080	133.40	50.31	0.280	0.144
Lifestyle	178	4.78	2.49	0.0081	0.0076	90.34	49.84	0.141	0.066
Movies	178	4.45	2.67	0.0029	0.0017	81.04	49.04	0.053	0.025
Music Video	178	3.61	1.86	0.0019	0.0009	67.98	39.64	0.036	0.017
Reality	178	3.11	1.55	0.0056	0.0062	50.58	25.28	0.088	0.063
Sports	178	5.11	3.41	0.0041	0.0053	96.87	68.43	0.071	0.029

Note: Total program 1/2 hours is the average number of 1/2 hour time slots showing each programming type across all stations in a market. Average viewing share is the average fraction of the market population viewing each program during each timeslot. Average viewing per week is total viewing share for each program type over the workweek. See text for details.

Table 3: Station Measures: Viewing & Advertising

Advertising (Broadcast Stations Only)	N	Mean	SD
Overall Ad Price per Viewer	14,922	$0.36	$0.77
Local News Ad Price per Viewer	9,187	$0.39	$0.58
National News Ad Price per Viewer	13,236	$0.36	$0.78
Overall Ad Price per Second	14,922	$12.20	$21.01
Local News Ad Price per Second	9,187	$10.84	$23.98
National News Ad Price per Second	13,236	$11.56	$20.70
Overall Program Revenues	14,922	$5,024.04	$8,321.95
Local News Program Revenues	9,187	$4,206.91	$9,109.79
National News Program Revenues	13,236	$4,626.30	$7,918.86

Figure 1: Per Capita Local News Viewing

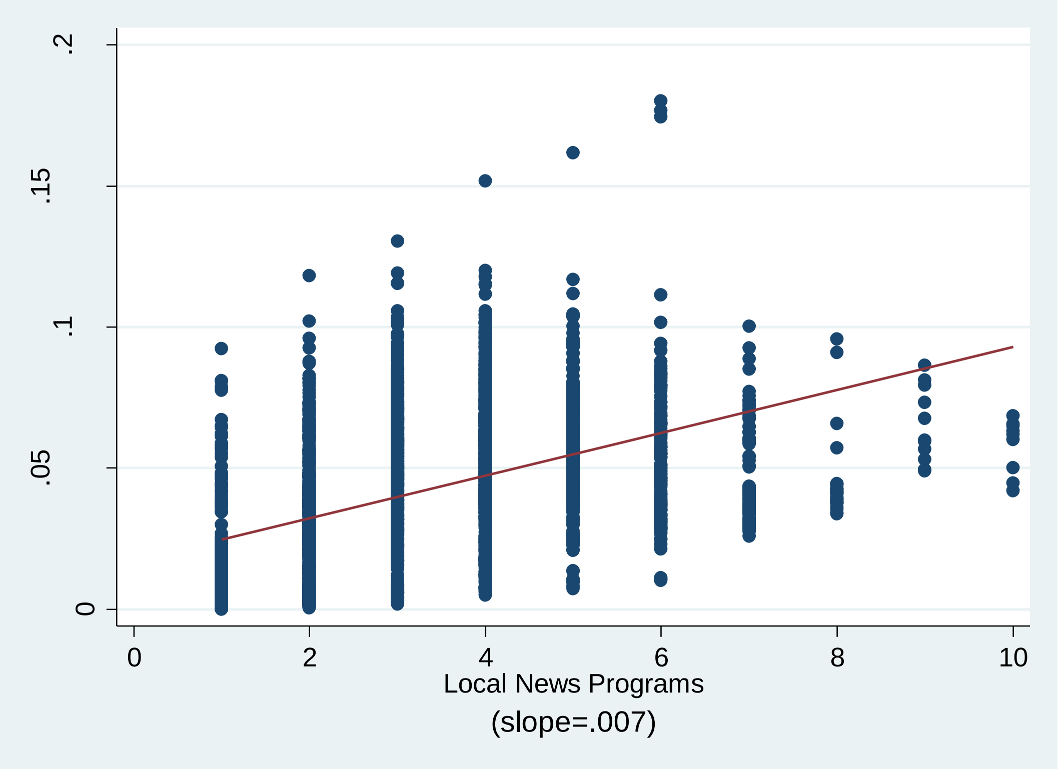

Figure 2: Local News Advertising Revenue

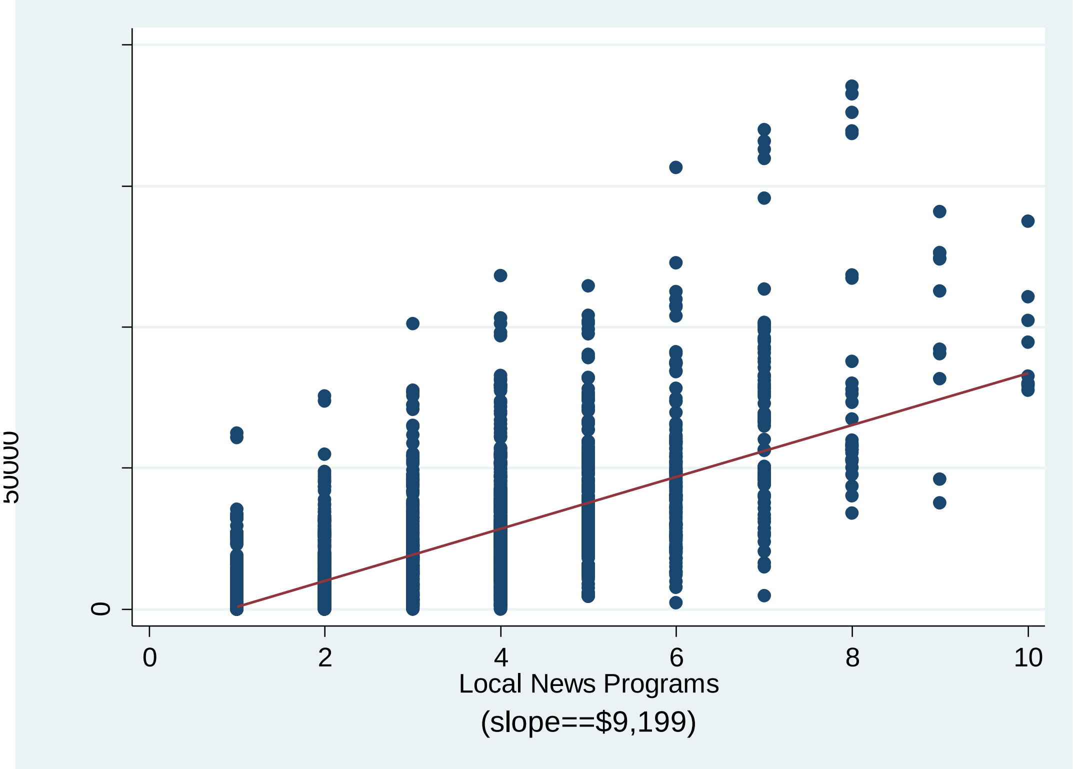

Figure 3: Price per Viewer by Viewing Share (All Categories)

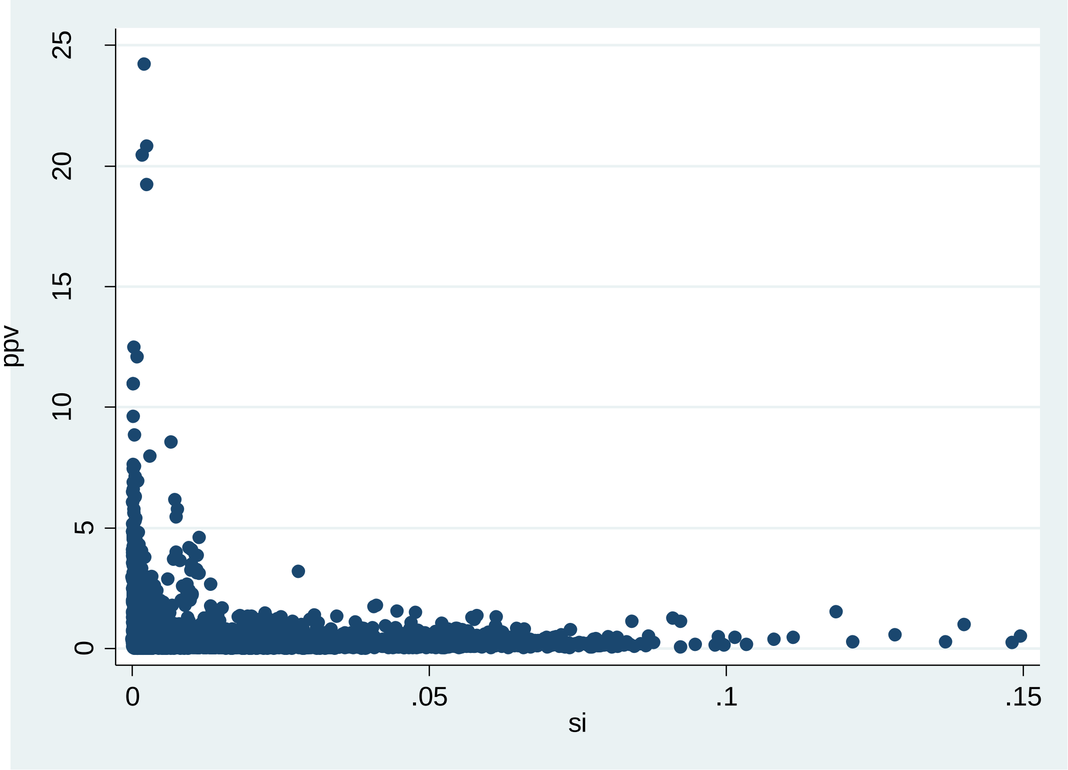

Figure 4: Small Market Examples

Monday, 5pm (184)

WVIR

		Local News	**Other**
WCAV	**Local News**	Revenue: \$4.39, \$2.23 (Total \$6.62) Viewing Share: 0.029,0.009 (Total 0.038)	Revenue: \$4.98, \$1.21 Total (Total \$6.19) Viewing Share: 0.036, 0.003 (Total 0.039)
	Other	Revenue: \$2.34, \$4.36 (Total \$6.7) Viewing Share:0.012, 0.029 (Total 0.041)	Revenue: \$2.31, \$0.29 (Total \$2.6) Viewing Share: 0.013,0.0001 (Total 0.013)

Friday, 5:30 (153)

WJMN

		Local News	**Other**
WLUC	**Local News**	Revenue: \$0.04, \$2.35 (Total \$2.39) Viewing Share: 0.000,0.007 (Total 0.007)	Revenue: \$1.27, \$2.67 (Total \$3.94) Viewing Share: 0.002,0.012 (Total 0.014)
	Other	Revenue: \$1.62, \$2.35 (\$3.97) Viewing Share: 0.004,0.007 (Total 0.011)	Revenue: 1.35, 2.57 (Total \$3.92) Viewing Share: 0.003,0.011 (Total 0.014)

Red Shading: Nash

Green Shading: Optimal

Table 4: Aggregate Local News Programming & Viewing

	Program Half-Hours per Day		Viewing Share (Impressions*100/Pop)	
	OLS	IV	OLS	IV
Local Stations	0.123**	0.276**	0.060**	0.010
	(10.92)	(22.40)	(3.77)	(0.65)
Outside Local Stations	0.260**		-0.014	
	(16.01)		(-0.59)	
Population (Millions)	0.000**		-0.000**	
	(3.06)		(-3.02)	
Pop Growth 2000-2009	-0.145	-1.207	-11.752**	-11.201**
	(-0.09)	(-0.61)	(-4.89)	(-4.69)
Banks Per Capita	-2259.647	-2166.226	-1421.281	-964.673
	(-1.39)	(-1.12)	(-0.61)	(-0.41)
Bank $ Per Capita	6.065	-31.623	5.578	6.945
	(0.31)	(-1.35)	(0.20)	(0.25)
Retail Outlets Per Capita	-140.989	503.265	-813.779	-986.773+
	(-0.37)	(1.11)	(-1.50)	(-1.81)
Retail $ Per Capita	-0.214	-0.024	0.849**	0.911**
	(-1.61)	(-0.15)	(4.49)	(4.83)
Food & Hotel $ Per Capita	0.030	0.311+	0.096	0.068
	(0.20)	(1.72)	(0.45)	(0.31)
Food & Hotel Outlets Per Capita	-304.701	-1020.309+	-2506.180**	-2340.634**
	(-0.67)	(-1.91)	(-3.89)	(-3.63)
Physicians Per Capita	339.275**	367.559**	412.295*	445.013**
	(3.00)	(2.74)	(2.56)	(2.75)
Hospital Beds Per Capita	-368.357**	-275.718*	-261.763+	-316.271*
	(-3.66)	(-2.30)	(-1.83)	(-2.19)
Violent Crime Per Capita	102.851	-3.116	134.096	158.999
	(1.21)	(-0.03)	(1.10)	(1.29)
Property Crime Per Capita	9.589	9.212	13.779	15.998
	(0.66)	(0.53)	(0.66)	(0.77)
Fraction Urban	-1.715	-3.052+	-6.903**	-6.131**
	(-1.30)	(-1.93)	(-3.68)	(-3.22)
Fraction Black	-2.652+	-3.153+	-5.936**	-6.365**
	(-1.90)	(-1.90)	(-2.99)	(-3.18)
Fraction Hispanic	-2.523+	-4.456**	-13.717**	-13.788**
	(-1.76)	(-2.62)	(-6.70)	(-6.71)
Fraction College	-9.283*	-7.933+	-5.878	-6.575
	(-2.58)	(-1.85)	(-1.15)	(-1.27)
Fraction <HS	-5.121+	-2.574	18.986**	19.748**
	(-1.74)	(-0.74)	(4.54)	(4.70)
Fraction Low Income	16.040	0.196	-33.495*	-27.610+
	(1.44)	(0.01)	(-2.11)	(-1.72)
Fraction Income>75k	23.135	-1.508	-35.900	-30.097
	(1.27)	(-0.07)	(-1.38)	(-1.15)
Fraction Income 200k+	228.203**	-22.955	79.571	39.051
	(2.76)	(-0.24)	(0.67)	(0.33)
Constant	6.304**	5.515*	20.942**	20.618**
	(2.81)	(2.07)	(6.56)	(6.42)

+ p<0.10, * p<0.05, ** p<0.01

Table 5: Program Viewing by Program Type

	Dependent Variable: Viewing Share by Program Type (Impressions/Pop)												
	Local News	National News	Public Affairs	Docu-mentary	Enter-tainment	Info-mercials	Infor-mation	Kids & Family	Lifestyle & Culture	Movies	Music Video	Reality	Sports
Local News	0.023**	-0.003**	-0.003**	-0.001**	-0.011**	-0.000	0.000	0.000	-0.003**	-0.002*	-0.000**	-0.003**	-0.003**
National News	-0.010**	0.025**	0.001	-0.002**	-0.008**	0.000	-0.000	0.001**	-0.002*	-0.003**	-0.000*	-0.001	-0.003*
Public Affairs	-0.004	-0.001	0.021**	-0.005**	-0.010*	0.000	-0.001	-0.000	0.000	-0.005*	-0.001**	-0.009**	0.002
Documentary	-0.003	0.002*	0.001	0.001**	-0.001	-0.001+	0.000	0.000	0.001	-0.003**	-0.000	-0.001	-0.001
Entertainment	-0.000	-0.000	-0.001	-0.000	0.003**	0.000	0.000*	0.000	-0.001**	-0.000	-0.000**	-0.002**	-0.000
Infomercials	0.006+	-0.002	-0.009**	0.000	0.010**	0.004**	0.000	-0.001*	0.002	-0.002	-0.000	-0.003+	-0.007**
Information	-0.008	0.000	-0.003	0.004	0.006	-0.003	0.025**	-0.000	0.004	-0.006	-0.001	-0.009	-0.005
Kids & Family	0.003	0.005**	0.003*	-0.001**	-0.003	-0.000	-0.000	0.003**	-0.004**	-0.003**	0.000	-0.002	-0.006**
Lifestyle	0.004+	-0.002+	-0.002	-0.001*	-0.008**	0.001*	0.000	0.000	0.011**	-0.005**	0.000	-0.000	-0.005**
Movies	0.003*	0.001	-0.000	-0.002**	-0.007**	0.000	0.000	0.000	-0.004**	0.005**	-0.000**	-0.003**	-0.002*
Music Video	-0.001	0.002	0.001	-0.002*	-0.008+	0.001	0.000	-0.000	0.002	-0.006**	0.001**	-0.000	-0.002
Reality	0.003	-0.004**	-0.003*	-0.001**	-0.001	0.000	-0.000	-0.000	0.000	-0.000	0.000	0.008**	-0.001
Sports	-0.003*	-0.003**	-0.002	0.001+	-0.001	-0.001+	0.000	0.000+	0.001	0.001	0.000	-0.001	0.009**
Constant	0.047	-0.053	0.052	0.081**	0.279**	0.005	-0.030**	-0.008	0.066*	0.153**	0.014**	0.133**	0.156**
R-Squared	0.826	0.802	0.621	0.910	0.855	0.410	0.533	0.923	0.749	0.885	0.857	0.480	0.783

Dependent variable is viewing share by programming type measured as impressions divided by population. Independent variables are the number of programs offered by type. The unit of observation is the timeslot-day-station-market. All specifications include day, timeslot & market fixed effects. Significance: <.01***, <.05**, <.1+.

Table 6: Estimation Results

	Viewing OLS	Viewing TSLS	Viewing OLS	Viewing TSLS	Advertising Probit Local News	Advertising Probit Non-News
σ (Combined)	0.934**	0.896**				
	(0.0009)	(0.0016)				
σ Local News			0.883**	0.968**		
			(0.0045)	(0.0065)		
σ National News			0.816**	0.805**		
			(0.0023)	(0.0047)		
σ Non-News (Other)			0.956**	0.911**		
			(0.0010)	(0.0017)		
Local News	-0.248**	-0.460+	-0.414**	-0.083		
	(0.0059)	(0.2757)	(0.0089)	(0.2757)		
National News	-1.066**	-0.990**	-1.432**	-1.269**		
	(0.0039)	(0.0065)	(0.0076)	(0.0144)		
$1-\eta$					0.598**	0.501**
					(0.0065)	(0.0075)
Mills Ratio					-0.462**	-0.284**
					(0.0437)	(0.0475)
Constant	-3.129**	-3.268**	-3.02**	-3.21	-3.42**	-2.73**
	(0.0051)	(0.0192)	(0.0054)	(0.020)	(0.0617)	(0.0764)
N	142,927	138,558	142,927	138,558	5,735	7,497
R-Squared	0.914	0.754	0.916	0.755	0.866	0.766

Viewing and advertising specifications include time, day, and market fixed effects. Two-stage least squares uses two periods of viewing leads as instruments for current viewership and outside station viewership as instruments for local news broadcasting.

Table 7: Welfare Simulation

	Actual	**Optimal**	**%Difference**
Viewing			
Average Viewership	0.054	0.056	3.7%
Average Local News Broadcasts (Time-Day-Market)	2.26	2.13	5.8%
Total Local News Broadcasts	5,735	5,475	4.5%
Advertising			
Advertising Surplus per Second	7.39	7.44	0.67%
Total Advertising Surplus /Week	315,000,000	317,000,000	0.63%
Total Local News Broadcasts/Week	5,735	5,380	6.1%
Stations			
Advertising Price per Second	8.32	8.35	0.36%
Total Station Revenues / Week	59,500,000	59,700,000	0.33%
Total Local News Broadcasts/Week	5,735	5,863	2.2%
	Over Provision	**Optimal Provision**	**Under Provision**
Timeslots			
Viewers	360	2,639	378
Advertisers	319	2,913	145
Stations	90	3,051	236
Markets			
Viewers	111	26	41
Advertisers	131	38	9
Stations	30	94	54

References [Incomplete]

Ackerberg, Daniel, Lanier C. Benkhard, Steven Berry, and Ariel Pakes. "Econometric Tools for Analyzing Market Outcomes." in Handbook of Econometrics, Vol VI. Amsterdam: Elsevier 2007.

Anderson, Simon P., and Stephen Coate. "Market Provision of Broadcasting: A Welfare Analysis." *Review of Economic Studies* 72, no. 4 (2005): 947-72.

Anderson, Simon P., Jacob K. Goeree, and Roald Ramer. "Location, Location, Location." *Journal of Economic Theory* 77, no. 1 (1997): 102-27.

Bajari, Patrick, Han Hong, and Steven Ryan. "Identification and Estimation of a Discrete Game of Complete Information." Econometrica 78, no. 1 (2010): 1529-1568.

Bajari, Patrick, Han Hong, John Krainer, and Denis Nekipelov. "Estimating Static Models of Strategic Interaction." Forthcoming, *Journal of Business and Economic Statistics*, 2009.

Beebe, Jack H. "Institutional Structure and Program Choices in Television Markets." *Quarterly Journal of Economics* 91, no. 1 (1977): 15-37.

Berry, Steven. "Estimating Discrete Choice Models of Product Differentiation." *Rand Journal of Economics* 25 (1994): 242-62.

Berry, Steven, James Levinsohn, and Ariel Pakes. "Differentiated Products Demand Systems from a Combination of Micro and Macro Data: The New Car Market." *Journal of Political Economy* 112, no. 1 (2004): 68-105.

Berry, Steven, and Peter C. Reiss. "Empirical Models of Entry and Market Structure." in Handbook of Industrial Organization, Vol. III. Amsterdam: Elsevier, 2007.

Bjorn, P, and Q. Vuong. "Simultaneous Equations Models for Dummy Endogenous Variables: A Game Theoretic Formulation with an Application to Labor Force Participation." SSWP 537, California Institute of Technology. 1985.

Borsch-Supan, Axel. "On the Compatibility of Nested Logit Models with Utility Maximization." *Journal of Econometrics* 43, no. 3 (1990): 3733-88.

Bresnahan, Timothy F., and Peter C. Reiss. "Entry in MOnopoly Markets." *Review of Economic Studies* 57: (1990): 531-53.

Bresnahan, Timothy F., and Peter C. Reiss. "Entry and Competition in Concentrated Markets." *Journal of Political Economy* 99: no. 5 (1991): 997-1009.

Chamberlin, Edward. *The Theory of Monopolistic Competition : A Re-Orientation of the Theory of Value*. 2nd ed, Harvard Economic Studies. Cambridge(Mass.): Harvard U.P., 1933.

d'Aspremont, C., Jean J. Gabszewicz, and J. F. Thisse. "On Hotelling's 'Stability in Competition'." *Econometrica* 47, no. 5 (1979): 1145-50.

Dixit, Avinash K., and Joseph E. Stiglitz. "Monopolistic Competition and Optimum Product Diversity." *American Economic Review* 67, no. 3 (1977): 297-308.

Ellickson, Paul B., and Sanjog Misra. "Enriching Interactions: Incorporating Outcome Data into Static Discrete Games," University of Rochester Working Paper (2010).

Downs, Anthony. *An Economic Theory of Democracy*. New York: Harper & Row, 1957.

Gentzkow, Matthew. "Television and Voter Turnout." *Quarterly Journal of Economics* 121, no. 3 (2006): 931-72.

George, Lisa M. "The Internet and the Market for Daily Newspapers." *B.E. Journal of Economic Analysis and Policy: Advances in Economic Analysis and Policy* 8, no. 1 (2008).

George, Lisa M. "Symposium on Advertising and Disclosure: National Television and the Market for Local Products: The Case of Beer." *Journal of Industrial Economics* 57, no. 1 (2009): 85-111.

George, Lisa M., and Joel Waldfogel. "National Media and Local Political Participation: The Case of the New York Times." In *Information and Public Choice: From Media Markets to Policy Making*, edited by Roumeen Islam, 33-48: Washington, D.C.: World Bank, 2008.

George, Lisa M., and Joel Waldfogel. "The New York Times and the Market for Local Newspapers." *American Economic Review* 96, no. 1 (2006): 435-47.

George, Lisa, and Joel Waldfogel. "Who Affects Whom in Daily Newspaper Markets?" *Journal of Political Economy* 111, no. 4 (2003): 765-84.

Gil-Molto, Maria Jose, and Arne Risa Hole. "Tests for the Consistency of Three-Level Nested Logit Models with Utility Maximization." *Economics Letters* 85, no. 1 (2004): 133-37.

Herriges, Joseph A., and Catherine L. Kling. "Testing the Consistency of Nested Logit Models with Utility Maximization." *Economics Letters* 50, no. 1 (1996): 33-39.

Hotelling, Harold. "Stability in Competition." In *The Economics of Business Strategy*, edited by John Kay, 692-708: Elgar Reference Collection. International Library of Critical Writings in Economics, vol. 163.Cheltenham, U.K. and Northampton, Mass.:Elgar, 2003. Reprint, [1929].

Maddala, G. S. *Limited-Dependent and Qualitative Variables in Econometrics*, Econometric Society Monographs in Quantitative Economics. Cambridge Cambridgeshire ; New York: Cambridge University Press, 1983.

Oberholzer-Gee, Felix, and Joel Waldfogel. "Media Markets and Localism: Does Local News En Espanol Boost Hispanic Voter Turnout?" *American Economic Review* 99, no. 5 (2009): 2120-28.

Osborne, Martin J. "Spatial Models of Political Competition under Plurality Rule: A Survey of Some Explanations of the Number of Candidates and the Positions They Take." *Canadian Journal of Economics* 28, no. 2 (1995): 261-301.

Prescott, Edward C., and Michael Visscher. "Sequential Location among Firms with Foresight." *Bell Journal of Economics* 8, no. 2 (1977): 378-93.

Reiss, Peter C., and Pablo T. Spiller. "Competition and Entry in Small Airline Markets," *Journal of Law and Economics* 32, no. 2 (1989): S179-202.

Snyder, James M., Jr., and David Stromberg. "Press Coverage and Political Accountability." *Journal of Political Economy* 118, no. 2 (2010): 355-408.

Spence, Michael. "Product Differentiation and Welfare." *American Economic Review* 66, no. 2 (1976): 407-14.

Spence, Michael. "Product Selection, Fixed Costs, and Monopolistic Competition." *Review of Economic Studies* 43, no. 2 (1976): 217-35.

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

Stromberg, David. "Radio's Impact on Public Spending." *Quarterly Journal of Economics* 119, no. 1 (2004): 189-221.

Sutton, John. *Sunk Costs and Market Structure: Price Competition, Advertising, and the Evolution of Concentration*: Cambridge, Mass. and London:MIT Press, 1991.

Waldfogel, Joel. "Preference Externalities: An Empirical Study of Who Benefits Whom in Differentiated-Product Markets." *RAND Journal of Economics* 34, no. 3 (2003): 557-68.

Waldfogel, Joel. "Who Benefits Whom in Local Television Markets?" *Brookings-Wharton Papers on Urban Affairs* (2004): 257-84.

Zhu, Ting, Vishal Singh and Mark D. Manuszak. "Market Structure and Competition in the Retail Discount Industry." *Journal of Marketing Research* 46, no. 4 (2009): xx-xx.