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Ownership Consolidation and Product Characteristics: A Study of the US Daily Newspaper Market†

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This paper develops a structural model of newspaper markets to analyze the effects of ownership consolidation, taking into account not only firms' price adjustments but also the adjustments in newspaper characteristics. A new dataset on newspaper prices and characteristics is used to estimate the model. The paper then simulates the effect of a merger in the Minneapolis newspaper market and studies how welfare effects of mergers vary with market characteristics. It finds that ignoring adjustments of product characteristics causes substantial differences in estimated effects of mergers. (*JEL* G32, L13, L82, M37)

Do mergers affect product characteristics? Standard merger analyses typically study price effects only and ignore changes in product characteristics. This paper endogenizes both. It is likely that firms would adjust the features of their products after a merger. Ignoring this aspect of firm decisions in a merger analysis can lead to a bias in estimated welfare effects. Specifically, I study how ownership consolidation affects product characteristics and welfare in the US daily newspaper market. The newspaper market provides an ideal environment for analyzing the effect of mergers on product features for both econometric and economic reasons. First of all, individual newspapers often circulate in local markets. There is substantial variation in demographics and ownership structure across these markets. This variation is crucial for this study. Secondly, the characteristics of newspapers are obviously important for welfare. For example, after an ownership consolidation, do newspaper publishers improve or diminish the content quality? Do they enlarge or shrink the local news ratio? Do they increase or decrease content variety?

To address these questions, I set up a structural model of the US daily newspaper market that describes the demand for newspapers, the demand for advertising, and publishers' decisions. The model is estimated using a new dataset that I have compiled from various data sources, which includes information on newspaper

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characteristics, subscription prices, advertising rates, circulation, and advertising quantity for US daily newspapers between 1997 and 2005.

Based on the estimates of the model parameters, I simulate the effects of an ownership consolidation of two newspapers in the Minneapolis market that was blocked by the Department of Justice. The simulation results show that if the merger had occurred, both newspapers would have decreased the news content quality, the local news ratio, and the content variety. These changes in the newspaper characteristics would have been accompanied by a rise in both newspapers' subscription price. Overall, circulation would have declined, and the local news content read per household would have decreased by 10.75 percent. Reader surplus would have decreased by 3.28 million dollars, and publisher surplus would have increased by 4.32 million dollars. The simulation also indicates that ignoring characteristic adjustment leads to an underestimation of the loss for readers by 1.05 million dollars and the gain for publishers by 0.10 million dollars.

The above case study shows how the framework provided in the paper can be used to analyze the effect of ownership consolidation for a specific market. Such a study can be computationally involved. To provide some general guidance, I therefore study in a more reduced-form way what aspects of market characteristics are important for the welfare analysis of ownership consolidation. I use the distribution of the welfare effects across markets to examine the correlation between the welfare effect of ownership consolidation and the underlying market structure. To this end, I quantify the welfare implications of ownership consolidation in all duopoly markets and triopoly markets in the last year of my sample. I find that readers' welfare loss is positively correlated with how much they value newspapers in general and with how important the common circulation area of the two merged parties is to these two newspapers. Readers' welfare loss is negatively correlated with the asymmetry of newspaper size measured by premerger circulation levels.

This article contributes to three strands of literature. First and foremost, it is part of the literature on mergers. One group of papers in this literature analyzes outcomes of actual mergers in the data. Examples include Borenstein (1990); Berry and Waldfogel (2001); Focarelli and Panetta (2003); George (2007); as well as Chandra and Collard-Wexler (2009). Another group of papers takes a more structural approach and very often quantifies the welfare effects of mergers. These papers typically study the effect of mergers on prices and welfare effects through price changes only. Examples include Baker and Baresnahan (1985); Hausman, Leonard, and Zona (1994); Werden and Froeb (1994); Nevo (2000); Town (2001); and Ivaldi and McCullough (2010). This paper is part of the second group and adds to this literature by showing that ignoring characteristic adjustment can be a serious omission when investigating the welfare effect of a merger.

Second, this paper also contributes to the emerging literature on endogenous product choice, examples of which include Mazzeo (2002); Crawford and Shum (2006); as well as Draganska, Mazzeo, and Seim (2009).[1] The latter also studies the effect of mergers. Endogenizing product choice typically introduces important computational challenges. Papers in the literature either directly specify a profit function that

[1] Other examples in this literature include Seim (2006); Watson (2009); Chu (2010); Eizenberg (2011); Lustig (2011); Sweeting (2012); and Crawford and Yurukoglu (2012).

is not derived from demand (such as Mazzeo 2002) or focus on monopoly industries (such as Crawford and Shum 2006), or examine markets with a naturally finite and discrete product choice set (such as Draganska, Mazzeo, and Seim 2009). This article builds an oligopoly model where the profit function is derived from underlying demand and the product characteristics are continuous. I overcome the computational burden by using an estimation strategy similar to that in Villas-Boas (2007). Endogenizing product characteristics also invalidates the typical instrumental variables used in the literature of estimating demand with differentiated products. For example, Berry, Levinsohn, and Pakes (1995) use the characteristics of competitors' products, which are considered endogenous in this article. To overcome this problem, I exploit a key feature of the newspaper industry: it is typical that the circulation area of a newspaper overlaps with other newspapers' circulation areas, but only partially so. This allows me to use the demographics (demand shifters) in nonoverlapping markets of a newspaper's competitors as instruments. Even though these demographics do not directly enter the newspaper's own demand curve, they affect its choice of characteristics through competitive effects.

Finally, this paper is also related to an empirical literature on newspapers. Examples in this literature include Rosse (1967); Ferguson (1983); Genesove (1999); Argentesi and Filistrucchi (2007); George (2007); Chandra and Collard-Wexler (2009); Gentzkow and Shapiro (2010); Chiang and Knight (2011); as well as Schulhofer-Wohl and Garrido (2012). George (2007) is the most closely related to this paper as she also studies market structure and product differentiation in the newspaper industry. She regresses measures of product variety on ownership concentration and finds a positive correlation between them. Since the concept of market structure is difficult to capture by a simple index, in this article I model it explicitly. Moreover, a structural approach allows me to calculate the welfare effect of a merger.

The rest of the article is organized as follows. Section I presents the structural model of newspaper markets and derives estimating equations. The data are described in Section II. Section III explains the estimation approach and reports the estimation results. Section IV contains two subsections, where I study the effect of a counterfactual ownership consolidation in the Minneapolis market and quantify the welfare implications of ownership consolidation in duopoly and triopoly markets. This latter section also studies the correlation between the welfare effects of ownership consolidation and the underlying market structure. Section V concludes.

I. The Model

A. *Demand*

Newspaper profit comes from both selling newspapers to readers and selling advertising space to advertisers. In this section, I describe the demand for newspapers and the demand for advertising.

Since my data on newspaper circulation are at the county level, I start with the county demand for newspapers, which is derived from the aggregation of heterogeneous households' multiple discrete choices. A multiple discrete choice model is necessary to explain duplicate readership. For example, in 275 county/years in the data, the total circulation of all newspapers is even larger than the number of

households.[2, 3] I assume that a household in the model buys no more than two newspapers. The model is based on Hendel (1999), and I augment it in two ways. First, I allow for decreased utility from the second choice. Second, I ensure that a household in the model buys no more than one copy of a newspaper.

Specifically, suppose all households in a county face the same choice set, and the number of daily newspapers available in county c in year t is J_{ct}. A household i in this county gets utility u_{ijct} from subscribing to newspaper j in year t and utility u_{i0ct} from an outside choice.[4] The probability that household i subscribes to newspaper j is the sum of the probability that j is the first choice and the probability that j is the second choice:

$$(1)\quad \Pr\Big(u_{ijct} \geq \max_{h=0,\ldots,J_{ct}} u_{ihct}\Big) + \sum_{j'\neq j} \Pr\Big(u_{ij'ct} \geq u_{ijct} \geq \max_{h\neq j'} u_{ihct},\, u_{ijct} - \kappa \geq u_{i0ct}\Big),$$

where the inequality $u_{ij'ct} \geq u_{ijct} \geq \max_{h\neq j'} u_{ihct}$ in the second term ensures that j' is the first best and j is the second best; and κ is a parameter that captures the diminishing utility from subscribing to a second newspaper.

I assume that a household derives utility from the characteristics of a newspaper and that this utility is also affected by county-specific factors and individual-specific tastes. The conditional indirect utility of household i in county c from subscribing to newspaper j in year t is assumed to be

$$(2)\qquad u_{ijct} = p_{jt}\alpha + \mathbf{x}_{jt}\boldsymbol{\beta}_{ict} + \mathbf{y}_{jct}\boldsymbol{\psi} + \mathbf{z}_{ct}\boldsymbol{\varphi} + \xi_{jct} + \varepsilon_{ijt},$$

where p_{jt} is the annual subscription price, and $\mathbf{x}_{jt}$ is a three-dimensional vector of the endogenous newspaper characteristics chosen by the newspaper publishers. They are a news content quality index, the local news ratio, and a measure of content variety. The first endogenous newspaper characteristic, the news content quality index,

[2] The average newspaper penetration (total newspaper circulation in a county divided by the number of households in the county) of these 275 county/years is 1.13. To investigate whether measurement errors could be the explanation for the existence of such county/years, I plotted the histogram of the county-level newspaper penetration. The distribution of the penetration seems continuous. For example, there are more than 275 county/years with the newspaper penetration larger than 95 percent and even more with the penetration larger than 90 percent. While it is not a proof that measurement errors are not the explanation, the continuous distribution rules out the case where the newspaper penetration in all county/years except these 275 is smaller than, for example, 90 percent. Such a data pattern would suggest that it is due to measurement error that we observe 275 county/years with the newspaper penetration larger than 100 percent. Moreover, the newspaper penetration is indeed positively correlated with the number of newspapers.

[3] I could have used a single discrete choice model with an inflated number of households as the market size (for example, population in a county). But the number of households is the measure for market size used in the newspaper literature because newspapers are nonexclusive products that can be shared by all members in a household. It is also the market size used in the newspaper industry. For example, the Audit Bureau of Circulations, my data source for circulation, uses the number of households in a county as the market size for computing county penetration. A multiple discrete choice model, which does not complicate the model much, therefore describes the industry better.

[4] Utility actually varies across i, j, t. The subscript c is redundant in u_{ijct}, as each household can be in only one county. I add the subscript c to emphasize that utility is affected by some county-specific tastes, which are operationalized in the estimation by county-level demographics.

depends on the so-called news hole (nonadvertising space, denoted x_{11jt}), the number of staff for opinion sections (x_{12jt}), and the number of reporters (x_{13jt}):

$$x_{1jt} = x_{11jt} + \varpi_2 x_{12jt} + \varpi_3 x_{13jt}. \tag{3}$$

The second characteristic, the local news ratio, captures a newspaper's emphasis on local news and is proxied by the percentage of local-news staff over the total number of staff. The third characteristic, variety, is measured by $100\left[1 - \sum_i (\text{share of staff in section } i)^2\right]$. It is decreasing in the concentration measure, $\sum_i (\text{share of staff in section } i)^2$, which is analogous to the Herfindahl-Hirschman Index for industry concentration.

The vector $\mathbf{y}_{jct}$ includes the newspaper characteristics that are assumed to be exogenous in the model because they rarely change over time. For example, the location of a newspaper's headquarters determines the distance between the centroid of county c and newspaper j's home county centroid. The distance is included in $\mathbf{y}_{jct}$ to capture readers' taste for local newspapers. The vector $\mathbf{z}_{ct}$, which includes demographics of county c, captures county/year-specific tastes for newspapers. This vector also includes a constant term.

The term ξ_{jct} is the unobservable county/year-specific taste for newspaper j. It captures a county-specific taste that is not captured by $\mathbf{z}_{ct}$. It also captures characteristics of the newspaper that are relevant for readers but unobservable to the econometrician and therefore not included in $\mathbf{x}_{jt}$ or $\mathbf{y}_{jct}$.

The stochastic term ε_{ijt} is i.i.d. and follows the Type I extreme value distribution. It represents unobservable household-specific tastes. Household heterogeneity in tastes for newspaper characteristics is captured by the random coefficient $\beta_{kict} = \beta_k + \mathbf{z}_{ct}\boldsymbol{\theta}_k + \sigma_k \varsigma_{kict}$, which is household i's specific taste for the kth endogenous characteristic.[5] I assume that ς_{kict} is identically and independently distributed across characteristics and households and follows the standard normal distribution. This allows the characteristic to be horizontal. For example, some consumers might prefer higher local content ratio, and some might prefer lower.

Instead of treating the utility from the outside choice as fixed, I model it as a time trend to capture changes due to the development of online news sources during the sample period. Specifically, I assume that the utility from the outside choice is

$$u_{i0t} = (t - t_0)\rho + \varepsilon_{i0t}, \tag{4}$$

where t_0 is the first year in the data and ρ is a parameter to be estimated.

The market penetration[6] of newspaper j in county c is the aggregation of households' newspaper choices in the county. The aggregation is similar to that in Berry, Levinsohn, and Pakes (1995)—henceforth, BLP. Define the "relative" county mean utility, δ_{jct}, as the difference between the mean utility in county c from newspaper j and the mean utility of the outside choice: $(p_{jt}\alpha + \mathbf{x}_{jt}\boldsymbol{\beta} + \mathbf{x}_{jt}\mathbf{z}_{ct}\boldsymbol{\theta} + \mathbf{y}_{jct}\boldsymbol{\psi} +$

[5] Consumer heterogeneity in price sensitivity is very small and statistically insignificant according to the estimation of a more general model.

[6] This is typically called "market share" in a single discrete choice model. But in a multiple discrete choice model, the sum of "market shares" can be larger than 1. "Market penetration" is therefore a better term and is used by the Audit Bureau of Circulations.

$\mathbf{z}_{ct}\boldsymbol{\varphi} + \xi_{jct}) - (t - t_0)\rho$. Then county market penetration can be expressed as a function of $\boldsymbol{\delta}_{ct} = (\delta_{jct}, j = 1, \ldots, J_{ct})$ and $\mathbf{x}_{ct} = (\mathbf{x}_{jt}, j = 1, \ldots, J_{ct})$: $\mathscr{s}_j(\boldsymbol{\delta}_{ct}, \mathbf{x}_{ct}; \boldsymbol{\sigma}, \kappa)$. See Appendix C for the expression of the county penetration function $\mathscr{s}_j$.

Following BLP, I do not use the market penetration equation in the estimation directly, but invert it to obtain the relative mean utility for estimation. I show in Appendix C that the BLP invertibility result holds for the multiple discrete choice model in this paper under two conditions. Furthermore, the contraction mapping defined in BLP is still valid, leading to a simple algorithm to solve for $\boldsymbol{\delta}_{ct}$. The two conditions are (i) $0 < s_{jt} < 1$ for $\forall j = 1, \ldots, J_{ct}$ and (ii) $\sum_{j=1}^{J_{ct}} s_{jt} < 2$. These two assumptions are quite mild. Assumption (i) means that there is always some household choosing newspaper j and some household not choosing it. Assumption (ii) means that there is always some household choosing to purchase fewer than two newspapers. Under these two conditions, the solution to $s_{jct} = \mathscr{s}_j(\boldsymbol{\delta}_{ct}, \mathbf{x}_{ct}; \boldsymbol{\sigma}, \kappa)$ is unique. Denote this solution by $\boldsymbol{\delta}_{ct}(\mathbf{s}_{ct}; \boldsymbol{\sigma}, \kappa)$.[7] Therefore, for the true value of the parameters,

$$\delta_{jct}(\mathbf{s}_{ct}; \boldsymbol{\sigma}, \kappa) = p_{jt}\alpha + \mathbf{x}_{jt}\boldsymbol{\beta} + \mathbf{x}_{jt}\mathbf{z}_{ct}\boldsymbol{\theta} + \mathbf{y}_{jct}\boldsymbol{\psi} + \mathbf{z}_{ct}\boldsymbol{\varphi} - (t - t_0)\rho + \xi_{jct}. \tag{5}$$

This is the first estimation equation. To conclude the description of the demand for newspaper j, let H_{ct} be the number of households in county c in year t. The demand for newspaper j, i.e., the total circulation of newspaper j, is then the sum of the circulation in all counties covered by newspaper j (denoted by $\mathcal{C}_{jt}$):

$$q_j(\boldsymbol{\delta}_{ct}, \mathbf{x}_{ct}; \boldsymbol{\sigma}, \kappa) = \sum_{c:\, c \in \mathcal{C}_{jt}} H_{ct}\mathscr{s}_j(\boldsymbol{\delta}_{ct}, \mathbf{x}_{ct}; \boldsymbol{\sigma}, \kappa). \tag{6}$$

The demand for advertising is modeled as in Rysman (2004):

$$a(r_{jt}, q_{jt}, H_{jt}; \eta, \boldsymbol{\lambda}) = e^{\eta} H_{jt}^{\lambda_0} q_{jt}^{\lambda_1} r_{jt}^{\lambda_2}, \tag{7}$$

where r_{jt} and q_{jt} are newspaper j's advertising rate in column inches and total circulation.[8] H_{jt} is the number of households in newspaper j's circulation area, which shifts the demand for advertising.

Let ι_{jt} be an i.i.d. and mean zero measurement error for advertising linage (the advertising quantity measured in column inches); then the second estimation equation is

$$\log a_{jt} = \eta + \lambda_0 \log H_{jt} + \lambda_1 \log q_{jt} + \lambda_2 \log r_{jt} + \iota_{jt}. \tag{8}$$

[7] The solution depends on $\mathbf{x}_{ct}$ as well as $\mathbf{s}_{ct}$. The subscript ct is added to $\boldsymbol{\delta}$ to recognize this dependence.

[8] Note that in this specification circulation affects advertising demand. What about the other direction? In an auxiliary estimation of the demand for newspapers where I allow advertising quantity to affect consumers' utility, I find that the effect of advertising linage on consumers' utility is negative, very small, and statistically insignificant. Therefore, I have assumed that readers care only about the news hole and not about advertising.

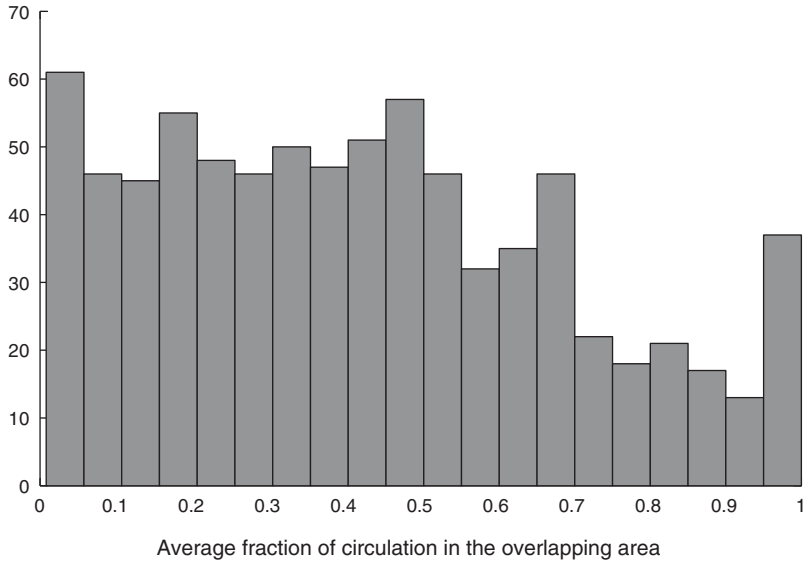


Figure 1. Newspaper Coverage Overlap in 2005

B. *Supply*

The term "market" is typically used to describe either a set of competing firms or a set of available products. This implies that a market is a geographic area that satisfies two criteria: (i) all consumers in the area face the same choice set, and (ii) the suppliers of these choices in the area compete with each other and with no one else. In the daily newspaper industry, however, there is no geographic area satisfying both criteria because circulation areas of newspapers partially overlap. Figure 1 demonstrates this partial overlapping feature of the newspaper industry using the 2005 data. For each newspaper j circulating in multiple counties, I divide j's circulation in an area that j shares with another newspaper j' by j's total circulation. I then compute for each newspaper j the average of this fraction across all such newspapers j'. Figure 1 plots the histogram of this newspaper-specific partial overlapping index.

The partial overlapping of newspaper coverage leads to a chain of substitution. For example, when newspapers A and B compete in county 1 and newspapers B and C compete in county 2, the three newspapers are interacting in a single game because A and B, as well as B and C, are direct competitors, and A and C are indirect competitors because they share a common competitor.[9] In that sense, all newspapers in the United States are potentially competing, which makes the model intractable. To limit the number of players in a game, I make three assumptions.

First, it is unreasonable to think that national newspapers compete with all small newspapers. Thus, I assume that the characteristics and prices of the three national

[9] Few newspapers have different subscription prices for households outside the home county or the home state. In 2005, for example, fewer than 30 newspapers among more than 1,400 newspapers charge different prices according to the subscriber's location. For these newspapers, I use the local price and ignore price discrimination. Also note that newspaper characteristics studied in this paper are the same no matter where the subscriber of the newspaper is.

newspapers (*Wall Street Journal*, *New York Times,* and *USA Today*) are taken as given in the model.

Second, a newspaper has to report to the Audit Bureau of Circulations, a nonprofit circulation-auditing organization and my data source for circulation, its circulation in all counties receiving 25 or more copies. But a newspaper probably does not compete in a county with such small circulation. Therefore, for each newspaper/year, I sort the counties covered in descending order of county circulation and define the market of the newspaper as the set of counties that covers at least 85 percent of total circulation. I assume that a newspaper competes only with newspapers in this set of counties. This 85 percent criterion is used by the Audit Bureau of Circulations for defining the Newspaper Designated Market. According to the Audit Bureau of Circulations, the Newspaper Designated Market is the "geographical area which is considered to be the market served by the newspaper."

Finally, on the supply side, I assume that a newspaper publisher can exploit economies of scope only if the home counties of its newspapers are in the same Metropolitan Statistical Area (MSA). Details on economies of scope are described later in this section.

These three assumptions limit the number of players in a game. I now describe the game that models the supply side. In the game, all player publishers[10] choose the characteristics of their newspapers in the first stage, and newspaper prices and advertising rates in the second stage. The ownership and circulation area of each newspaper are assumed to be determined before the start of the game and are considered exogenous. In the remainder of this section, the subscript t is suppressed for ease of exposition. It is only restored in the statement of the estimation equations.

Suppose the fixed cost of choosing a certain combination of newspaper characteristics is given by $fc(\mathbf{x}_j, \boldsymbol{\nu}_j; \boldsymbol{\tau})$, where $\mathbf{x}_j$ stands for the characteristics, $\boldsymbol{\nu}_j$ represents the unobservable cost shocks, and $\boldsymbol{\tau}$ is a vector of parameters. This cost is fixed with respect to circulation and advertising. Then the profit function that is relevant for the first-stage decision is

$$\pi_j^{\mathrm{I}}(\mathbf{x}) = \pi_j^{\mathrm{II}}\big(\mathbf{p}^*(\mathbf{x}), \mathbf{r}^*(\mathbf{x}); \mathbf{x}\big) - fc(\mathbf{x}_j, \boldsymbol{\nu}_j; \boldsymbol{\tau}), \tag{9}$$

where $\pi_j^{\mathrm{II}}(\mathbf{p}, \mathbf{r}; \mathbf{x})$ is the variable profit from circulation and advertising, and $p_j^*(\mathbf{x})$ and $r_j^*(\mathbf{x})$ are equilibrium newspaper prices and advertising rates. In fact, the equilibrium prices also depend on other variables such as county demographics. They are omitted for presentational simplicity. The variable profit π_j^{II} is the sum of circulation profit, display advertising profit, and preprint profit. I now specify each of the three components.

Circulation profit is the difference between circulation revenue determined by the demand for newspapers described in Section IA and the variable cost of printing and delivery. This cost varies with circulation and at the margin depends on publication frequency and the number of pages. To capture potential economies of scale and

[10] Under the assumptions above, there might be newspapers that circulate in the market of the players but are not competing with them. They are called "nonplayers" in this game. For example, the three national newspapers are nonplayers. Since nonplayers in a game are assumed not to compete with the player newspapers, their characteristics and prices are taken as given in the game.

economies of scope in printing and delivery, I allow average costs to depend on the total circulation of all newspapers that circulate in the neighboring area of newspaper j (defined by whether their home counties are in the same MSA) and are owned by j's publisher. This total circulation is denoted by Q_j. Specifically, $Q_j = q_j$ when j's publisher owns only one newspaper (i.e., newspaper j) or when the home counties of its other newspapers are not in the same MSA as that of j. Otherwise, Q_j is the total circulation of all of its newspapers whose home counties are in the same MSA as that of newspaper j. To summarize, I assume that the average cost is

$$ac_j^{(q)} = \left(\gamma_1 + \gamma_2 f_j + \gamma_3 (x_{1j} + a_j)\right) \log (Q_j)^{\gamma_4} + \omega_j, \tag{10}$$

where f_j is the publication frequency measured by the number of issues per year, $(x_{1j} + a_j)$ is the annual pages, i.e., the sum of annual nonadvertising space in pages and annual display advertising linage, and ω_j is an unobservable factor that determines the average cost.

The advertising demand described in Section IA is really demand for display advertising, which is printed on the newspapers' pages along with the news. There exists another type of advertisement, namely preprints, which is inserted into copies of a newspaper and distributed along with them. This is essentially a delivery service provided by newspapers. I do not observe the advertising rate for preprints. Therefore, I do not derive the preprint profit from a demand model. Instead, I assume that it is a simple quadratic function of circulation:

$$\mu_1 q_j + \frac{1}{2} \mu_2 q_j^2. \tag{11}$$

Display advertising profit, on the other hand, is derived from the advertising demand model. Display advertising involves two costs. One is the cost of printing, which is captured by the cost varying with circulation as explained above. The other cost is the marginal advertising sales cost, which I assume is

$$mc_j^{(a)} = (1 + 1/\lambda_2)\left(\overline{\zeta} + \zeta_j\right), \tag{12}$$

where λ_2 is the price elasticity of demand for display advertising, as defined in (7),[11] and ζ_j is a mean-zero exogenous random variable. Then the display advertising profit is given by

$$r_j a_j - mc_j^{(a)} a_j. \tag{13}$$

Note that the main arguments offered for ownership consolidation revolve around the concepts of synergies in printing and in the delivery of newspapers. There is

[11] Because $\overline{\zeta}$ is a parameter to be estimated, $(1 + 1/\lambda_2)$ is just a normalization used to make the optimal display advertising rate condition (16) simple.

rarely a similar discussion on synergies for the advertising sales component. I therefore assume a constant marginal advertising sales cost while allowing the average cost of circulation to vary with total circulation.

In summary, the variable profit is given by the sum of circulation profit, display advertising profit, and preprint profit:

$$(14)\quad \pi_j^{\mathrm{II}} = \left(p_j q_j - ac_j^{(q)} q_j\right) + \left(r_j a_j - mc_j^{(a)} a_j\right) + \left(\mu_1 q_j + \frac{1}{2}\mu_2 q_j^2\right).$$

As defined in equation (9), profit is the difference between the variable profit and the fixed cost. The fixed cost captures the cost of choosing a specific product characteristic that is independent of circulation and advertising quantity. For instance, increasing the quality of a newspaper increases the cost of publishing the newspaper, but not the cost of having one additional subscriber. The latter cost mainly consists of the printing and delivery costs. I use a quadratic function to approximate the fixed cost function. Specifically, I assume that the slope of the fixed cost $fc(\mathbf{x}_j, \boldsymbol{\nu}_j; \boldsymbol{\tau})$ with respect to the kth endogenous characteristic x_{kj} is[12]

$$(15)\qquad \tau_{k0} + \tau_{k1} x_{kj} + \nu_{kj}.$$

The demand for newspapers and display advertising described in Section IA are both annual, i.e., they describe annual subscribers and annual advertising linage. The costs modeled in this section are therefore annual costs.

Finally, I observe Joint Operation Agreements (JOA) in the data. Newspapers under a JOA combine business operations while maintaining separate and competitive editorial operations. For business operations, the two newspapers under a JOA either form a third company or one of them acts as the operating partner for the other. Therefore, in the model, I assume that the operating party—either the third party or the operating publisher—chooses newspaper subscription prices and advertising rates for both newspapers in the second stage to maximize the joint profit for given newspaper characteristics. In the first stage, the two publishers choose the characteristics of their respective newspapers separately. Since I do not observe how the profit is split between the two newspapers, I assume that each newspaper publisher gets the profit from its own newspaper.

[12] The slope of the fixed cost could depend on the characteristics of other newspapers owned by the same publisher if there are economies of scope in the production of quality. I have estimated two models allowing economies of scope in quality production. In one model, I inflate the quality characteristics of newspaper j by $(1 + \gamma_0 m_j)$ in the utility function, where m_j is the number of newspapers owned by newspaper j's publisher. A significant and positive estimate of γ_0 would indicate that a certain number of reporters, for example, can generate higher quality when the publisher owns multiple newspapers. This would be evidence of economies of scope in producing quality. In the other model, economies of scope in providing quality are captured by multiplying the cost of providing quality by $m_j^{\gamma_0}$. A significant and negative estimate of γ_0 would indicate economies of scope in producing quality. The estimation of both models yields very small and statistically insignificant estimates of γ_0.

The slope of the fixed cost could also depend on competitors' characteristics if newspaper publishers are imperfectly competing in input markets. In this article, I take a partial equilibrium approach and assume that the input price is fixed. Thus, the slope of the fixed costs is independent of competitors' characteristics.

C. *Necessary Equilibrium Conditions*

I now derive the optimality conditions for prices, advertising rates, and newspaper characteristics.[13] Similar to Rosse (1967), these optimality conditions will be used to identify the cost structure of newspaper production.

A newspaper publisher makes a two-dimensional pricing decision: it must select the subscription price and the display advertising rate for each newspaper it owns. Taking the derivative of the second-stage profit function π_j^{Π} in (14) with respect to the advertising rate r_j yields the optimal display advertising rate as a function of circulation:

$$r_{jt} = \overline{\zeta} + \frac{\gamma_3}{1 + 1/\lambda_2} \log (Q_{jt})^{\gamma_4} q_{jt} + \zeta_{jt}. \tag{16}$$

To derive the first-order condition with respect to the subscription price, define a matrix Δ whose (h,j) element is given by

$$\Delta_{hj} = \begin{cases} -\dfrac{\partial q_j}{\partial p_h} & \text{if } h \text{ and } j \text{ have the same publisher;} \\ 0 & \text{otherwise.} \end{cases}$$

Similarly, I define the matrix $\mathbf{\Gamma}$, which captures economies of scale and scope, as

$$\Gamma_{hj} = \begin{cases} -\dfrac{\partial ac_j^{(q)}}{\partial Q_j} & \text{if } h \text{ and } j \text{ have the same publisher and} \\ & \text{their home counties are in one MSA;} \\ 0 & \text{otherwise.} \end{cases}$$

Also, I define Λ as a vector of the effect of circulation on display advertising profit:

$$\Lambda_j = -\frac{1}{\lambda_2} \frac{\partial a_j}{\partial q_j} r_j,$$

where λ_2 is the price elasticity of display advertising demand.

Then the first-order condition with respect to the subscription price can be expressed in matrix form as

$$\mathbf{p} = \Delta^{-1}\mathbf{q} - [\Lambda + (\mu_1 + \mu_2 \mathbf{q})] + \Gamma\mathbf{q} + \mathbf{ac}^{(q)}. \tag{17}$$

The difference between this first-order condition and a standard first-order condition lies in the second term $\big([\Lambda + (\mu_1 + \mu_2 \mathbf{q})]\big)$, which captures the effect of circulation on total advertising profit, and the third term $(\Gamma\mathbf{q})$, which captures economies of scale and scope in printing and delivering newspapers.

[13] Following the literature, I assume that a pure-strategy Nash equilibrium exists. Finding a set of sufficient conditions for the existence of a Nash equilibrium is beyond the scope of this article.

In the first stage, publishers choose newspaper characteristics. The necessary optimality condition for the kth characteristic is

$$\sum_{h \in \mathcal{J}_{mt}} \left(\frac{\partial \pi_{ht}^{\mathrm{II}}}{\partial x_{kjt}} + \sum_{j' \in \mathcal{J}_{g(jt)}} \frac{\partial \pi_{ht}^{\mathrm{II}}}{\partial p_{j't}} \frac{\partial p_{j't}^{*}}{\partial x_{kjt}} \right) = \tau_{k0} + \tau_{k1} x_{kjt} + \nu_{kjt}, \tag{18}$$

where $\mathcal{J}_{mt}$ is the set of newspapers of j's publisher m in year t and $\mathcal{J}_{g(jt)}$ represents the set of all player newspapers in the game that jt belongs to. The first term on the left-hand side is the direct impact of increasing the kth characteristic of newspaper j on the variable profit of newspaper h owned by the same publisher. A change in x_{kjt} also has an indirect effect on the variable profit of newspaper h through an impact on the equilibrium subscription prices for all newspapers in the game. This indirect effect is captured by the second term.

The partial derivatives $\left(\frac{\partial \pi_{ht}^{\mathrm{II}}}{\partial x_{kjt}}, \frac{\partial \pi_{ht}^{\mathrm{II}}}{\partial p_{j't}} \right)$ in (18) can be computed by taking derivatives of the variable profit function (14). The difficulty lies in computing the gradient of the equilibrium function, $\frac{\partial p_{j't}^{*}}{\partial x_{kjt}}$. I assume that the equilibrium pricing function is smooth with respect to characteristics and take an approach similar to that in Villas-Boas (2007). Since the estimation equation (18) is the optimality condition for the *observed* product characteristics, only the values of the gradient at the data points are needed to formulate (18). I compute these values by taking the total derivative of the first-order condition with respect to newspaper prices (17). Using this approach, I need to rule out corner solutions where the first-order conditions do not hold.[14]

II. Data

For this study, I have compiled a new dataset on the US newspaper market between 1997 and 2005 from various sources. Specifically, the dataset contains information on quantities and prices on both sides of the market. On the readers' side, I observe county circulation and annual subscription price (q_{jct}, p_{jt}). On the advertisers' side, I observe annual display advertising linage and display advertising rate (a_{jt}, r_{jt}), though display advertising linage data is available only for 422 newspaper/years between 1999 and 2005.[15] I use these 422 newspaper/years to estimate this advertising demand equation.

The dataset also contains information on newspaper characteristics. A newspaper is described by the following attributes: the news hole, the number of opinion section staff, the number of reporters, the local news ratio, variety, the frequency of publication, and edition (morning or evening newspaper). Direct data on the news hole is not available. News hole is the difference between the annual number of pages and the annual advertising quantity. The former (n_j) is observable in the

[14] Moreover, this approach can be used only for continuous characteristics. Note that the newspaper characteristics studied in this paper can reasonably be considered continuous. As will be explained in Section II, I measure the number of reporters, for example, by the number of reporters weighted by the inverse of the number of titles that each reporter has.

[15] I assume that the data are missing at random.

data. The latter is computed from the advertising demand function as specified in equation (7), which depends on observable variables and model parameters.[16]

The number of reporters in this study is measured by the number of reporters weighted by the inverse of the number of titles that each reporter has. For example, if a reporter also holds some managing job, this reporter contributes 1/2 to the number of reporters. The number of staff for each section is similarly defined. I then compute the share of staff for each of the following sections: "business and financial," "computers and technology," "editorial/opinion page," "entertainment and art," "features and lifestyle," "local news," "national and international news," "science and medicine," and "sports." As explained in Section IA, these shares are used to measure "variety" as $100\left[1 - \sum_i (\text{share of staff in section } i)^2\right]$.

Appendix A provides a detailed explanation of the data sources and the variable definitions. Missing data on price or pages per issue lead to the deletion of all newspapers interacting with a newspaper with missing information on price or pages.[17] I also delete games involving large counties because it is not clear whether two newspapers in a large county compete directly with each other. Specifically, I consider a county "large" if the number of households in this county is larger than 100,000 and the land area is larger than 1,000 square miles according to the 2000 census. Forty-nine counties fall into this category.

In the end, there are 5,843 newspaper/years in the sample. These newspaper/years' markets consist of 8,947 county/years. Summary statistics for the main variables for the final sample are provided in Tables 1 and 2.

III. Estimation

Five estimation equations are taken to the data: (5), (8), (16), (17), and (18). They are, respectively, derived from newspaper demand, advertising demand, and the first-order conditions with respect to advertising rate, subscription price, and newspaper characteristics.

The parameters to be estimated include (i) the parameters in the newspaper demand function; (ii) the parameters in the display advertising demand function; (iii) the cost parameters; and (iv) the parameters in the preprint profit function.

The identification of newspaper demand parameters is similar to the identification of analogous parameters in BLP. However, unlike BLP, product characteristics are endogenous in this article. As will be explained in Section IIIA, I therefore use a different source of exogenous variation to identify the effects of product characteristics and prices.

Among other parameters, the identification of the diminishing utility parameter κ needs an explanation. Identification of κ comes from the variation in the number of newspapers in a county. In counties with only one newspaper, diminishing utility does not play a role in determining market penetration. Suppose all parameters were identified using the data from such counties only. Then, based on these estimates,

[16] The news hole for newspaper j in year t is $n_{jt} - a(r_{jt}, q_{jt}, H_{jt}; \eta, \lambda)$ whether the advertising linage data is available for this newspaper/year or not. This is because I am concerned that the observed advertising linage includes a measurement error.

[17] This is because, for example, when the price of newspaper j is not observable, the optimality condition for any newspaper j' in j's game is not well defined. Therefore, j's game is deleted.

Table 1—Summary Statistics of Player Newspapers

	Mean	Median	SD	Min	Max	Observations
Total circulation	19,117	9,322	32,739	1,132	468,483	5,843[a]
Annual display ad linage (column inch)	1,362,154	1,168,452	760,828	123,124	4,337,941	422
Price of newspapers ($)	101.24	96.61	33.75	13.19	365.31	5,843
Display advertising rate ($/column inch)	23.50	12.91	36.16	2.45	520.29	5,843
Frequency (issues/52 weeks)	308.16	312.00	53.70	208.00	364.00	5,843
Pages (pages/issue)	27.06	22.86	16.47	8.00	167.43	5,843
Opinion staff	1.36	0.33	3.05	0	42.42	5,843
Reporters	5.31	2.00	12.44	0	210.00	5,843
Local news ratio (percent)	13.69	13.89	10.16	0	62.50	5,843
Variety	69.80	75.06	17.50	0	88.63	5,843
Market penetration (percent)	33.70	32.82	16.63	0.56	97.08	11,203[b]
Distance to home county (100km)	0.26	0	0.38	0	3.95	11,203

[a] These observations are at the newspaper/year level.
[b] These observations are at the newspaper/county/year level.

Table 2—Summary Statistics: County Demographics

	Mean	Median	SD	Min	Max	Observations
Percent of population over 25 with bachelor's degree or higher	16.88	15.05	6.95	5.64	60.48	8,947[a]
Median income ($1,000)	34.17	32.82	7.09	16.36	76.31	
Median age	36.56	36.70	3.73	20.70	54.30	
Urbanization (percent)	48.80	50.50	26.05	0	100	
Number of households	28,550	14,876	47,949	710	858,719	

[a] These observations are at the county/year level.

market penetration in counties with multiple newspapers could be computed assuming that each household chooses *at most one newspaper*. The difference between the observed data and these counterfactual market penetrations assuming a single choice is then explained by the choice of a second newspaper, the probability of which is influenced by κ.[18]

A. *Instruments*

In the model, newspaper publishers know the unobservable (to econometricians) newspaper-county specific taste ξ_{jct} and the unobservable cost shocks $(\zeta_{jt}, \omega_{jt}, \boldsymbol{\nu}_{jt})$ before they choose the characteristics, the subscription prices, and the advertising rates of their newspapers. These choices are therefore likely to be correlated with the unobservables. Instrumental variables are used to deal with this endogeneity. Specifically, I use the demographics in the market of j's competitors (excluding j's own market) as instruments.

The intuition for why the demographics in the competitors' market can be used as instruments is illustrated in Figure 2. The demographics in county 2 influence the demand for newspaper B and, thus, affect the prices and the attributes of this

[18] This identification relies on the exogeneity of newspapers' circulation area. As I have explained in Section I, the circulation area of each newspaper is assumed to be determined before the start of the game and is considered exogenous.

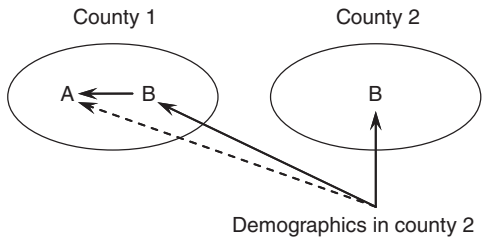


Figure 2. Instruments

newspaper. Because newspapers A and B are competitors, B's decision on product characteristics and prices affects A's decision. Therefore, the demographics in county 2 indirectly affect newspaper A's product choice and price decisions. For example, a local newspaper in a small county close to a large city with a metropolitan newspaper might want to position itself as an inexpensive and low-quality newspaper.

This instrument choice is in the same spirit as that in BLP, who use the characteristics of competitors' products as instruments. The instruments used in BLP are valid because firms consider what kind of products are available in the market when making a price decision, and the product characteristics are assumed to be exogenous in BLP. In this paper, the product characteristics are the focus and considered endogenous. But firms consider what kind of consumers they serve, i.e., demographics, when making a decision on product characteristics and prices. The demographics of competitors' markets, therefore, can be used as instruments. The underlying assumption in BLP is that the product characteristics are exogenous. The underlying assumption here is that the entry/location choices are exogenous. This is plausible because location decisions are typically of a longer horizon than both characteristic and price decisions.

In summary, the partial overlapping feature of the industry allows the demographics in competitors' markets to be used as instruments—specifically, the excluded instruments. The included instruments include the demographics of a newspaper's own market. Table 3 reports the correlation between the included and the excluded instruments. Specifically, it reports the correlation between the mean educational level, for example, in the market of a newspaper and the mean of the educational levels in the counties that belong to its competitors' markets but are not in its own market. This table shows that the demographics of neighboring counties are not highly correlated, i.e., the included instruments and the excluded instruments are not highly correlated.

Note that among the demographic measures only the number of households in a county varies across years. This is because the data on the number of households come from the yearly County Penetration Report by the Audit Bureau of Circulations, while the county-level demographics data come from census, and yearly data are not available. So the main variation is cross-sectional. The exogenous sources of variation that lead to changes in prices and newspaper characteristics over time include the variation in market structure such as ownership and the time trend.

Table 3—Correlation of Demographics in Neighboring Counties

	Educational level	Median income	Median age	Urbanization
Correlation	0.1277	0.3509	0.4526	0.2767

B. *Estimation Results*

The parameters are estimated using the Generalized Method of Moments. See Appendix D for the list of instrumental variables used in this study. Appendix E provides details on the GMM estimation. Estimation results are presented in Table 4. The reported standard errors are robust to correlation for the same newspaper across counties and across years. As explained in Section IB, I define the market of the newspaper as the set of counties that covers at least 85 percent of total circulation. Estimation results when 80 percent of total circulation is used as the criterion are reported in online Appendix F. The results are quite close.

The endogenous newspaper characteristics include the news content quality index (x_1), the local news ratio (x_2), and variety (x_3). The news content quality index depends on the news hole, the number of staff for opinion sections, and the number of reporters according to equation (3). I normalize the weight on the news hole to be 1. The news hole, the nonadvertising space, is measured in 10,000 pages in a year. The estimated weights on the number of staff for opinion sections and the number of reporters are 0.466 and 6.264, respectively. When I estimate a random coefficient model for only newspaper demand allowing for taste heterogeneity in all three endogenous characteristics (the news content quality index, the local news ratio, and variety), I find little such heterogeneity for the first and the third dimensions. Therefore, to keep the estimation of the full model tractable, I consider only consumer heterogeneity in the taste for the local news ratio. Specifically, I allow a consumer's taste to depend on the education level and the median age of the county she resides in and a consumer-specific random term.[19] The estimates indicate that more educated and older people are more interested in local content. For an average household in a county with the average educational level and average median age, a decrease in the local news ratio by 0.1 is equivalent to an increase in the annual subscription price by \$0.19.[20] Since a household's taste depends on the demographics of the county she resides in and a consumer-specific random term, this equivalent decrease in the annual subscription price varies across households. The standard deviation is \$5.

The exogenous characteristics include the number of households in the market of a newspaper, whether the newspaper is a morning newspaper or an evening newspaper, whether a county is its home county, and the distance between the county and its home county. The corresponding parameters are ψ_1 to ψ_4. The negative sign of ψ_1 indicates that readers value a newspaper with, for example, ten reporters covering a small region more than they do a newspaper that has ten reporters and serves a large area. The estimates also show that readers prefer morning newspapers (see

[19] The estimates for a model where a consumer's taste for the local news ratio also depends on median income and urbanization indicate that its dependency on these demographics is not significant.

[20] The standard deviation of the local news ratio is 0.1.

Table 4—Estimation Results

	Parameter	Estimate	SE
Utility			
Price ($100)	α	−1.411***	0.030
log(1 + content quality)	β_1	0.772***	0.017
log(1 + local news)	β_2	−0.002***	0.001
log(1 + variety)	β_3	0.013***	0.001
Weight on news hole in content quality	1		
Weight on opinion in content quality	ϖ_2	0.466*	0.301
Weight on reporters in content quality	ϖ_3	6.264***	0.322
log(1 + local news), education	θ_1	0.003***	0.000
log(1 + local news), median age	θ_2	0.004***	0.001
log(1 + local news), standard deviation	σ	0.007	0.016
log(households in the market)	ψ_1	−0.728***	0.015
Morning edition	ψ_2	0.072***	0.008
Local dummy	ψ_3	0.541***	0.007
County distance (1,000km)	ψ_4	−3.904***	0.061
Constant	φ_0	4.990***	0.130
Education	φ_1	0.607***	0.039
Median income ($10,000)	φ_2	−0.203***	0.037
Median age	φ_3	0.043***	0.001
Urbanization	φ_4	0.640***	0.016
Time	ρ	0.144***	0.002
Diminishing utility	κ	1.919***	0.078
Display advertising demand			
Ad market size	λ_0	0.043**	0.026
Total circulation	λ_1	1.673***	0.039
Ad rate	λ_2	−1.195***	0.029
Constant	ϕ	−1.625***	0.269
Average cost of circulation			
Constant	γ_1	−82.315	145.240
Frequency	γ_2	1.768***	0.112
Pages in a year	γ_3	0.022***	0.004
Economies of scale/scope	γ_4	−0.448***	0.045
Marginal cost of ad sales	$\bar{\zeta}$	11.775***	0.518
Slope of the fixed cost for content quality			
Constant	τ_{10}	91,248***	2,932
Content quality	τ_{11}	0.00003	17.929[a]
Slope of the fixed cost for local news			
Constant	τ_{20}	88.681	181.590
Local news	τ_{21}	4.650**	2.803
Slope of the fixed cost for variety			
Constant	τ_{30}	1.276	68.278
Variety	τ_{31}	0.373	2.511
Preprint profit			
Circulation	μ_1	142.690***	54.610
Square of circulation	μ_2	−0.002***	0.0001

[a] Since the parameter is essentially at a boundary, the standard error computed according to the standard asymptotic distribution cannot be trusted.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

the estimate of ψ_2). Readers' taste for local newspapers is captured by the distance between the centroid of county c and the centroid of newspaper j's home county. A local dummy, i.e., whether the distance is 0, is also included to allow readers' taste to be nonlinear in the distance. The estimates of ψ_3 and ψ_4 indicate that readers value newspapers whose home counties are close and have a particular taste for local newspapers.

County demographics used in this paper include educational level, median income, median age, and urbanization, all of which positively affect the demand for newspapers except median income. The positive sign of ρ indicates that readers' utility from subscribing to a newspaper decreases over time. This is consistent with the advent of online news, which motivates the inclusion of the time trend in the model.

The parameter κ measures the diminished utility of subscribing to a second newspaper. In a single discrete choice model, this parameter is essentially set to infinity so that consumers buy at most one product. The estimate of κ in the present multiple discrete choice model is 1.919. It implies that in 3,480 out of 7,696 county/years with multiple newspapers, less than 1 percent of newspaper subscribers purchase two newspapers. In other words, duplicate readership is negligible in about 45 percent of the county/years with multiple newspapers. In the 731 county/years with more than 5 percent of newspaper subscribers purchasing two newspapers, on average 9.41 percent of the subscribers do so.

All parameters in the advertising demand function have the expected signs: the display advertising demand is increasing in the market size and circulation; it is decreasing in advertising rate. The price elasticity of display advertising demand is close to -1. The circulation elasticity of display advertising demand, however, is larger than 1. As will be explained in the next section, this has an important implication for how publishers adjust the characteristics and the prices of their newspapers after a market structure change.

The negative sign of the estimate of γ_4 is consistent with synergies in printing and delivery. For example, when two newspapers with the same premerger circulation level and the same publication frequency and number of pages merge, the cost saving is 27 percent of the premerger printing/delivery cost if the postmerger total circulation is simply the sum of the premerger circulation. If the postmerger total circulation is 75 percent of the total premerger circulation, the cost synergy is 17 percent.

IV. Counterfactual Simulations

This section contains two subsections. Section IVA studies an ownership consolidation of two newspapers in the Minneapolis market that was blocked by the Department of Justice. Section IVB studies the welfare effects of mergers in all duopoly and triopoly markets in the 2005 sample and examines the general pattern of how the welfare effect of a merger varies with market characteristics. Throughout this section, I use "ownership consolidation" and "merger" interchangeably. The equilibrium in the counterfactual simulations is computed using best-response iteration.

A brief discussion of welfare measures is in order (details can be found in Appendix B). The welfare effect on readers is measured by compensating variation similar to that in Small and Rosen (1981). Publisher surplus is given by the profit function in (9). Advertiser surplus, however, cannot be estimated. Since I observe only the advertising linage for newspapers instead of each advertiser's individual behavior, only the price elasticity of the market demand for advertising is identified. Due to the potential externality of aggregate advertising on the effectiveness of individual advertising, the market demand does not correspond to an individual agent's

willingness to pay. Thus, there is not enough information in the data to measure advertiser surplus. However, as shown in Appendix B, there is enough information to compute the percentage change of advertiser surplus after an ownership consolidation. I denote these three welfare measures by *RS* (for reader surplus), *AS* (for advertiser surplus), and *PS* (for publisher surplus).

A. *A Case Study for the Minneapolis/St. Paul Metropolitan Area*

In 2006, the McClatchy Company purchased its much larger rival Knight Ridder Inc. After the acquisition of Knight Ridder, McClatchy owned two daily newspapers in the Minneapolis/St. Paul metropolitan area: the *Minneapolis Star Tribune* (henceforth, the *Star*) and the *St. Paul Pioneer Press* (henceforth, the *Pioneer*), the latter of which was previously owned by Knight Ridder. Three months after the announcement of the transaction, the Department of Justice filed a complaint. Two months later, McClatchy sold the *Pioneer* to the Hearst Corporation, which later sold it to MediaNews Group. Neither Knight Ridder nor MediaNews owned another newspaper in this market. Therefore, this series of events did not lead to a market structure change in the framework of this paper, as the publisher of the *Pioneer* was simply relabeled.

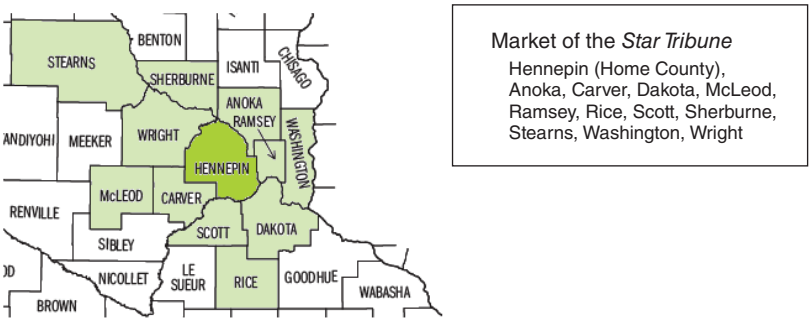
In this section, I investigate what would have happened to newspaper characteristics, subscription prices, advertising rates, and welfare if the ownership consolidation of the *Star* and the *Pioneer* had been upheld. These two newspapers are in a game with three other newspapers: the *Faribault Daily News*, the *St. Cloud Times*, and the *Stillwater Gazette*. Their markets are illustrated in Figure 3.

The Minneapolis-based *Star* and the St. Paul-based *Pioneer* are direct competitors, as their markets overlap in five counties. The *Star* circulates in a larger area. The *Faribault Daily News* and the *St. Cloud Times* compete with the *Star* only. The *Stillwater Gazette* competes with both the *Star* and the *Pioneer*.

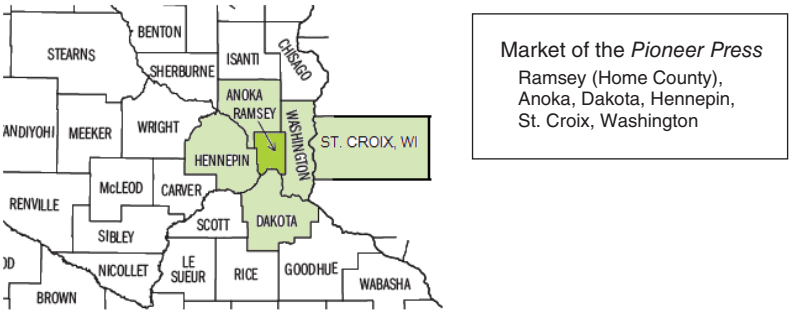
Table 5 presents subscription prices and advertising rates at the postmerger equilibrium when only prices are adjusted.

From the table, we can see that both the *Star* and the *Pioneer* increase their subscription prices. This is because after the publisher of the *Star*, McClatchy, purchases the *Pioneer*, it internalizes the positive cross price effect of these two newspapers: a higher price for the *Star*, for example, leads to an increase in the market share of the *Pioneer* and therefore raises its profit. The table also shows that the price of the *Pioneer* is increased by $8, larger than the price adjustment for the *Star*. In other words, the adjustment of the smaller party to the merger (the *Pioneer*) is much larger than that of the larger party (the *Star*). As explained in Section IIIB, the model estimates indicate that the advertising profit function is convex in circulation, implying that the marginal value of circulation is higher for larger newspapers. Therefore, a multinewspaper publisher has an incentive to shift circulation from its small to its large newspapers. Here, McClatchy, who owns both the *Star* and the *Pioneer* after the ownership consolidation, adjusts the price of the smaller newspaper by a bigger margin due to this incentive. Overall, the circulation of the *Star* will decrease by 7,189 and that of the *Pioneer* by 11,345. The decline in circulation shifts the advertising demand curve to the left, which explains the decrease in the advertising rate for both newspapers.

Panel A. Market of the *Star Tribune*



Panel B. Market of the *Pioneer Press*



Panel C. Markets of the *St. Cloud Times,* the *Faribault Daily News,* and the *Stillwater Gazette*

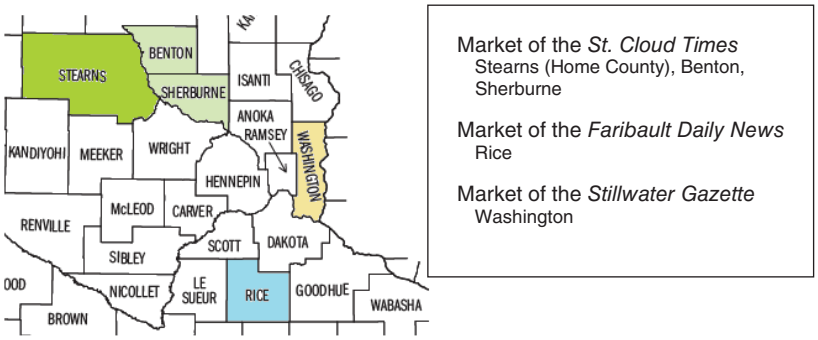


FIGURE 3. NEWSPAPER DESIGNATED MARKET

In Table 6, I allow adjustments in both prices and product characteristics. According to the simulation, McClatchy will decrease the content quality for both newspapers by 2 percent for the *Star* and 11 percent for the *Pioneer*. The same intuition for the asymmetric adjustment in prices in Table 5 also applies here to explain the asymmetric adjustment in the content quality: due to the incentive to shift circulation from its smaller newspaper to its larger newspaper, McClatchy lowers the content quality of the *Pioneer* by a bigger margin. McClatchy will also reduce the local news ratio and variety for both newspapers. The percentage changes in these two newspaper characteristics for the *Star* are 4 percent and 2 percent, respectively.

Table 5—Effects of Ownership Consolidation of the *Star* and the *Pioneer* without Characteristic Adjustment

		Star	Pioneer	Faribault	St. Cloud	Stillwater
Price ($/year)	before	172.79	171.51	111.31	150.07	78.33
	after	175.98	179.52	111.32	149.95	75.03
	change	3.19	8.01	0	−0.12	−3.30
Ad rate ($/column inch)	before	230.88	153.08	12.37	44.15	11.13
	after	227.00	147.07	12.39	44.19	11.25
	change	−3.87	−6.00	0.02	0.03	0.12
Circulation	before	317,337	159,864	6,384	24,578	3,341
	after	310,148	148,519	6,434	24,667	3,644
	change	−7,189	−11,345	50	89	303

Table 6—Effects of Ownership Consolidation of the *Star* and the *Pioneer* with Characteristic Adjustment

		Star	Pioneer	Faribault	St. Cloud	Stillwater
Content quality index	before	788.49	474.29	7.00	65.28	0.70
	after	771.78	422.59	7.17	66.26	0.31
	change	−16.72	−51.70	0.17	0.98	−0.40
Local news (percent)	before	22.00	27.48	14.29	35.42	0
	after	21.15	23.88	14.47	35.60	0.05
	change	−0.85	−3.60	0.18	0.18	0.05
Variety	before	83.38	82.07	50.00	74.50	0
	after	81.79	74.61	50.35	75.01	0
	change	−1.58	−7.46	0.35	0.51	0
Price ($/year)	before	172.79	171.51	111.31	150.07	78.33
	after	175.39	178.83	111.26	149.64	87.41
	change	2.59	7.32	−0.05	−0.43	9.08
Ad rate ($/column inch)	before	230.88	153.08	12.37	44.15	11.13
	after	227.09	144.4	12.42	44.29	10.83
	change	−3.79	−8.68	0.05	0.13	−0.3
Circulation	before	317,337	159,864	6,384	24,578	3,341
	after	310,223	140,635	6,518	24,939	2,597
	change	−7,114	−19,229	134	361	−744

The percentage changes for the *Pioneer* are 13 percent and 9 percent, respectively. These changes are accompanied by an increase in both newspapers' subscription prices. Overall, the circulation of the *Star* will decrease by 7,114 (2.43 percent of the premerger circulation) and that of the *Pioneer* by 19,229 (12.03 percent of the premerger circulation). The local news read per household in the market decreases by 10.75 percent.[21] Similar measures for quality content index and variety decrease by 8.28 percent and 8.78 percent. As for the competitors, the *Stillwater Gazette* adjusts its characteristics and prices more than the other two competitors. This is because the *Stillwater Gazette* competes with both the *Star* and the *Pioneer*, and its whole circulation area overlaps with those of the *Star* and the *Pioneer*. The *St. Cloud*

[21] For each newspaper in this market, I use the data to compute its premerger local news content (local news ratio × news hole) and its premerger penetration in the market (premerger circulation/households in the market). I then compute the product of these two terms for each newspaper and sum over these products across all newspapers in the market. This gives the premerger "local news content read per household" in the market. I also compute the postmerger "local news content read per household" based on the simulated result and then compare the two.

Table 7—Welfare Effects of Ownership Consolidation of the *Star* and the *Pioneer*

	Without characteristic adjustment	With characteristic adjustment
Change in *RS* (million $)	−2.22	−3.28
Percentage change in *RS*	−4.67	−6.87
Percentage change in *AS*	−4.66	−7.10
Change in *PS* (million $)	4.23	4.32
Percentage change in *PS*	36.41	37.25

Times and the *Faribault Daily*'s circulation areas, however, only partially overlap with that of the *Star*.

The welfare effect of the ownership consolidation of the *Star* and the *Pioneer* is reported in Table 7. Overall, reader surplus declines by $3.28 million (6.87 percent of the premerger reader surplus) and publisher surplus increases by $4.32 million (37.25 percent of the premerger publisher surplus). As explained at the beginning of Section IV, there is only enough information to measure the percentage change of advertiser surplus. In this study, advertiser surplus declines by 7.10 percent. To understand how the effect of characteristic adjustment compares to the effect of price adjustment, I decompose the reader surplus change into ("reader surplus with *postmerger* prices and *postmerger* characteristics" − "reader surplus with *postmerger* prices and *premerger* characteristics") and ("reader surplus with *postmerger* prices and *premerger* characteristics" − "reader surplus with *premerger* prices and *premerger* characteristics"). These two parts of the reader surplus change represent, respectively, the effect of characteristics and the effect of prices on consumers. They are −$1.31 million and −$1.96 million.[22] The decomposition suggests that the price adjustments have a larger impact on consumers than the characteristic adjustments. But the latter are not negligible. They still account for 40 percent of the total reader surplus change. One can also see the effect of characteristic adjustment by comparing the welfare effects of ownership consolidation with and without characteristic adjustment. Table 7 shows that the welfare change *without* characteristic adjustment is −$2.22 million for readers, −4.23 percent for advertisers, and $4.06 million for publishers. Therefore, ignoring characteristic adjustment leads to an underestimate of the welfare loss for readers by $1.05 million, the welfare loss for advertisers by 1.86 percent, and the increase in publisher surplus by $0.10 million. The general relationship between the bias in estimating the welfare effect from ignoring characteristic adjustment and the underlying market structure is analyzed in Section IVB.

B. *Welfare Analysis of Duopoly and Triopoly Mergers*

The welfare effects of ownership consolidation in a market depend on the details of the market structure. The previous section shows how the framework in this paper can be used to study ownership consolidation in one specific market. I now

[22] An alternative decomposition is ("reader surplus with *premerger* prices and *postmerger* characteristics" − reader surplus with *premerger* prices and *premerger* characteristics") and ("reader surplus with *postmerger* prices and *postmerger* characteristics" − "reader surplus with *premerger* prices and *postmerger* characteristics"). The results are almost identical (−$1.38 and −$1.89 million).

investigate the general pattern of how the welfare effect of a merger varies with market characteristics. The results of this investigation can be used to guide competition policy. To this end, I study the welfare implications of ownership consolidations in all duopoly and triopoly markets in the 2005 sample. Specifically, I compute the welfare effects for such mergers, and then examine how they vary with market characteristics. In a duopoly merger, the publisher of one newspaper buys the other and becomes a monopolist in the market. A triopoly merger is defined as one involving the ownership consolidation of the two largest newspapers in a game with three player newspapers.

Figures 4 and 5 show welfare changes after an ownership consolidation in 41 duopoly markets and 12 triopoly markets in the 2005 sample, the last year in the data.

The markets are sorted according to the change in average per-household reader surplus ($\overline{\Delta RS}$) allowing characteristic adjustments. Dots in Figure 4, panel A represent $\overline{\Delta RS}$ in simulations where characteristic adjustments are allowed. Squares represent $\overline{\Delta RS}$ when such characteristic adjustments are not allowed. The distance between a square and a dot on the same vertical line therefore represents the bias in estimating $\overline{\Delta RS}$ when characteristic adjustment is ignored. Figure 4, panel B plots changes in total reader surplus (ΔRS) in million dollars. Figure 4, panel C shows changes in publisher surplus (ΔPS) in million dollars. Figure 4, panels D, E, F plot the corresponding percentage changes in reader surplus, advertiser surplus, and publisher surplus, respectively. Finally, Figure 5 represents the same measures for the 12 triopoly markets. The mean changes and percentage changes in different welfare measures are presented in Table 8.

To understand how the welfare effect of a merger varies across markets, I run a regression of the welfare effect on market characteristics. I focus on reader surplus here. Let $\overline{\Delta RS}_m$ be the change in average per-household reader surplus in market m. A market in the newspaper industry is characterized by market size, demographics of readers, the set of newspapers, each newspaper's designated market, ownership structure, etc. Since the market structure cannot be captured by simple indices, I regress $\overline{\Delta RS}_m$ on a triopoly dummy and endogenous variables that are correlated with the underlying market characteristics. The regression therefore captures a correlation pattern rather than a causal effect. It is a way to summarize the results from the simulations.

The results of the regression are as follows (standard errors are in parentheses):

$$\begin{aligned}\overline{\Delta RS}_m \;=\; & \underset{(3.73)}{9.85} - \underset{(7.76)}{42.40}\, pen_m - \underset{(14.85)}{27.50}\, overlap_m + \underset{(0.76)}{3.14} \log\left(\frac{q_{1m}}{q_{2m}}\right) \\ & + \underset{(2.56)}{1.74}\, triopoly_m + \varrho_m .\end{aligned}$$

The impact of ownership consolidation on readers' welfare depends on how much readers in a market value newspapers in general. Obviously, if households in a market do not like reading newspapers, then changes in newspaper characteristics and prices do not affect their welfare much. The premerger newspaper penetration (pen_m), measured by the ratio of the total newspaper circulation to the number of households in market m, is used to capture this aspect of the market. The negative sign in the estimate is as expected: readers' welfare loss ($-\overline{\Delta RS}_m$) increases when readers

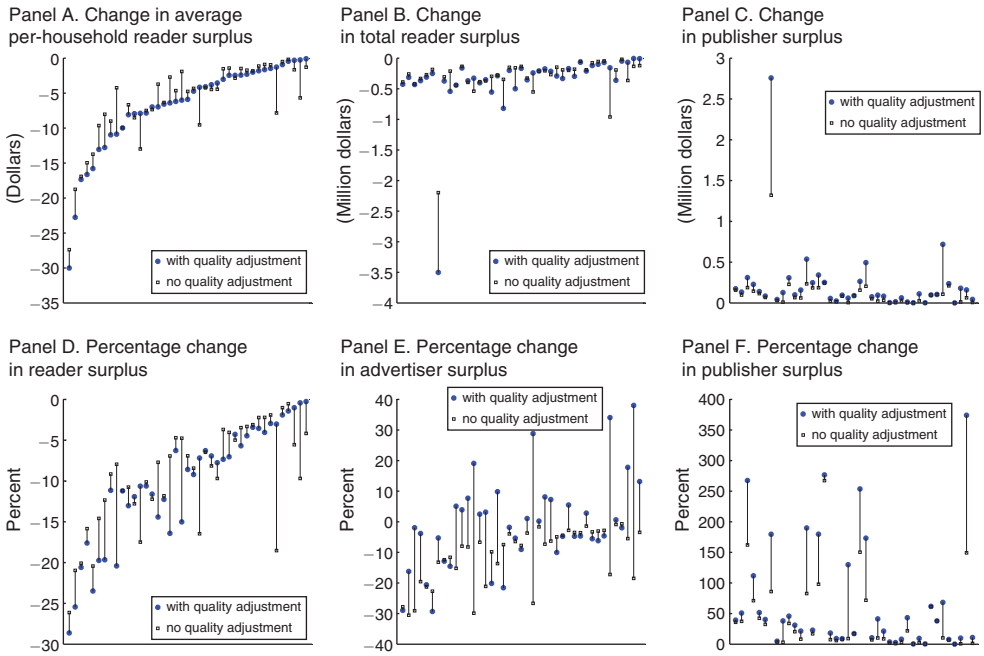


FIGURE 4. WELFARE IMPLICATIONS OF DUOPOLY MERGERS

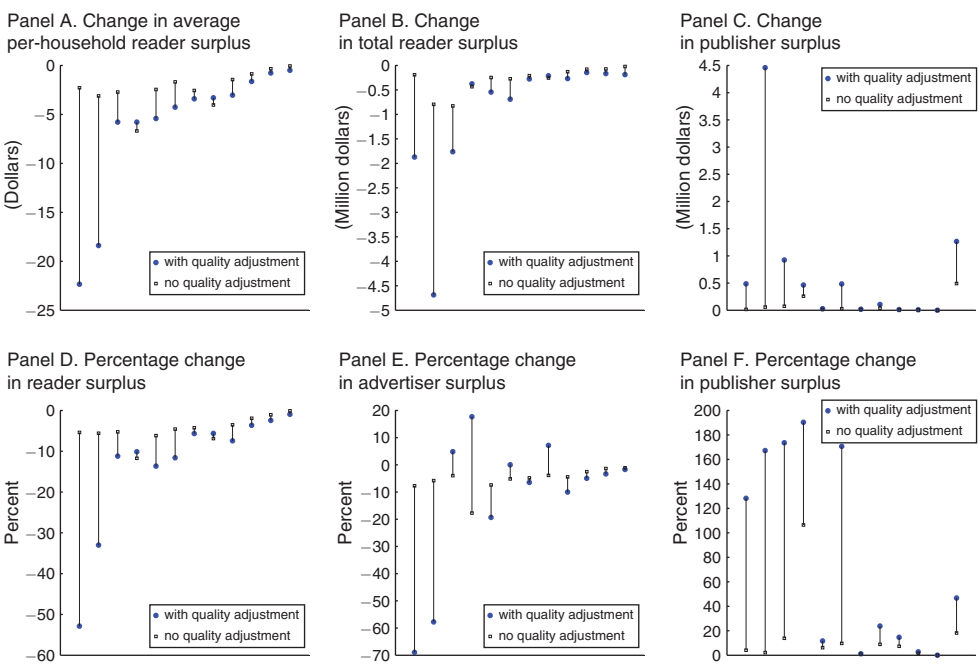


FIGURE 5. WELFARE IMPLICATIONS OF TRIOPOLY MERGERS

Table 8—Mean Welfare Changes across Duopoly and Triopoly Markets

	$\overline{\Delta RS}$ (\$)	ΔRS (millions \$)	ΔPS (millions \$)	$\%\Delta RS$ (percent)	$\%\Delta AS$ (percent)	$\%\Delta PS$ (percent)
Duopoly with characteristic adjustment	−6.83	−0.36	0.22	−10.17	−0.62	70.05
Duopoly without characteristic adjustment	−6.28	−0.31	0.11	−9.33	−10.92	38.91
Triopoly with characteristic adjustment	−6.22	−0.93	0.69	−13.19	−11.9	77.55
Triopoly without characteristic adjustment	−2.35	−0.29	0.08	−4.71	−5.48	14.96

care more about newspapers. An increase in the penetration by 1 percentage point is related to an increase in the average welfare loss per household of \$0.42 cents.

Another market feature that affects $\overline{\Delta RS}_m$ is the importance of the merging parties' common circulation area to these two newspapers. This influences how strong the cross effect between the two newspapers is. Suppose that two newspapers compete with each other only in a county that is far away from their home counties. This county might not play a large role in generating profit for these two newspapers because of readers' taste for local newspapers. When this is the case, a change in the characteristics of one newspaper does not affect the profit of the other newspaper much, and thus the cross effect is weak. Hence, the postmerger adjustment is small. This feature is captured by the premerger overlapping rate of the two newspapers under ownership consolidation:

$$overlap_m = \left(\sum_{c \in CTY_{1,2}} q_{1mc} + q_{2mc}\right) \Big/ (q_{1m} + q_{2m}),$$

where $CTY_{1,2}$ is the intersection of the markets of the two newspapers, and q_{1mc}, q_{1m} and q_{2mc}, q_{2m} are county circulation (in county c) and total circulation of the two merging parties. The above regression indicates a negative correlation between $\overline{\Delta RS}_m$ and $overlap_m$, meaning that the larger the overlapping area is, the larger is the welfare loss for readers.

The third factor is the premerger asymmetry of the two parties to the merger in terms of circulation, measured by $\log\left(\frac{q_{1m}}{q_{2m}}\right)$. As explained in Section IVA, since the marginal benefit of increasing circulation is larger for a larger newspaper, the publisher of the merged parties typically downgrades the larger newspaper by a smaller margin than that of its smaller newspaper. As an adjustment in a larger newspaper has a bigger impact on readers' welfare than the same adjustment in a smaller newspaper, asymmetry matters. Specifically, the larger the asymmetry, the smaller the welfare loss for readers, as indicated by the positive sign in the above regression. Finally, the presence of a competitor mitigates the welfare loss for readers. Therefore, the triopoly dummy has a positive sign in the regression, though the estimate is statistically insignificant.

To understand the variation of the bias in the welfare effect when characteristic adjustment is ignored, I run a second regression of the bias on market characteristics.

Let $\Delta\overline{\Delta RS}_m$ be the difference between ($\overline{\Delta RS}_m$ without characteristic adjustment) and ($\overline{\Delta RS}_m$ with characteristic adjustment). The regression result is as follows:

$$\Delta\overline{\Delta RS}_m = \underset{(3.58)}{3.38} + \underset{(2.09)}{4.36}\, triopoly_m + \underset{(3.98)}{1.64}\, pen_m - \underset{(2.35)}{4.04}\, elas_m + \varrho_m.$$

Again, the triopoly dummy and the premerger penetration matter. For example, the positive coefficient of pen_m means that a higher penetration is related to a larger bias in measuring welfare change. Another factor that determines the bias is the demand elasticity with respect to price. This is because the bias is generated by the difference between the postmerger/without–characteristic adjustment equilibrium and the postmerger/with–characteristic adjustment equilibrium. The bias is therefore the welfare effect of a policy that forces a publisher to set newspaper characteristics back to the premerger level. Suppose the premerger characteristic of one newspaper is higher. Then, as the publisher increases the characteristic of the newspaper under this policy, it can increase the price. How much it will increase the price depends on the price elasticity of demand. Therefore, in the regression I include the average own elasticity of the two merging newspapers. The negative sign in the regression result implies that a higher price elasticity of demand is related to a smaller bias from ignoring characteristic adjustment.

V. Conclusion

In this paper, I set up a structural model of the US daily newspaper market and study the welfare implications of newspaper ownership consolidation, taking into account endogenous product choice as well as price choices. A large new dataset is collected to estimate the model. Based on the estimates, I study mergers in the Minneapolis market. I also quantify the welfare implications of ownership consolidation in all duopoly and triopoly markets in the 2005 sample. The distribution of the welfare effects across markets is used to study the correlation between the welfare effect of ownership consolidation in a market and the structure of the market. The main findings are as follows.

First, in the counterfactual ownership consolidation of the *Star Tribune* and the *St. Paul Pioneer Press* in the Minneapolis market, the publisher of these two newspapers decreases the content quality, the local news ratio, and variety of the *Star* and the *Pioneer*. Subscription prices of both newspapers increase. The overall change in characteristics and prices leads to a decrease in circulation of both newspapers, with a larger drop in the *Pioneer*. The resulting welfare impacts on readers, advertisers, and publishers are −$3.28 million, −7.10 percent of the premerger advertiser surplus, and $4.32 million, respectively.

Second, ignoring characteristic adjustment can lead to a bias in estimating the welfare effects. For example, in the ownership consolidation of the *Star Tribune* and the *St. Paul Pioneer Press*, the welfare loss for readers is underestimated by $1.05 million.

Third, the simulation results of mergers in duopoly and triopoly markets show that readers' welfare loss resulting from ownership consolidation in a market is positively correlated with how much households in the market care about newspapers in

general and how important the overlapping area of the two merged parties is to these two newspapers. It is negatively correlated with the asymmetry of newspaper size measured by premerger circulations. The magnitude of these correlations is reported in the last section.

A couple of limitations to this article need to be acknowledged. First, the preprint demand is not modeled. Preprint profit is actually an important part of a newspaper's profit. With better data on the preprint advertising rate, one could study the demand for preprint and how newspaper characteristics affect the preprint profit. Second, after ownership consolidation, newspaper publishers may even shut down one newspaper. The exits of newspapers may have important political and economic impacts. Infrequent exiting during the time span of the data does not allow me to estimate parameters relevant for the exiting decision. I therefore do not incorporate the decision on the closure of newspapers in this article. It is an interesting topic for future research.

Appendix A: Data Sources and Definition of Variables

Demand.—Data on county circulation for newspapers that are members of the Audit Bureau of Circulations (ABC) is from the *Newspaper County Circulation Report*. ABC members account for about 2/3 of all daily newspapers in the United States. For non–ABC members, county circulation figures are from newspapers' sworn postal statements available in *SRDS Circulation*. Display advertising linage data is available for 485 newspaper/years between 1999 and 2005. The data come from *TNS Media Intelligence*.

Prices.—Data on annual subscription prices and display advertising rates are from *Editor and Publisher International Year Book* (*E&P*). A tiny number of newspapers have multiple subscription prices. The local price is used. Display advertising rate is the open inch rate measured in dollars per column inch.

Characteristics.—Data on average pages per issue are from *E&P*. It is defined as the weighted sum of average pages per issue for weekdays and that for Sunday with weights $\left(\frac{6}{7}, \frac{1}{7}\right)$.

The number of reporters is collected from *Bacon's Newspaper Directory*. Bacon's Directory provides information on the titles, for example "Business Reporter," and names of all managing and editorial staff for all daily newspapers in the United States. For each newspaper, I collect the names of all reporters and assign a weight to each of them. The weight is the inverse of the number of titles that a reporter has. I then sum up the weights to get "the number of reporters." For example, if a person is a reporter and has only one title, she is counted as 1. If she is a court reporter and a crime reporter, she is counted as 1 as well. But if that same reporter holds some managing job at the same time and has therefore another entry in the directory, she contributes to 2/3 in "the number of reporters." The number of columnists and editorial editors is similarly defined. So is the number of staff for each section. I then compute the share of staff for each of the following sections: "business and financial," "computers and technology," "editorial/opinion page," "entertainment and art," "features and lifestyle," "local news," "national and international news," "science and medicine," and "sports."

Data on the frequency of publication, on the edition type (morning versus evening newspaper), and the information on the home county of a newspaper are from *E&P*. The distance of two counties is computed based on the data of latitude and longitude of county centers provided by the Census Bureau.

County Demographics.—The number of households is from the Audit Bureau of Circulations. Other county demographics are from the 2000 census.

The data sources and the description of the variables are summarized in Table A1.

Table A1—Data Description and Sources

	Var	Data description	Data source
Newspaper demand	q_{jct}	County circulation	ABC, SRDS
Display ad demand	a_{jt}	Annual display advertising linage	TNS
Price of newspaper	p_{jt}	Annual subscription price (1997 \$)	E&P
Price of display ad	r_{jt}	Adverting rate (1997 \$/column inch)	E&P
Newspaper characteristics	x_{12jt}	Weighted count of columnists and editorial editors	Bacon
	x_{13jt}	Weighted count of reporters and correspondents	Bacon
	x_{2jt}	Share of staff on local news	Bacon
	x_{3jt}	$100\left[1 - \sum_i (\text{share of staff in section } i)^2\right]$	Bacon
	f_{jt}	Frequency of publication (issues/52 weeks)	E&P
	y_{2jt}	Edition (morning or evening)	E&P
	n_{jt}	Annual number of pages	E&P
County distance	y_{4jct}	Distance between county c and newspaper j's home county	E&P, census
Ownership		Publisher	Bacon
County demographics	z_{1c}	Percent of population over 25 with bachelor's degree or higher	Census
	z_{2c}	Median income (1997 \$)	Census
	z_{3c}	Median age	Census
	z_{4c}	Percent of urban population	Census
	H_{ct}	Number of households	ABC

Notes: ABC: County Circulation Report by Audit Bureau of Circulations; Bacon: Bacon's Newspaper Directory; E&P: Editor and Publisher International Year Book; SRDS: SRDS Circulation; TNS: TNS Media Intelligence.

Appendix B: Welfare Measures

Reader Surplus.—The compensating variation for household i is given by

$$CV_{ict} = \frac{V_{ict}^0 - V_{ict}^1}{\alpha},$$

where $\alpha < 0$ is the negative of the household's marginal value of income, and $V_{ict}^0 - \alpha I_i$ and $V_{ict}^1 - \alpha I_i$ are the expected maximum utility for household i with income I_i (expectation with respect to the extreme value taste shocks) before and after a merger. Specifically,[23]

[23] The derivation of this expression follows directly from Small and Rosen (1981) for a single discrete choice model. The only difference is the second and the third terms, the sum of which is the expectation (with respect to the extreme value taste shocks) of the second highest utility.

$$V_{ict}^{0} = \ln\left(\sum_{j=1}^{J_{ct}} e^{U_{ijct}^{0}} + 1\right) + \sum_{j=1}^{J_{ct}} \ln\left(\sum_{h\neq j} e^{\left(U_{ihct}^{0}-\kappa\right)} + 1\right)$$

$$- (J_{ct}-1)\ln\left(\sum_{h=1}^{J_{ct}} e^{\left(U_{ihct}^{0}-\kappa\right)} + 1\right),$$

where $U_{ijct}^{0} = u_{ijct}^{0} - \varepsilon_{ijct}$ is the utility before the merger, net of the extreme value taste shock. The postmerger utility V_{ict}^{1} is analogously defined to V_{ict}^{0}, replacing U_{ijct}^{0} by U_{ijct}^{1} and u_{ijct}^{0} by u_{ijct}^{1}.

Given the compensating variation for a specific household above, the change in the average per-household reader surplus in county c in year t is given by $\overline{\Delta RS_{ct}} = E_{\zeta_i}(CV_{ict})$. The total welfare change is then the sum of the welfare change in all the counties in a game: $\Delta RS = \sum_{ct} H_{ct}\overline{\Delta RS_{ct}}$, where H_{ct} is the number of households in county c in year t. The change in average per-household reader surplus is $\overline{\Delta RS} = \frac{\Delta RS}{\sum_{ct} H_{ct}}$.

Advertiser Surplus.—As mentioned in Section IVA, I have information to measure only the percentage change in advertising surplus. This can be seen as follows. As in Rysman (2004), suppose a representative advertiser has the following maximization problem:

$$\text{(B1)} \qquad \max_{\{a_j\}} \sum_j \left(\eta' q_j^{\lambda_1'} A_j^{\lambda_2'} a_j^{\lambda_3'} - r_j a_j\right), \qquad 0 < \lambda_3' < 1, \qquad \eta' > 0,$$

where a_j is the advertising space that the advertiser purchases in newspaper j, and A_j is the total advertising space in newspaper j. Let m_j be the market size of advertising. So, total advertising is $A_j = m_j a_j$. The total advertising space influences the visibility of a specific advertisement. When λ_2' is negative, there exist negative externalities in advertising.

The solution to the advertiser's problem is

$$\text{(B2)} \qquad a_j = (\lambda_3'\eta')^{\frac{1}{1-\lambda_3'}} q_j^{\frac{\lambda_1'}{1-\lambda_3'}} A_j^{\frac{\lambda_2'}{1-\lambda_3'}} r_j^{\frac{1}{\lambda_3'-1}}.$$

Aggregation (setting $A_j = m_j a_j$) yields

$$A_j = m_j^{\frac{1-\lambda_1'}{1-\lambda_2'-\lambda_3'}} (\lambda_3'\eta')^{\frac{1}{1-\lambda_2'-\lambda_3'}} q_j^{\frac{\lambda_1'}{1-\lambda_2'-\lambda_3'}} r_j^{\frac{1}{\lambda_2'+\lambda_3'-1}},$$

which can be rewritten as follows with $\lambda_1 = \frac{\lambda_1'}{1-\lambda_2'-\lambda_3'}$, $\lambda_2 = \frac{1}{\lambda_2'+\lambda_3'-1}$, and

$$\eta_j = \log\left[m_j^{\frac{1-\lambda_1'}{1-\lambda_2'-\lambda_3'}} (\lambda_3'\eta')^{\frac{1}{1-\lambda_2'-\lambda_3'}}\right]:$$

$$\text{(B3)} \qquad a(r_j, q_j, \eta_j; \boldsymbol{\lambda}) = e^{\eta_j} q_j^{\lambda_1} r_j^{\lambda_2}.$$

This is the advertising demand function in (7) with $\eta_j = \eta + \lambda_0 \log H_j$. Plugging it into the advertiser's profit function in (B1) gives the measure for advertiser surplus

$$AS = \left(\frac{1}{\lambda_3'} - 1\right) A_j r_j,$$

where $\frac{1}{\lambda_3' - 1}$ is the representative advertiser's demand elasticity with respect to price (see (B2)). Since the representative advertiser's price elasticity parameter, λ_3', and the externality parameter, λ_2', cannot be identified separately given only aggregate data, I report the percentage change in advertiser surplus.

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