# Competition and Ideological Diversity:
## Historical Evidence from US Newspapers

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**Abstract**

We use data on US newspapers from the early 20th century to study the economic incentives that shape ideological diversity in the media. We show that households prefer newspapers whose political content agrees with their own ideology, that newspapers with the same political content are closer substitutes than newspapers with different political content, and that newspapers seek both to cater to household tastes and to differentiate from their competitors. We estimate a model of newspaper demand, entry, and affiliation choice that captures these forces. We show that competitive incentives greatly enhance the extent of ideological diversity in local news markets, and we evaluate the impact of policies designed to increase such diversity.

*JEL classification*: L11, L52, L82
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# 1 Introduction

Economists have long been concerned with the optimal amount of product diversity in the marketplace (Dixit and Stiglitz 1977, Mankiw and Whinston 1986). In the context of the news media, product diversity matters not only for the usual reasons of consumer and producer surplus, but also because it may contribute to the competitiveness of the marketplace of ideas and hence of the political process (Becker 1958, Downs 1957). Thus, "the [First] Amendment rests on the assumption that the widest possible dissemination of information from diverse and antagonistic sources is essential to the welfare of the public" (*Associated Press v. United States, 1945*).

Three main policy instruments have been directed at increasing ideological diversity in media markets: explicit subsidies, relaxation of antitrust rules, and limits on joint ownership. Federal, state, and local governments in the United States subsidized newspapers in the nineteenth and early twentieth centuries, and many European governments continue to do so today, with the explicit goal of maintaining diversity (Murschetz 1998). The Newspaper Preservation Act of 1970 allowed competing newspapers to jointly set advertising and circulation prices in an effort to prevent second and third papers from exiting. The Act states its goal as "maintaining a newspaper press editorially and reportorially independent and competitive in all parts of the United States." The Federal Communications Commission has long regulated US media ownership "on the theory that diversification of mass media ownership serves the public interest by promoting diversity of program and service viewpoints" (FCC 2010).

In this paper, we study the economic forces that determine equilibrium ideological diversity in newspaper markets. We formulate an equilibrium model of entry and product positioning, with competition for both consumers and advertisers. We show descriptive evidence consistent with the model's core predictions, and estimate the model using data on the circulation and affiliations of US daily newspapers in 1924. We then use the estimated model to decompose the incentives that promote diversity and evaluate the impact of the public policies discussed above.

Studying newspapers in a historical context affords several advantages that offset the intrinsic disadvantage of moving further away from contemporary policy settings. First, during the time period that we study it was common for newspapers to declare explicit political affiliations (Gentzkow et al. 2006, Hamilton 2006). A newspaper's affiliation serves as a good proxy for the ideological tilt of the newspaper's content (Gentzkow et al. forthcoming), so the presence of explicit affiliations alleviates the challenge of measuring ideology that confronts studies of modern news media (Groseclose and Milyo 2005, Gentzkow and Shapiro 2010). Second, during the period we study there were a large number of local markets in the US with multiple competing daily newspapers. Although many media remain fiercely competitive today, few afford researchers a large cross-section of experiments that can be used to study competitive interactions.

Partisanship emerges as an important determinant of newspaper demand. Within a metropolitan area, an increase of 10 percentage points in the proportion of a town's votes going to Republicans increases the relative circulation of Republican papers in the town by 10 percent. Adding a second Republican paper to a town with one Republican and one Democratic newspaper reduces the relative circulation of the existing Republican paper by 4 percent. These findings survive flexible controls for the quality of the newspaper and for the town's overall taste for news.

Such patterns in demand should induce newspapers to choose affiliations commensurate with the ideology of the local market, and to choose affiliations different from those of local competitors. Both patterns are present in our data. A 10 percentage point increase in a market's fraction Republican increases the probability that an entering newspaper chooses a Republican affiliation by 23 percentage points. Controlling for the fraction Republican, adding an additional Republican incumbent reduces an entering paper's likelihood of choosing a Republican affiliation by 15 percentage points.

Our economic model embeds Gentzkow's (2007) multiple-discrete-choice demand framework in a sequential entry game in the spirit of Bresnahan and Reiss (1991) and Mazzeo (2002). In the model, firms first decide whether to enter the market, then choose either Republican or Democratic affiliation, taking into account household demand, the responses of other entering firms, and the effect of affiliation choice on subscription and advertising prices. The model allows households to exhibit a preference for newspapers whose ideology matches their own, and to regard newspapers with the same political affiliation as more substitutable than newspapers with different affiliations. Our model of advertising demand builds on the recent two-sided markets literature in allowing advertisers to place advertisements in multiple newspapers and to value "single-homing" and "multi-homing" consumers differently (Armstrong 2002, Ambrus and Reisinger 2006, Anderson et al. 2011).

A crucial identification issue arises from unobserved heterogeneity in household ideology. Such heterogeneity will cause the choices of firms within a given market to be positively correlated, biasing downward estimates of the incentive to differentiate. It will also bias demand estimates, for similar reasons. We address this issue by allowing explicitly for unobserved cross-market variation in household ideology, which is identified by correlation of choices across markets that are close enough to share similar characteristics but far enough apart that their newspapers do not compete. We assume in the spirit of Murphy and Topel (1990) and Altonji et al. (2005) that the spatial correlation in unobservable dimensions of ideology matches that of observable measures. Experiments with specifications that ignore unobservable heterogeneity show that even qualitative conclusions of the model are sensitive to the quality of the econometrician's observable proxies for ideology, whereas conclusions from a model that allows for unobservable heterogeneity are robust.

We find that competition plays a critical role in driving ideological diversity. Newspapers with the same affiliation are better substitutes than newspapers of different affiliations, creating a strong incentive to differentiate. This effect is enhanced by competition in both circulation and advertising prices. Were entering newspapers to ignore the presence of competitors in choosing their affiliations, the number of "diverse" news markets with at least one paper affiliated with each political party would decline by almost half.

We use the model to simulate the effects of various public policies that are often motivated by a desire to maintain diverse news markets. Antitrust leniency, in the form of joint operating agreements that permit pricing and advertising collusion, decreases the incentive to differentiate, but increases entry. On net, this policy increases the share of households living in markets with diverse papers from 28 percent to 41 percent. Joint operating agreements also increase consumer welfare, both through increased entry and through lower prices that result from the increased attractiveness of consumers to advertisers. Newspaper subsidies such

as US postal subsidies or direct press subsidies (such as those in many European countries) affect diversity mainly through their impact on the number of newspapers.

Our work builds on recent empirical models of entry and product positioning with explicit demand systems (Reiss and Spiller 1989, Einav 2007 and 2010, Draganska et al. 2009, Seim and Waldfogel 2010, Fan 2010). Like Fan (2010), we study a news market with both subscription and advertising sides. Our model differs from past work in allowing unobserved shocks at both the firm-level and the market-level. We show that market-level heterogeneity is important in our setting, and that properly accounting for it has a significant impact on our substantive results.

Our paper also contributes to the literature on two-sided markets. Consistent with recent theoretical work (Armstrong 2002, Ambrus and Reisinger 2006, Anderson et al. 2011), we find that the nature of advertising competition depends crucially on the extent to which consumers read multiple newspapers. We show that this force, in turn, has an important effect on firms' incentive to differentiate from their competitors. Along with Fan (2010), ours is among the first empirical studies to estimate a micro-founded model of advertising competition. In this sense, we extend past empirical work by Rysman (2004), Kaiser and Wright (2006), Wilbur (2008), Argentesi and Filistrucchi (2007), Chandra and Collard-Wexler (2009), Sweeting (2010), and others.

Substantively, our paper is most closely related to research on the incentives that shape the political orientation of the news media. Gentzkow and Shapiro (2010) use a similar framework to study ideological positioning of US newspapers in recent years. Because few modern markets have more than one newspaper, however, they cannot address the impact of competition. Other related work studies the way content relates to electoral cycles (Puglisi 2011), economic conditions (Larcinese et al. 2007), political scandals (Puglisi and Snyder 2008), and government influence (Durante and Knight forthcoming, Qian and Yanagizawa 2010), without explicitly modeling the role of competition. Chiang's (2010) study of US newspapers is the closest to ours in investigating equilibrium positioning of newspapers in multi-paper markets. Chiang (2010) uses household-level data to test the predictions of a variant of Mullainathan and Shleifer's (2005) model, and finds that ideologically extreme households in multi-paper markets are more likely to read a newspaper than those in single-paper markets.

Like Chiang (2010) and Gentzkow and Shapiro (2010), we focus on the commercial, rather than political, incentives of news outlets. Commercial considerations likely dominated political incentives at the time of our study (Baldasty 1992). In other work, we show that newspapers' affiliations exert, on average, at most a small effect on electoral outcomes (Gentzkow et al. forthcoming), and that incumbent parties exert at most a limited influence on newspapers' political affiliations (Gentzkow et al. 2011). We note, however, that Petrova (2009) provides evidence that political patronage influenced newspaper affiliations in the late 1800s.

The remainder of the paper is organized as follows. Section 2 introduces the historical data that forms the basis of our analysis. Section 3 discusses the historical context for our data. Section 4 lays out our economic model. Section 5 presents descriptive evidence on the determinants of newspaper demand and affiliations. Section 6 details our econometric assumptions and explains how we implement our estimator. Section 7 discusses model identification. Section 8 presents estimates and key counterfactuals from the

model. Section 9 concludes.

# 2 Data

## 2.1 Cross-section of Daily Newspaper Markets

We define the universe of potential daily newspaper markets to be all cities with populations between 3,000 and 100,000 and at least one *weekly* newspaper as of 1924. Data on the universe of cities and their populations comes from the 1924 N. W. Ayer & Son's *American Newspaper Annual.*

We take data on daily newspapers from the US Newspaper Panel introduced in Gentzkow et al. (forthcoming). The data are drawn from annual directories of US newspapers from 1869 and from every presidential year from 1872 to 1924, inclusive. In each year, we extract the name, city, political affiliation, and subscription price of every English-language daily newspaper. We match newspapers across years on the basis of their title, city, and time of day. Gentzkow et al. (forthcoming) provide details on data collection and validation of data quality.

We define a time-constant measure of affiliation for each newspaper, where papers are classified as Republican if they ever declare a Republican affiliation and Democratic if they ever declare a Democratic affiliation. In the handful of cases where a newspaper declares a Republican affiliation in one year and a Democratic affiliation in another, we use the majority affiliation. We exclude 142 newspapers whose only affiliation is Independent and 36 newspapers that never declare an affiliation of any kind from our sample.

For each market in our universe with two or more daily newspapers, we define the order of entry by the order in which the papers appear in the US Newspaper Panel. When necessary we break ties randomly.

We match markets to Census place definitions in 1990 and match each Census place to the county containing the largest share of the place's population in 1990. We use the Census place-county match to combine city level newspaper data with county level voting data from various sources, as in Gentzkow et al. (forthcoming). Our main measure of consumer ideology is the average share of the two-party presidential vote going to Republicans over the period 1868 to 1928. We exclude a small number of markets for which we cannot identify the presidential vote share.

Table 1 presents summary statistics for our cross-section of markets. Our sample includes 1910 markets, 950 of which have at least one daily newspaper, and 338 of which have more than one daily newspaper. Population is highly correlated with the number of newspapers. In total there are 1338 newspapers in the sample, of which 57 percent are Republican. Overall, 54 percent of multi-paper markets are ideologically diverse in the sense of having at least one Republican and at least one Democratic newspaper. In the average market, Republican and Democratic presidential candidates tend to get a similar number of votes, but there is substantial cross-market variation in the vote share.

## 2.2 Town-level Circulation Data

We assemble a separate cross-section of towns that are close enough to newspaper markets that newspapers circulate in them, but that are not the headquarters of any daily newspaper themselves. These "hinterland"

towns will be the basis of our demand analysis. Data on circulation by town comes from the 1924 Audit Bureau of Circulations (ABC) Auditor's Reports of individual newspapers. In most cases the audits cover a twelve-month period ending in 1924; in some cases the examination period is shorter or ends in 1923. We obtained the reports on microfilm from ABC. A document imaging firm scanned the microfilm, and a data entry firm converted the scanned reports to machine readable text. ABC audit reports are a standard source for newspaper circulation data, but as far as we know this is the first effort to digitize a full report from the early twentieth century.

From each audit report we extract the paper's name, location, and circulation in each town that receives "25 or more copies daily through carriers, dealers, agents, and mail." We sum circulation by town across multiple editions of the same paper and average circulation by town across multiple audit reports (if more than one edition or audit report is available).

We match newspapers in the ABC data to papers in the US Newspaper Panel using the paper's name and location. We construct a cross-section of towns with at least one matching circulating newspaper. We exclude from our sample any town that is itself the headquarters of a daily newspaper. For computational reasons, we exclude 52 towns with more than 10 newspapers available.

We match towns to 1990 Census place codes using town and state name, and we use place codes to match towns to counties. We exclude towns that we cannot successfully match to Census geographies, and a small number for which we do not have county presidential voting data.

Table 2 presents summary statistics for the towns in our sample. Our sample includes 12198 towns, in 8052 of which more than one daily newspaper circulates. Population is highly correlated with the number of newspapers. Overall, 53 percent of multi-paper towns are ideologically diverse in the sense of having at least one Republican and at least one Democratic newspaper available.

### 2.3 Cost and Revenue Data

We obtain 1927 balance sheet data on 94 anonymous newspapers from the Inland Daily Press Association (Yewdall 1928). We match each record in the US Newspaper Panel to the record in the balance sheet data with the closest circulation value. Performing this match allows us to estimate cost and revenue components for each newspaper in the panel.

We compute the marginal cost of each newspaper as the annual per-copy cost of printing and distribution, including paper and ink costs and mailing and delivery costs. We also compute the annual per-copy advertising revenue of each newspaper. Finally, we compute the annual per-copy circulation revenue of each newspaper (revenue from subscriptions and single-copy sales).

## 3 Background on Newspaper Partisanship

The median newspaper in our 1924 cross-section entered its market prior to 1896. At that time it was common for newspapers to choose explicit partisan affiliations (Gentzkow et al. 2006, Hamilton 2006). The practice faded over time: by the mid-twentieth century it was rare for entering newspapers to declare an explicit affiliation.

A newspaper's affiliation played a clear role in determining its likely appeal to different readers. For example, in 1868, the Democratic *Detroit Free Press* announced, "The *Free Press* alone in this State is able to combine a Democratic point of view of our state politics and local issues with those of national importance" (Kaplan 2002, 23). Similarly, in 1872, the Republican *Detroit Post* declared as its mission "To meet the demands of the Republicans of Michigan and to advance their cause" (Kaplan 2002, 22).

Anecdotal evidence supports the view that newspapers' affiliations depended on those of competing newspapers in the same market. James E. Scripps declared in 1879 that "As a rule, there is never a field for a second paper of precisely the same characteristics as one already in existence. A Democratic paper may be established where there is already a Republican; or vice versa; an afternoon paper where there is only a morning; a cheap paper where there is only a high-priced one; but I think I can safely affirm that an attempt to supplant an existing newspaper...of exactly the same character has never succeeded" (quoted in Hamilton 2006, 47). Through the early twentieth century, James' brother, E.W. Scripps, exploited the nominal independence of his newspaper chain to adapt editorial content to market conditions, emphasizing Republican ideas in markets with established Democratic newspapers, and Democratic ideas when Republicans were entrenched (Baldasty 1999, 139).

In Gentzkow et al. (forthcoming) we report the results of a quantitative content analysis of newspapers that uses the mentions of Republican and Democratic presidential candidates as a proxy for the political orientation of a newspaper's content. The analysis shows that the partisanship of a newspaper's content is strongly related to its political affiliation and is not strongly related to the political orientation of voters in the market once we condition on political affiliation. Moreover, for newspapers that switched from being partisan to independent, historical political affiliation remains a strong predictor of the newspaper's content. As we argue in more detail in Gentzkow et al. (forthcoming), these findings support measuring political affiliations as permanent and binary (Republican/Democrat).

As noted above, we exclude papers that never declare a Republican or Democratic affiliation from our sample. The set of completely unaffiliated papers includes many specialized commercial newspapers (e.g., mining industry news) that can plausibly be treated as separable in demand from affiliated newspapers. The set of papers that only declare Independent affiliation is more likely to include competitors to those we study. A content analysis of Independent newspapers (not shown) shows that Independent papers' orientation is, if anything, even more related to local market ideology than that of affiliated papers, though the two relationships are not statistically distinguishable. This suggests that it may be reasonable to think of Independent papers as having unreported affiliations.

# 4 Model

## 4.1 Overview

We consider a cross-section of markets, each of which has a large number of potential entrants. For now we consider the game that occurs in a particular market; we introduce market subscripts when we turn to estimation below.

We index the $J$ newspapers that choose to enter in equilibrium by $j \in \{1, ..., J\}$. Each entering newspaper

chooses a political affiliation $\tau_j \in \{R, D\}$, a circulation price $p_j \geq 0$, and a pair of advertising prices described below. We denote the vectors of types and circulation prices chosen by all entering newspapers by $\tau$ and $p$ respectively. The market has $S$ households indexed by $i$, each of which has a political affiliation $\theta_i \in \{R, D\}$. We denote the share of households with $\theta_i = R$ by $\rho$ and assume that $\rho$ is common knowledge to all potential entrants.

The profits of entering newspaper $j$ are given by

$$\pi_j = S\left[\left(p_j + a_j - MC\right) q_j - \xi_j\left(\tau_j\right)\right] - \kappa \tag{1}$$

where $a_j$ is newspaper $j$'s advertising revenue per copy sold, $MC$ is a marginal cost common to all newspapers, $q_j$ is the share of households purchasing newspaper $j$, $\xi_j(\tau_j)$ is an affiliation-specific variable cost, and $\kappa$ is a fixed cost.

The game proceeds in five stages. First, the potential entrants choose sequentially whether or not to enter. Second, the newspapers that have entered observe their own $\xi_j$ and sequentially choose their political affiliations. Third, newspapers simultaneously choose their circulation prices. Fourth, newspapers simultaneously choose their advertising prices. Finally, households make purchase decisions and profits are realized. At the end of each stage, all newspapers' choices are observable to all other firms. The only elements of a given newspaper $j$'s profit function that are private information are the variable costs $\xi_j(\tau_j)$. We describe the stages from last to first. At the end of this section, we describe a separate (unmodeled) process that determines which newspapers are available in each hinterland town.

## 4.2 Household Demand

Our demand specification follows Gentzkow (2007). In the model consumers can consume any bundle of the $J$ available newspapers, or no newspapers at all. For consumers in newspaper markets, we assume that the available newspapers are those headquartered in the market.

Households differ in the utility they get from consuming a given bundle. Let $\mathbb{B} = \mathscr{P}(\{1, ..., J\})$ denote the set of all possible bundles of newspapers, with $B \in \mathbb{B}$ denoting a generic bundle. Household $i$'s utility from bundle $B$ is given by

$$U_i(B) = u(\theta_i, B) + \varepsilon_i(B) \tag{2}$$

where $\varepsilon_i(B)$ is a type-I extreme value error i.i.d. across households and bundles. The function $u(\theta, B)$ denotes the mean utility from consuming bundle $B$ for households with affiliation $\theta$.

We define mean utilities $u(\theta, B)$ as follows. Let $k(B)$ denote the number of distinct two-newspaper subsets of bundle $B$ such that the two newspapers have the same political affiliation. We write:

$$u(\theta, B) = \sum_{j \in B} \left(\underline{\beta}\, \mathbf{1}_{\theta \neq \tau_j} + \overline{\beta}\, \mathbf{1}_{\theta = \tau_j} - \alpha p_j\right) - k(B)\Gamma \tag{3}$$

where $\mathbf{1}$ denotes the indicator function. The mean utility from consuming no newspapers is normalized to $u(\theta, \emptyset) = 0$. A household receives per-newspaper utility $\overline{\beta}$ for each newspaper in the bundle that has

the same affiliation as the household, and per-newspaper utility $\underline{\beta}$ for each newspaper that has a different affiliation. The household's utility is diminished by an amount $\Gamma$ for every pair of newspapers with the same affiliation and by $\alpha$ for every dollar spent. Consistent with existing empirical evidence (Kaiser and Song 2009), we assume that consumer utility does not depend directly on the quantity of advertising.

Each household chooses its utility-maximizing bundle. Let $q_j(\theta)$ denote the share of households of type $\theta$ who purchase newspaper $j$. Then

$$q_j(\theta) = \frac{\sum_{\{B \in \mathbb{B}: j \in B\}} exp(u(\theta, B))}{\sum_{B' \in \mathbb{B}} exp(u(\theta, B'))}. \tag{4}$$

The market-wide share of households purchasing newspaper $j$ is then

$$q_j = \rho q_j(R) + (1-\rho) q_j(D). \tag{5}$$

### 4.3 Advertising Prices

There exists a unit mass of potential informative advertisers, each of which receives a benefit $a_I$ from each household reached at least once by its advertising. There also exists a mass of potential persuasive advertisers, each of which receives a benefit $a_P$ per impression. Unlike informative advertisers, persuasive advertisers experience no diminishing returns from multiple impressions per household.

After circulation prices are chosen, each newspaper simultaneously declares two advertising prices: one for informative advertisements and another for persuasive advertisements. After advertising prices are posted, each advertiser simultaneously decides whether to advertise in each newspaper.

Denote the share of firm $j's$ readers who read only newspaper $j$ by $\psi_j$. In any pure strategy equilibrium, all advertisers advertise in all newspapers. Informative advertising revenue is given by $a_I \psi_j$ (Armstrong 2002, Anderson et al. 2011). The reason is that, from the informative advertiser's perspective, two newspapers that reach the same household are perfect substitutes in the market for advertising to that household. Therefore a newspaper can obtain informative advertising revenue only for those households that read it exclusively. Because there are no diminishing returns to additional persuasive impressions, in any pure strategy equilibrium persuasive advertisers pay $a_P$ per reader.

We can therefore write newspaper $j's$ advertising revenue per reader, $a_j$, as

$$a_j = a_h \psi_j + a_l (1 - \psi_j) \tag{6}$$

where $a_l \leq a_h$, and $a_l$ and $a_h$ are functions of both the per-reader advertiser valuations $a_I$ and $a_P$ and the relative mass of persuasive and informative advertisers.[1]

### 4.4 Circulation Prices

All newspapers that have entered the market choose prices simultaneously, having observed the set of entrants and their affiliations $\tau$. An equilibrium of this game is a vector of prices $p^*$ such that each element $p_j^*$

[1] Let $s_P$ be the mass of persuasive advertisers. Then $a_h = a_I + s_P a_P$ and $a_l = s_P a_P$.

satisfies:

$$p_j^* \in \underset{p_j}{\operatorname{argmax}} \left(p_j + a_j\left(p_j, p_{\sim j}\right) - MC\right) q_j\left(p_j, p_{\sim j}\right). \tag{7}$$

Here we represent explicitly the fact that demand (and hence advertising prices) depend on the prices charged by the newspapers. We write $p_{\sim j}$ to denote the vector of newspaper $j$'s competitors' prices.

We denote by $v_j = (p_j + a_j - MC)\, q_j$ the equilibrium variable profit of newspaper $j$ net of the affiliation-specific variable cost $\xi_j(\tau_j)$.

### 4.5 Political Affiliations

Entering newspapers choose their affiliations sequentially in order of their indices $j$. Each newspaper observes the affiliation choices of preceding newspapers. Let $\tau_{j^-}$ and $\tau_{j^+}$ denote vectors of affiliations of newspapers with indices less than and greater than $j$, respectively. Newspaper $j$'s expected variable profit upon choosing $\tau_j$ is:

$$\overline{v}_j\left(\tau_j, \tau_{j^-}\right) = E_{\tau_{j^+}} v_j\left(\tau_j^-, \tau_j, \tau_j^+\right). \tag{8}$$

We make explicit here the dependence of a newspaper's variable profit on its own affiliation choice and the choices of the other newspapers. The expectation is taken with respect to newspaper $j$'s conjecture about the affiliation choices of the newspapers that follow it.

The equilibrium is a vector of choices $\tau^*$ such that each $\tau_j^*$ satisfies:

$$\tau_j^* \in \underset{\tau_j \in \{R,D\}}{\operatorname{argmax}}\, \overline{v}_j\left(\tau_j, \tau_{j^-}\right) - \xi_j\left(\tau_j\right). \tag{9}$$

The shock $\xi_j(\tau_j)$ is private information and is revealed to newspaper $j$ after it chooses to enter and before it chooses its affiliation. We assume that $\xi_j(\tau_j)/\sigma_\xi$ is distributed type I extreme value i.i.d. across newspapers and affiliations, where $\sigma_\xi > 0$ is a constant that scales the variability in the cost shocks.

Given past affiliations $\tau_{j^-}$, newspaper $j$ chooses affiliation $\tau_j$ with probability

$$P_j\left(\tau_j, \tau_{j^-}\right) = \frac{\exp\left[\frac{1}{\sigma_\xi}\overline{v}_j\left(\tau_j, \tau_{j^-}\right)\right]}{\sum_{\tau \in \{R,D\}} \exp\left[\frac{1}{\sigma_\xi}\overline{v}_j\left(\tau, \tau_{j^-}\right)\right]}. \tag{10}$$

Given realized variable profits $v_j - \xi_j(\tau_j)$ for each newspaper $j$, there is a unique equilibrium vector of affiliation choices that can be characterized by backward induction. The last newspaper $J$ takes as given the affiliation choices of all preceding newspapers, so it knows $v_J(\tau_J, \tau_{J^-}) - \xi_J(\tau_J)$ with certainty. Newspaper $J-1$ integrates over the distribution of $\xi_J(\tau_J)$ to assess newspaper $J's$ probability of choosing each possible affiliation, as a function of newspaper $J-1's$ affiliation choice and that of all preceding newspapers. And so on.

### 4.6 Entry

After entry, indices are assigned at random and cost shocks $\xi_j(\tau_j)$ are realized. Let $P(\tau, J)$ denote the equilibrium probability of affiliation vector $\tau$ as of the entry stage (i.e., before cost shocks are realized). Then the expected variable profit of each entering firm as of the entry stage is

$$V(J) = \frac{1}{J}\sum_{j=1}^{J}\sum_{\tau}\left[P(\tau, J)\, E\left((v_j - \xi_j(\tau_j))\,|\tau\right)\right]. \tag{11}$$

Here, the conditional expectation $E\left((v_j - \xi_j(\tau_j))\,|\tau\right)$ reflects the fact that newspaper $j$ chooses its affiliation after observing its cost shocks $\xi_j(\tau_j)$.

We define an equilibrium of the entry game to be a number of newspapers $J^*$ such that, in expectation, entering newspapers are profitable but a marginal entrant would not be. That is,

$$V(J^*) \geq \frac{\kappa}{S} > V(J^* + 1). \tag{12}$$

If $V(1) < \frac{\kappa}{S}$ then it is an equilibrium for no newspapers to enter.

### 4.7 Circulation in the Hinterland

Each newspaper may be available for circulation in one or more hinterland towns. These towns' contribution to total circulation is small, so we ignore them in the entry and affiliation choices that we model above. However, we use data on town-level circulation to identify the parameters of our demand model.

The decision about whether to make a newspaper available in a given town is made based on expected variable profit, and any fixed and variable costs of transportation.

Expected variable profit depends on expected circulation. We assume that demand for newspapers in towns follows the same structure assumed above for markets. Therefore circulation depends on the share of households in the town that are Republican $\rho$, the number of households $S$, and the number and affiliations of available newspapers in the town.

In equilibrium, the number and affiliations of the available newspapers will therefore be a function of $\rho$, $S$, and (possibly town-specific) fixed and variable costs of transportation.

## 5 Descriptive Evidence

Before turning to formal estimation, we present descriptive evidence from our data on the economic forces captured in the model.

### 5.1 Partisanship and Newspaper Circulation

In our model household utility depends on (i) the match between the newspaper's type and the household's type and (ii) the presence of substitute newspapers in the household's consumption bundle.

As table 3 illustrates, both factors play a significant role in driving observed demand. The table presents OLS regressions of the difference in mean log circulation between Republican and Democratic newspapers on measures of household ideology and/or the presence of substitutes. Specification (1) includes only household ideology, specification (2) includes only counts of available newspapers, and specification (3) includes both. Specification (4) adds county fixed effects to control carefully for household characteristics. Given the construction of the dependent measure, coefficients can be interpreted as the marginal effect of a given variable on the circulation of Republican papers relative to Democratic papers.

The greater is the Republican share of households in a town, the greater will be the relative circulation of Republican newspapers. However, having more Republican newspapers available will tend to depress the circulation of the average Republican paper due to substitution effects. Because Republican newspapers are more likely to be available in towns with more Republican households, these two effects tend to work in opposite directions. Therefore, we expect that specification (1) understates the effect of household ideology and specification (2) understates the importance of substitutes. Specification (3) shows that, as expected, both effects are estimated to be larger when the regression includes measures of both household ideology and the presence of substitutes. Specification (4) shows that using county fixed effects to control carefully for household characteristics further increases the estimated substitution effects.

The estimated relationships in specification (3) are economically significant. Increasing the fraction Republican among voters by 10 percentage points increases the relative circulation of Republican papers by 10 percent. Adding a second Republican paper to a market with one Republican and one Democratic newspaper reduces the relative circulation of the existing Republican paper by 4 percent.

The evidence in the data that household ideology and the presence of substitutes influence newspaper demand is quite robust. In the online appendix, we present evidence from a specification that uses a fixed-effects strategy similar to Gentzkow and Shapiro's (2010) to isolate the effect of these forces from variation in newspaper quality and the quality of the outside option. We find similar qualitative conclusions to those we report here.

### 5.2 Determinants of Newspapers' Affiliation Choices

Given that households demand own-type newspapers and that same-type papers are more substitutable, we would expect that newspaper affiliation would respond both to household ideology and to market structure.

Table 4 shows that these expectations are borne out in our data. The table presents OLS regressions of a dummy for whether a newspaper chooses a Republican affiliation on measures of household ideology and incumbent affiliations. Specification (1) includes only household ideology, specification (2) includes only incumbent affiliations, and specification (3) includes both. Specification (4) adds market fixed effects, identifying the effect of incumbents solely from the order of entry.

The more Republican are the households in a market, the more likely is an entering paper to choose a Republican affiliation. However, facing a Republican incumbent reduces the likelihood that an entering paper affiliates with the Republican party. Because Republican incumbents are more likely in markets with more Republican households, these two effects tend to work in opposite directions. Therefore, we expect that specification (1) understates the effect of household ideology, and specification (2) understates the effect

of incumbent affiliation. Specification (3) shows that, as expected, both effects are estimated to be larger when the regression includes measures of both household ideology and incumbent affiliations. Specification (4) shows that the effect of incumbent affiliations survives controls for marked fixed effects.

The effects we estimate in specification (3) are economically significant. A 10 percentage point increase in the fraction Republican among households increases the likelihood of a Republican affiliation by 23 percentage points. Having a Republican incumbent instead of a Democratic incumbent reduces the likelihood of a Republican affiliation by 28 percentage points.

# 6 Estimation

In this section we lay out the stochastic assumptions that we impose in estimation. We estimate the model in two steps. The first step estimates the demand system via maximum likelihood. The second step estimates the remaining parameters via maximum likelihood, taking as given the demand parameters from the first step. We refer to the second step as the "supply" model for convenience, although both demand and supply parameters ultimately influence firm conduct. We present stochastic assumptions first for the supply model, then for the demand model.

## 6.1 Supply Model

Index markets by $m \in \{1,...,M\}$. Our identification strategy will exploit spatial correlation of $\rho_m$ across markets. We assume that each market is paired with a single neighboring market and that $\rho_m$ is correlated within pairs but independent across pairs. We define a mapping $n : \{1,...,M\} \to \{1,...,M/2\}$ such that markets $m$ and $m'$ are in the same pair if and only if $n(m) = n(m')$. We take as given an observable estimate $Z_m$ of the share of households that are Republican.

We assume that $\rho_m$ has an unobservable component that varies at both the pair and market level. Let $\delta_{n(m)}$ be a pair-specific unobservable distributed i.i.d. normally across pairs with mean $\mu_\delta$ and variance $\sigma_\delta^2$. Let $\eta_m$ be a market-specific unobservable distributed i.i.d. normally across markets with mean 0 and variance $\sigma_\eta^2$. The distributions of $\delta_{n(m)}$ and $\eta_m$ are assumed to be independent of one another and of $Z_m$. We assume that

$$\rho_m = \text{logit}^{-1}\left(\text{logit}(Z_m) + \delta_{n(m)} + \eta_m\right). \tag{13}$$

The logit transformation ensures that $\rho_m \in [0,1]$ . We impose the following restriction on the covariance structure of the unobservables:

$$R \equiv \frac{Cov\left(\text{logit}(Z_m), \text{logit}(Z_{m'})\right)}{Var\left(\text{logit}(Z_m)\right)} = \frac{\sigma_\delta^2}{\sigma_\delta^2 + \sigma_\eta^2} \tag{14}$$

for any $m$ and $m'$ such that $n(m) = n(m')$.

Let $G(x|S)$ denote the CDF of fixed costs per household $\frac{\kappa}{S}$ conditional on population $S$. We assume that

$$G(x|S) = \text{logit}\left(\frac{x - \mu_\kappa^0 - \mu_\kappa^1 log(S)}{\sigma_\kappa}\right), \tag{15}$$

i.e. that $\frac{\kappa}{S}$ is distributed logistic with mean $\mu_\kappa^0 + \mu_\kappa^1 log(S)$ and dispersion parameter $\sigma_\kappa$.

The observed data consist of the affiliation vector $\tau_m$, the number of firms $J_m$, the population $S_m$, and the observed share Republican $Z_m$. We treat the affiliation vector $\tau_m$ and the exact number of firms $J_m$ as unobserved in any market with $J_m > \bar{J}$ for a cutoff value $\bar{J}$. (Note that we do not incorporate information on observed prices in the likelihood function.)

To derive the likelihood of the data, begin by supposing the econometrician can also observe the true share Republican among households, $\rho_m$. In this case, the likelihood of a given market $m$, which we can denote by $L_m(\rho_m)$, can be written as

$$L_m(\rho_m) = \begin{cases} (1 - G(V(J_m+1, \rho_m)|S_m))\, P(\tau_m, J_m, \rho_m) & \text{if } J_m = 0 \\ (G(V(J_m, \rho_m)|S_m) - G(V(J_m+1, \rho_m)|S_m))\, P(\tau_m, J_m, \rho_m) & \text{if } J_m \in \{1, ..., \bar{J}\} \\ G(V(\bar{J}, \rho_m)|S_m) & \text{if } J_m > \bar{J} \end{cases} \tag{16}$$

Here we make explicit that both $V()$ and $P()$ depend on $\rho_m$.

In fact the econometrician does not observe $\rho_m$. Therefore the likelihood $L_n$ for a given pair $n$ of markets $m$ and $m'$ integrates over the joint distribution of $\rho_m$ and $\rho_{m'}$:

$$L_n = \int_{\rho_m} \int_{\rho_{m'}} L_m(\rho_m) L_{m'}(\rho_{m'})\, dF(\rho_m, \rho_{m'}|Z_m, Z_{m'})\, d\rho_m d\rho_{m'} \tag{17}$$

where $F()$ is the conditional CDF of the joint distribution of $\rho_m$ and $\rho_{m'}$ . The log likelihood of the data is then the sum of the log of $L_n$ across all pairs.

## 6.2 Demand Model

Index hinterland towns in the ABC data with at least one newspaper of each affiliation available by $t \in \{1, ..., T\}$. We group towns into pairs and assume that the distribution of $\rho_t$ conditional on $Z_t$ follows the same parametric form as it does for markets $m$. We do not constrain the parameters of the distribution of $\rho_t$ to equal those for $\rho_m$. (That is, we allow the analogues of $\sigma_\delta$, $\sigma_\eta$, $\mu_\delta$, and $R$ to differ.)

As with markets, let $J_t$ denote the number of newspapers available in town $t$ and $\tau_t$ denote their affiliations. Let $S_t$ denote town population. We treat $J_t$ as nonstochastic in estimation.

To address the endogeneity of $\tau_t$ with respect to $\rho_t$, we allow that the share of Republican papers in a town is a stochastic function of $\rho_t$. We assume that for each newspaper $j$ available in town $t$:

$$\Pr(\tau_j = R) = \text{logit}^{-1}\left(\mu_\rho^0 + \mu_\rho^1 \text{logit}(\rho_t)\right) \tag{18}$$

We think of this as an econometric approximation to the economic process by which news agents and other

decision-makers decide which newspapers to transport to which towns, a process that we do not model explicitly. The approximation we use allows for a positive correlation between the (unobserved) share of readers who are Republican and the observed share of available newspapers that are Republican.

Let $\hat{Q}_{jt}$ denote the measured circulation of newspaper $j$ in town $t$. We assume that

$$\hat{Q}_{jt} = q_{jt} S_t \zeta_{jt} \tag{19}$$

where $q_{jt}$ is the share of households in town $t$ who purchase newspaper $j$ and $\zeta_{jt}$ is measurement error with $ln\zeta_{jt} \sim N\left(0, \sigma_\zeta\right)$ i.i.d. across newspapers and towns.

In each town, the econometrician is assumed to observe only the difference in mean log circulation between Republican and Democratic newspapers. We impose this restriction because it intrinsically scales out variation in population, which is likely to be poorly measured and therefore a significant source of heterogeneity in observed circulation.

To derive the likelihood function, suppose that the econometrician observed $\rho_t$ in each town. Then the likelihood $L_t\left(\rho_t\right)$ is, up to a constant, given by:

$$L_t\left(\rho_t\right) = \phi\left(\frac{\frac{\sum_j I_{\tau_{jt}=R} ln\left(\hat{Q}_{jt}/q_j\right)}{\sum_j I_{\tau_{jt}=R}} - \frac{\sum_j I_{\tau_{jt}=D} ln\left(\hat{Q}_{jt}/q_j\right)}{\sum_j I_{\tau_{jt}=D}}}{\tilde{\sigma}_{\zeta_t}}\right) exp\left(-\tilde{\sigma}_{\zeta_t}\right) \Pr\left(\tau_t | \rho_t, J_t\right) \tag{20}$$

where $\phi$ denotes the normal PDF and

$$\tilde{\sigma}_{\zeta_t} = \sigma_\zeta \sqrt{\frac{1}{\sum_j I_{\tau_{jt}=R}} + \frac{1}{\sum_j I_{\tau_{jt}=D}}}. \tag{21}$$

In fact the econometrician does not observe $\rho_t$. Therefore the likelihood $L_n$ for a given pair $n$ of towns $t$ and $t'$ integrates over the joint distribution of $\rho_t$ and $\rho_{t'}$ conditional on $Z_t$ and $Z_{t'}$:

The log likelihood of the difference in mean log circulation between Republican and Democratic papers is given by

$$L_n = \int_{\rho_t} \int_{\rho_{t'}} L_t\left(\rho_t\right) L_{t'}\left(\rho_{t'}\right) dF\left(\rho_t, \rho_{t'} | Z_t, Z_{t'}\right) d\rho_t d\rho_{t'} \tag{22}$$

where $F\left(\right)$ is the conditional CDF of the joint distribution of $\rho_t$ and $\rho_{t'}$. The log likelihood of the data is then the sum of the log of $L_n$ across all pairs.

## 6.3 Implementation

### 6.3.1 Calibration of Ancillary Moments

We compute cost and revenue parameters for monopoly newspapers with $Z_t \in [0.45, 0.55]$. We calibrate $a_h$ to the average annual advertising revenue per copy and $MC$ to the average annual variable cost per copy. Annual circulation revenue is typically below posted prices, partly because of discounts to subscribers. We

compute the average discount as the average ratio of subscription price to annual circulation revenue, and apply this discount to all subscription prices to compute the effective price of each newspaper.

### 6.3.2 Pairing of Markets and Towns

Both our supply and demand models exploit spatial correlation in ideology to identify the unobservable component of $\rho$, the share of households that are Republican. This strategy requires that correlation in $\rho$ be the only source of correlation in firms' and households' decisions across markets and towns that are paired together. On the supply side, this means pairing markets that are far enough apart that their newspapers do not compete directly. On the demand side, it means pairing towns that are far enough apart that the same exact newspapers are unlikely to be available in both towns in a pair.

To estimate the supply model, we require that paired markets be between 100 and 400 kilometers apart and located in the same state. Among possible market pairs, we identify the pair with lowest absolute difference in log population, breaking ties randomly. We then remove the matched pair from consideration and find the pair with the next closest population. We repeat this matching process until all pairs are matched.

Figure 1 illustrates the economic logic of our approach to pairing markets. Two counties located $100-400$ kilometers apart have a highly correlated Republican vote share and fraction white. However, due to physical transportation costs, newspapers headquartered in the first county rarely circulate in the second at such distances. Therefore, the correlation in firms' choices across markets located $100-400$ kilometers apart plausibly reflect the response to household characteristics, rather than a direct competitive response to firms in neighboring markets.

We use the same algorithm to pair towns for demand estimation that we use to pair markets for supply estimation. Here, the economic logic is similar: towns at such distances typically have non-overlapping sets of newspapers available. Therefore, at such distances, spatial correlation in households' demand for Republican and Democratic newspapers is likely to reflect unobservable heterogeneity in household ideology rather than, say, unmeasured variation in newspaper quality.

### 6.3.3 Computational Methods

We estimate via two-step maximum likelihood. We first estimate the demand model. We then estimate the supply model taking demand model parameters as given. We compute asymptotic standard errors using a numerical Hessian, adjusting for the use of a two-step procedure following Murphy and Topel (1985).

We approximate the likelihood via sparse grid integration with Gaussian kernel and accuracy 3 (Heiss and Winschel 2008, Skrainka and Judd 2011). In the online appendix, we present estimates of the model in which we reduce and increase the accuracy by 1.

We maximize the likelihood using KNITRO's active-set algorithm for unconstrained problems (Byrd et al. 2006). We use exponential transforms to ensure that all standard deviations are positive so that the likelihood is well-defined. In estimating the demand model, we use an exponential transform to constrain $\Gamma > 0$ (otherwise newspapers are complements). We also constrain parameters so that the predicted price and circulation share of a monopoly newspaper in a market with $\rho = 0.5$ is equal to the sample means for

monopoly markets with $Z_t \in [0.45, 0.55]$.[2]

For demand estimation we choose starting values either at zero or at a value (typically one) reflecting the expected order of magnitude of the parameter. For supply estimation we begin with order-of-magnitude starts, and estimate two sub-models to improve the accuracy of the starting values supplied to the final estimator. The first sub-model is a post-entry version of the model that conditions on the number of newspapers entering each market. The second sub-model is an estimate of the entry game taking the post-entry parameters as given.

Evaluation of the supply model likelihood requires imposing equilibrium in the entry stage, affiliation choice stage, pricing stage, and advertising pricing stage. We provide above an explicit characterization of the equilibrium in the affiliation and advertising pricing stages. For given fixed costs $\kappa$ and variable profit $V()$, the entry stage game admits a unique and explicit solution provided $V()$ is strictly decreasing in the number of entering newspapers. In repeated simulations we find that this property holds for all markets at the estimated parameters. The equilibrium of the pricing game is characterized by a system of first-order conditions, which we solve using MINPACK's (Moré et al. 1980) implementation of Powell's (1970) hybrid method.[3] We choose a starting value close to the observed prices ($4) and verify that the solution is not sensitive to local variation (plus or minus $1 per copy) in the choice of starting value at the estimated parameters.

We set $\bar{J} = 3$ so that we treat affiliations as unobserved in markets with four or more newspapers. Only 8 markets in our data have four or more newspapers.

The online appendix presents Monte Carlo experiments and experiments with random starting values for both the demand and supply steps of the estimation.

# 7 Identification

In this section, we present a heuristic overview of the features of the data that identify the model's parameters. We begin with a heuristic discussion of the role of spatial correlation in identifying the incentive to differentiate. We then turn to a step-by-step discussion of the model stages.

## 7.1 Incentive to Differentiate

It is helpful to begin by considering the following reduced-form approximation of the model. Each market has two newspapers, which we refer to as the Incumbent and the Entrant. Newspapers successively choose affiliations in order of entry. A reduced-form profit function governs the payoff to each newspaper from choosing $R$ relative to the payoff from choosing $D$.

The Entrant's payoff to choosing $R$ is a function of household ideology, the Incumbent's affiliation, and an idiosyncratic shock. The Incumbent's payoff to choosing $R$ is a function of household ideology and an

[2] This constraint implies an explicit (closed form) solution for $\alpha$ and $\underline{\beta}$ as a function of the other parameters that is trivial to compute.

[3] We use the C/C++ implementation of MINPACK distributed by Frédéric Devernay.

idiosyncratic shock. (In the model we estimate, the Incumbent's payoff also incorporates the Incumbent's beliefs about the Entrant's choice of affiliation.)

The econometrician wishes to recover the extent to which the incentive to differentiate drives diversity. The econometrician observes newspapers' affiliations but not household ideology, which may vary across markets.

The incentive to differentiate depends on the Entrant's payoffs. If the Entrant's payoff to $R$ is much greater when the Incumbent chooses $D$, then the incentive to differentiate will play an important role in determining equilibrium diversity. If the Entrant's payoff to $R$ is independent of the Incumbent's choice, then diversity will not depend on competitive forces.

From equilibrium market configurations alone it will be difficult to recover the incentive to differentiate. Consider the data in the first row of table 5, which shows summary statistics on the affiliation choice of second entrants in our data. In markets where the Incumbent is $D$, the Entrant is $R$ about half the time. In markets where the Incumbent is $R$, the Entrant is slightly *more* likely to be $R$.

Based on these data two conclusions are possible. The first is that the incentive to differentiate is weak. The second is that unmeasured variation in household ideology is driving both Incumbent and Entrant affiliations, leading to a slightly positive empirical correlation in affiliations that masks important competitive forces.

One solution to this problem is to condition on observable proxies for household ideology. As table 4 illustrates, that approach will lead to a significantly negative conditional correlation between Incumbent and Entrant affiliations. But, such an approach leaves open the possibility that the observable proxy does not capture all variation in household ideology. If it does not, estimates based on observed configurations will tend to understate the incentive to differentiate.

We will couple an observable measure of household ideology with an additional source of information on the importance of unobservable variation in ideology: the spatial correlation in newspapers' affiliation choices. The second row of table 4 illustrates the logic of this approach. A given Entrant's choice of affiliation is strongly positively correlated with the choice of the Incumbent in a neighboring market. Because we construct pairs to minimize the chance of direct economic competition between neighbors, the natural interpretation of this correlation is that it reflects spatially correlated variation in household ideology.

If household ideology were unobserved but identical across neighboring markets, a fixed effects or differences-in-differences strategy would be sufficient to control for the confounding effect of ideology and recover the incentive to differentiate. Because an Entrant's affiliation choice is more positively correlated with its neighboring Incumbent's affiliation than with its own Incumbent's affiliation, such a fixed effects strategy would show a strong incentive to differentiate.

However, it is unlikely to be appropriate in general to assume that neighboring markets have identical household attributes. Such an assumption would be false for observed characteristics, which are highly, but imperfectly, correlated across neighbors. Instead of assuming perfect correlation of the unobservables, we assume the correlation in unobservables matches that of our observable proxy for ideology. Speaking loosely, this amounts to scaling up the correlation between the Entrant's affiliation and that of the neighboring Incumbent, and subtracting the scaled correlation from the correlation between the Entrant's affiliation

and that of its own Incumbent.

### 7.2 Supply Model

Take the estimated demand system as given. We work backwards through the stages of the game.

Begin with the advertising stage. The parameter $a_l$ governs the extent to which newspapers earn less on overlapping readers than singleton readers. Fixing other parameters, when $\overline{\beta}$ is large enough relative to $\underline{\beta}$, readership overlaps more between two newspapers that have the same affiliation than between two newspapers that have different affiliations. Therefore $a_l$, combined with the parameters of the demand system, determines the incentive to differentiate. Because the demand parameters are given, the parameter $a_l$ can be thought of as identified by the extent to which newspapers differentiate more than would be expected from the demand system alone, i.e. more than would be expected if $a_l = a_h$ and hence newspapers did not compete on advertising.

The incentive to differentiate is, in turn, identified from the assumptions we make about the spatial correlation in the unobservables. These assumptions also identify $\sigma_\delta$ and $\sigma_\eta$, the parameters that govern the extent to which ideology varies across markets conditional on observables.

Move next to the pricing game. Here there are no parameters to estimate: given newspapers' affiliations, the pricing game is fully determined by the demand system. Note that, in this sense, the argument for identification of the advertising stage above is dependent on conduct assumptions for the pricing game.

Consider next the game in which newspapers sequentially choose affiliations. Expected payoffs come from the pricing and advertising stages. The extent of variation $\sigma_\xi$ in cost shocks $\xi$ are identified as an unexplained residual in newspapers' affiliation choices. The mean of the unobservable $\mu_\delta$ is identified from the extent to which newspapers choose to be Republican "too often" given the parameters of the demand system and the observable fraction Republican in the market.

Move next to the entry game. Payoffs to entry as a function of the number of entrants are delivered by the stages above. These payoffs, in turn, identify the fixed cost cutoffs that determine the equilibrium number of entrants. The correlation between the number of newspapers and the market's population, and the extent of variation in the number of newspapers conditional on population, pin down the entry-stage parameters $\mu_\kappa^0$, $\mu_\kappa^1$ and $\sigma_\kappa$ respectively.

Note that, because newspaper fixed costs are increasing in market size (Berry and Waldfogel 2010), we cannot use the homogeneity assumption of Bresnahan and Reiss (1991) to identify the entry cutoffs directly. An important implication is that the identification of the entry stage partly "feeds back" into the identification of the later-stage parameters, which means that later-stage parameters are also influenced by the observed number of entrants and the fit of the entry model.

### 7.3 Demand Model

Suppose that there is no unobservable heterogeneity in town ideology, i.e. that $\sigma_\delta = \sigma_\eta = 0$ for towns. Then, fixing the affiliations of available newspapers, the correlation between the relative demand for Republican newspapers and the observed fraction Republican identifies $\overline{\beta}$ relative to $\underline{\beta}$. Given the relative magnitudes

of these parameters, the share of households reading the newspaper in markets with known ideological composition pins down their absolute value. Given these two parameters, observed monopoly markups with known ideological composition identifies the price sensitivity parameter $\alpha$.

Table 3 shows that, holding constant the observed fraction Republican, Republican newspapers on average get lower circulation in markets with more Republican newspapers available. That fact pins down the extent to which same-affiliation newspapers are substitutable in demand, which in turn identifies the remaining utility parameter $\Gamma$. Given utility parameters, the parameter $\sigma_\zeta$ , which governs the importance of measurement error in circulation, is identified as the variance of residual circulation.

The relationship between the share of a town's available newspapers and the observed share Republican then identifies the parameters $\mu_\rho^0$ and $\mu_\rho^1$.

The preceding argument presumes that the econometrician perfectly observes the share of Republican households in each market. In practice there is likely to be some unmeasured heterogeneity in household ideology. Markets with more Republican households will tend to have more Republican newspapers available, which means that a naive estimator will tend to understate both the difference between $\overline{\beta}$ and $\underline{\beta}$ and the extent of substitution $\Gamma$.

We address this issue by exploiting the spatial correlation in circulation, in a manner similar to that outlined in section 7.1 above. To the extent that the relative circulation in a given town is positively correlated with the number of Republican newspapers available in a neighboring town (or with the circulation patterns in the neighboring town), we interpret that as evidence of correlated heterogeneity in household ideology. Spatial covariance patterns then identify $\sigma_\delta$ and $\sigma_\eta$, as in the supply model.

For this strategy to make sense, it is important that paired towns be far enough away that there is little direct economic interaction in their news markets. Otherwise, unmeasured correlation in, say, newspaper quality could lead us to overstate the importance of unobservables on the demand side.

# 8 Model Estimates and Counterfactual Simulations

## 8.1 Model Estimates

Table 6 reports estimates of demand model parameters. The qualitative patterns are consistent with our economic intuition and with the descriptive evidence in table 3. Households prefer newspapers whose affiliations match their own. Same-type newspapers are substitutes in demand. There is unobservable heterogeneity in household ideology across towns, which in turn is correlated with the fraction of available newspapers that are Republican.

Table 7 reports estimates of supply model parameters. Consistent with our economic model we find that advertising rates are lower for overlapping readers than for singleton readers. As on the demand side, we find evidence of unobservable heterogeneity across markets in household ideology.

Our model implies that the average newspaper receives \$6 of circulation revenue and \$11 of advertising revenue per reader per year (in 1924 dollars). Thus, consistent with contemporaneous evidence, advertising accounts for the majority of revenue. Variable costs are \$8 per reader per year, and so variable profits are roughly \$9 per reader per year. These profits are high, but a good share are dissipated in fixed costs such as

editorial costs.

We estimate that the average newspaper sells 0.32 copies per household each day. Among households whose type is the majority in their market (R households in majority R markets or D households in majority D markets), this ratio rises to 0.35. For households whose political type is the minority in their market (D households in majority R markets or R households in majority D markets), the ratio falls to 0.27. Consistent with our reduced-form evidence, the match between a paper's affiliation and their consumers' ideology is an important determinant of newspaper demand.

In the online appendix, we present estimates of the main regression specifications in tables 3 and 4 using data simulated from the model at the estimated parameters. These regressions show that the estimated model fits key features of the data well.

## 8.2 Determinants of Equilibrium Diversity

Table 8 assesses how market forces determine the extent of political diversity in equilibrium. For our baseline model and a series of counter-factual models we perform 5 independent simulations of the affiliation choices of all newspapers in our empirical sample. We report the average across simulations of the share of multi-paper markets that are diverse. We define a newspaper market to be diverse if it has at least one Republican paper and one Democratic paper. At the estimated parameters, the model predicts that 58 percent of multi-paper markets are diverse.

In our first counterfactual, we assume that each entering newspaper chooses its affiliation as if it expected to be a monopolist in the market. The share of multi-paper markets that are diverse falls by nearly half, to 32 percent. The incentive to differentiate from competing papers is a powerful force encouraging diversity.

In our second counterfactual, we assume that each entering newspaper chooses its affiliation as if its market had equal numbers of R and D type households. The share of multi-paper markets that are diverse rises significantly, to 85 percent. The incentive to cater to households tastes significantly limits diversity.

In our third counterfactual, we assume that each entering firm chooses its affiliation as if $\xi = 0$. The cost shocks $\xi$ are simply a residual in the model, but one can interpret them as capturing the preferences or fixed assets of owners, along with other idiosyncratic factors. Eliminating such factors would reduce the share of multi-paper markets that are diverse from 58 percent to 42 percent: a nontrivial reduction, but not as large as the effect of ignoring competitors or of ignoring household preferences.

In our fourth and final counterfactual, we assume that newspaper owners are randomly chosen from the households in the market and a newspaper's affiliation is simply its owner's affiliation. Under this scenario, the share of multi-paper markets with diverse papers rises slightly from 58 percent to 60 percent. That is, economic forces result in diversity that is comparable to what would be observed if newspaper affiliations were chosen to be representative of households in the local market.

## 8.3 Model Specification and Implications for Diversity

Our model implies an important role for competition in generating ideological diversity in multi-paper markets. Table 9 illustrates the importance of allowing for heterogeneity in household ideology in reaching that

conclusion. The table presents the ratio of the diversity share absent competition (if entering newspapers acted as monopolists) to the diversity share at baseline under four different modeling assumptions.

The first row presents estimates allowing for unobservables. The first column also includes our observable measure of the fraction Republican and is therefore equivalent to the specification reported in table 8. Diversity would decline by about half if newspapers acted as monopolists. The second column shows results from a specification in which we ignore the information contained in our observable measure of the fraction Republican. Strikingly, the estimated effect of competition on diversity is almost unchanged. This is especially noteworthy given the significant power of the observable fraction Republican to predict newspapers' affiliation choices, as illustrated in table 4.

Contrast these findings with those from the second row, where we assume that there is no unobservable variation in the fraction Republican (by setting $\sigma_\delta = \sigma_\eta = 0$). When we include the information contained in observables, the result is similar to our main specification. But when we ignore the information contained in observables, the model returns the answer that competition plays no role in fostering diversity. The finding is intuitive: as in table 4, absent controls for household ideology, there is only a weak empirical correlation between an entering newspaper's affiliation and that of its incumbents. The model interprets this to mean that advertising competition is weak ($a_l$ is near to $a_h$) and hence that newspapers have only a limited incentive to differentiate on ideology.

In a model that assumes no unobservable cross-market heterogeneity in household ideology, counterfactual implications for diversity are highly dependent on the researcher's access to appropriate observable proxies for market ideology. By contrast, exploiting spatial correlation to allow for unobservable heterogeneity in household ideology results in a model that is far more robust to variation in the quality of observable ideology measures.

### 8.4 Policy Simulations

We turn in tables 10 and 11 to simulations of the effect of various government policies. We report the effect of these policies on market structure and diversity in table 10 and on welfare in table 11.

The first three counterfactuals relate to joint operating agreements. These were introduced under the Newspaper Preservation Act of 1970. The Act states its goal as "maintaining a newspaper press editorially and reportorially independent and competitive in all parts of the United States." The act allows newspapers, in essence, to collude on prices and advertising rates provided that they remain editorially independent. These have been allowed selectively in some US cities; in our simulations we assume they are operative everywhere.

We define collusion as setting prices or advertising rates to maximize the joint (total) profits of all entering newspapers. Formally, we define the collusive price of newspaper $j$ as the $j^{th}$ element of the price vector $p^*$ that solves

$$p^* \in \arg\max_p \sum_j \left(p_j + a_j(p) - MC\right) q_j(p) \tag{23}$$

where here we make explicit the dependence of advertising rates and demand on the full vector of prices.

We define the collusive advertising rate of newspaper $j$ as

$$a_j = a_h \left( \frac{1-q_0}{\sum_k q_k} \right) + a_l \left( 1 - \frac{1-q_0}{\sum_k q_k} \right) \tag{24}$$

where $q_0$ is the share of households that read no newspaper. Under collusive advertising, newspapers capture all surplus from both informative and persuasive advertisers, and distribute advertising revenue to each newspaper in proportion to its circulation.[4] Under pricing and advertising collusion, we assume that newspapers continue to make independent (non-collusive) affiliation decisions.

The remaining counterfactuals consider the impact of newspaper subsidies. We first consider the impact of eliminating postal subsidies to newspapers. In 1924, the post office's cost of publication delivery exceeded its revenue by a factor of more than three (Kielbowicz 1994). Assuming these subsidies apply equally to all postal deliveries, we estimate that the marginal cost of the average newspaper would have risen by 15 percent if postage were charged at cost. We next consider a subsidy modeled after the system of newspaper subsidies in Sweden, which favors a local market's "second papers," i.e. papers with lower circulation than the largest paper in the market. We implement the subsidy as a fixed payment to all second entrants equal to 15 percent of pre-subsidy revenue. We choose 15 percent to match the approximate share of second-paper revenue coming from subsidies in Sweden (Gustaffson et al. 2009).

As table 10 shows, joint operating agreements increase equilibrium diversity. This is the result of two countervailing effects. Conditional on the number of firms in the market, joint operating agreements soften the competitive incentive to differentiate and thus make diverse configurations less likely. Thus, the share of two-firm markets with diverse papers falls from 42 percent to 37 percent and the share of markets with three or more firms that are diverse falls from 79 percent to 76 percent. At the same time, joint operating agreements encourage entry and thus increase the number of markets with multiple firms. This was the primary motivation for the Newspaper Preservation Act, and we find this effect is large: the number of markets with two firms increases from 146 to 212 and the number of markets with three or more firms increases from 108 to 258. On net, the effect of increased entry on diversity dominates the effect of decreased differentiation. The share of all markets with at least one newspaper that have diverse papers increases from 15 percent to 28 percent and the share of households living in a market with diverse papers increases from 22 percent to 35 percent.

The table shows that subsidies also increase diversity. Eliminating postal subsidies and adding subsidies for second entrants have small effects on differentiation conditional on market structure but large effects on entry. On net, the share of households in markets with diverse papers falls to 13 percent in the former case, and increases to 28 percent in the latter case.

Table 11 shows that joint operating agreements have a net positive effect on both consumer and producer surplus. Average consumer surplus per household rises from \$3.25 to \$4.45 and average firm profit per household rises from \$0.28 to \$0.41. The somewhat counter-intuitive finding that consumers benefit from collusion results in part from the two-sided nature of the market. Higher advertising rates effectively lower

[4] Under collusion, total advertising revenue across all newspapers is given by $a_I(1-q_0) + \sum_k q_k s_P a_P$. That is, each informative advertiser pays $a_I$ for each household that reads at least one newspaper, and each persuasive advertiser pays $a_P$ for each impression.

marginal cost and so lead firms to lower their prices. Thus, average prices actually fall under joint operating agreements from \$6.26 to \$5.98. Consumers also benefit from increased entry. Note that this does not mean that joint operating agreements are Pareto improving, since our calculations ignore the welfare of advertisers.

The table shows that subsidies also increase consumer surplus. Firm surplus falls due to increased entry. Note, however, that in the case of the second-entrant subsidy the firm surplus numbers do not include the value of the subsidy itself.

# 9 Conclusions

We estimate a model of newspaper partisanship in which partisanship affects household demand and is treated as a strategic decision by entering newspapers. We find evidence that partisanship influences the composition of readership and that it affects patterns of substitution among competing papers. We find, in turn, that entering newspapers take competitors' partisan affiliations into account when choosing their own. The model implies that competition is a crucial determinant of ideological diversity in media markets, and permits simulation of a number of counterfactual experiments that are relevant to contemporary policy debates.

**Table 1:** Summary Statistics: Newspaper Markets

| Number of Newspapers | 0 | 1 | 2 | 3+ | All |
|---|---|---|---|---|---|
| Mean population | 5944 | 10688 | 24049 | 36832 | 10943 |
| Share of newspapers that are Republican | | .60 | .50 | .68 | .57 |
| Share of multi-paper markets that are diverse | | | .53 | .61 | .54 |
| Republican vote share | | | | | |
| Mean | .52 | .51 | .50 | .55 | .51 |
| Standard deviation | .15 | .15 | .12 | .09 | .15 |
| Number of markets | 960 | 612 | 297 | 41 | 1910 |
| Number of newspapers | 0 | 612 | 594 | 132 | 1338 |

Notes: Data are from cross-section of markets. Diverse markets are those with at least one Republican and at least one Democratic newspaper. Republican vote share is the average Republican share of the two-party vote in presidential elections from 1868-1928.

**Table 2:** Summary Statistics: Towns with Circulation Data

| Number of Circulating Newspapers | 1 | 2 | 3+ | All |
|---|---|---|---|---|
| Mean population | 450 | 389 | 580 | 477 |
| Share of newspapers that are Republican | .52 | .54 | .57 | .55 |
| Share of multi-paper towns that are diverse | | .38 | .67 | .53 |
| Republican vote share | | | | |
| Mean | .49 | .51 | .54 | .51 |
| Standard deviation | .16 | .16 | .15 | .16 |
| Number of towns | 4146 | 3737 | 4315 | 12198 |
| Number of newspaper-towns | 4146 | 7474 | 17221 | 28841 |

Notes: Data are from towns with circulation data. Diverse towns are those with at least one Republican and at least one Democratic newspaper. Republican vote share is the average Republican share of the two-party vote in presidential elections from 1868-1928.

**Table 3:** Demand for Partisanship

Dependent variable: Average log(circulation) of Republican papers - Average log(circulation) of Democratic papers

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Republican vote share | 0.8634 | | 0.9702 | |
| | (0.1913) | | (0.1984) | |
| Number of Republican papers | | -0.0217 | -0.0395 | -0.1330 |
| | | (0.0135) | (0.0137) | (0.0210) |
| Number of Democratic papers | | 0.0054 | 0.0159 | 0.1109 |
| | | (0.0145) | (0.0147) | (0.0262) |
| County fixed effects? | | | | X |
| R2 | 0.0104 | 0.0009 | 0.0133 | 0.5685 |
| Number of counties | 1215 | 1215 | 1215 | 1215 |
| Number of towns | 4287 | 4287 | 4287 | 4287 |

Notes: Data are from demand estimation sample. Models are OLS regressions. The dependent variable in each column is the difference in mean log circulation of Republican and Democrat newspapers. Republican vote share is the average Republican share of the two-party vote in presidential elections from 1868-1928. Standard errors in parentheses are clustered at the county level.

**Table 4:** Determinants of Newspaper Affiliation

Dependent variable: Dummy for newspaper choosing Republican affiliation

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Republican vote share | 2.1824 | | 2.3350 | |
| | (0.0557) | | (0.0611) | |
| Number of Republican papers | | -0.0145 | -0.1483 | -0.3931 |
| | | (0.0310) | (0.0332) | (0.0698) |
| Number of Democratic papers | | -0.0168 | 0.1308 | 0.5260 |
| | | (0.0380) | (0.0304) | (0.0755) |
| Market fixed effects? | | | | X |
| R2 | 0.3561 | 0.0003 | 0.3816 | 0.8384 |
| Number of markets | 950 | 950 | 950 | 950 |
| Number of newspapers | 1338 | 1338 | 1338 | 1338 |

Notes: Data are from supply estimation sample. Models are OLS regressions. Republican vote share is the average Republican share of the two-party vote in presidential elections from 1868-1928. The number of Republican and Democratic paper variables report the number of incumbent papers of each type at the time each paper enters. Standard errors in parentheses are clustered at the market level.

**Table 5:** Affiliation Choices in Own and Neighboring Markets

Share of second entrants choosing Republican affiliation

| | Incumbent Affiliation | |
|---|---|---|
| | Democratic | Republican |
| Incumbent Market: | | |
| Own | .50 | .53 |
| Neighbor | .33 | .66 |
| Number of markets | 269 | |

Notes: Data are from supply estimation sample and include all markets with at least two newspapers in which the neighboring market has at least one newspaper.

**Table 6:** Parameter Estimates: Demand Model

| | |
|---|---|
| Price coefficient ($\alpha$) | 0.1802 |
| | (0.0025) |
| Mean utility for different-affiliation paper ($\underline{\beta}$) | -0.1886 |
| | (0.0599) |
| Mean utility for same-affiliation paper ($\overline{\beta}$) | 0.7639 |
| | (0.0671) |
| Substitutability between same-type papers ($\Gamma$) | 0.2438 |
| | (0.0566) |
| Standard deviation of log-measurement error ($\sigma_q$) | 0.6995 |
| | (0.0077) |
| Mean of unobservable shifter of fraction Republican ($\mu_\delta$) | 0.0945 |
| | (0.0550) |
| Standard deviation of unobservable ($\sqrt{\sigma_\delta^2 + \sigma_\eta^2}$) | 0.2829 |
| | (0.0133) |
| Parameters governing share of town's newspapers that are Republican | |
| $\mu_\rho^0$ | -0.1680 |
| | (0.1107) |
| $\mu_\rho^1$ | 2.0006 |
| | (0.0338) |
| Calibrated parameters: | |
| Marginal cost ($MC$) | 8.1749 |
| Spatial correlation of unobservable ($R \equiv \frac{\sigma_\delta^2}{\sigma_\delta^2+\sigma_\eta^2}$) | 0.7229 |
| Number of Unique Towns | 12198 |
| Number of Unique Newspapers | 669 |
| Number of Newspaper-Towns | 28841 |

Notes: Table shows the estimated parameters of the demand model with asymptotic standard errors in parentheses.

**Table 7:** Parameter Estimates: Supply Model

| | |
|---|---|
| Advertising revenue per reader of non-singleton bundles ($a_l$) | 6.3598 |
| | (0.9195) |
| Standard deviation of affiliation cost shocks ($\sigma_\xi$) | 0.1976 |
| | (0.0260) |
| Mean of unobservable shifter of fraction Republican ($\mu_\delta$) | -0.0186 |
| | (0.0178) |
| Standard deviation of unobservable ($\sqrt{\sigma_\delta^2 + \sigma_\eta^2}$) | 0.0863 |
| | (0.1038) |
| Parameters governing the distribution of fixed costs | |
| $\mu_\kappa^0$ | 8.4314 |
| | (0.4604) |
| $\mu_\kappa^1$ | -0.6170 |
| | (0.0592) |
| $\sigma_\kappa$ | 0.3456 |
| | (0.0330) |
| Calibrated parameters: | |
| Advertising revenue per reader of singleton bundles ($a_h$) | 13.2811 |
| Spatial correlation of unobservable ($R \equiv \frac{\sigma_\delta^2}{\sigma_\delta^2+\sigma_\eta^2}$) | 0.7217 |
| Number of Markets | 1910 |
| Number of Newspapers | 1338 |

Notes: Table shows the estimated parameters of the supply model. The supply model is estimated taking the demand model parameters as given. Asymptotic standard errors in parentheses adjust for the two-step estimation procedure. The advertising rate $a_h$ is calibrated as described in section 6.3.1.

**Table 8:** Equilibrium Determinants of Diversity

| | Share of multi-paper markets that are diverse |
|---|---|
| Baseline | 0.58 |
| When choosing affiliation, newspapers: | |
| Ignore competitors' choices | 0.32 |
| Ignore household ideology | 0.85 |
| Ignore idiosyncratic cost shocks ($\xi$) | 0.42 |
| Owners chosen at random from local households and newspaper type equals owner type | 0.60 |

Notes: Table shows averages over 5 counterfactual simulations using the model estimates reported in tables 6 and 7. We define a market to have diverse papers if there is at least one Republican-affiliated paper and one Democrat-affiliated paper in this market. Counterfactuals are defined as follows. "Ignore competitors' choices" means that each entering newspaper chooses its affiliation as if it will be the only newspaper in the market. "Ignore household ideology" means that each entering newspaper chooses its affiliation as if exactly one-half of households are Republican ($\rho = 0.5$). "Ignore idiosyncratic cost shocks" means that each entering newspaper chooses its affiliation as if $\xi = 0$. "Owners chosen at random" means that a newspaper's affiliation is a random draw from the affiliations of households in its market. Number of newspapers is fixed at the value in the baseline simulation for all counterfactuals. Markets simulated to have five or more newspapers are treated as having five newspapers.

**Table 9:** Model Specification and Implications for Diversity

Share of ideological diversity that would persist if newspapers ignored competitors' choices

| | | Include observable fraction Republican | |
|---|---|---|---|
| | | Yes | No |
| Include unobservable | Yes | 0.54 | 0.55 |
| fraction Republican | No | 0.56 | 0.98 |

Notes: Table shows results from simulations using various estimates of the supply model, taking as given the demand estimates from table 6. We define a market to have diverse papers if there is at least one Republican-affiliated paper and one Democrat-affiliated paper in this market. In each case we report the ratio of the fraction of diverse markets under the "ignore competitors' choices" counterfactual to the fraction at baseline. "Ignore competitors' choices" means that each entering newspaper chooses its affiliation as if it will be the only newspaper in the market. Including unobservables and observables yields the model estimates reported in table 7. "No unobservables" uses estimates from a constrained version of the model in which there is no unobservable heterogeneity in household ideology ($\sigma_\delta = \sigma_\eta = 0$). "No observables" uses estimates from a version of the model in which we assume that all markets have measured fraction Republican $Z_m = 0.5$. Markets simulated to have five or more newspapers are treated as having five newspapers.

**Table 10:** Government Policy and Diversity

| Markets with: | 0 Firm (#) | 1 Firm (#) | 2 Firms (#) | 2 Firms (% Diverse) | 3+ Firms (#) | 3+ Firms (% Diverse) | All Mkts with Newspapers (% Diverse) | Share of Hhlds in Market with Diverse Papers |
|---|---|---|---|---|---|---|---|---|
| Baseline | 949 | 707 | 146 | 0.42 | 108 | 0.79 | 0.15 | 0.22 |
| Collusion | | | | | | | | |
| Pricing only | 949 | 683 | 145 | 0.37 | 132 | 0.76 | 0.16 | 0.23 |
| Advertising only | 949 | 497 | 215 | 0.38 | 248 | 0.78 | 0.29 | 0.35 |
| Joint operating agreements | 949 | 490 | 212 | 0.37 | 258 | 0.76 | 0.28 | 0.35 |
| Subsidies | | | | | | | | |
| Eliminate postal subsidy | 1383 | 392 | 78 | 0.40 | 56 | 0.76 | 0.14 | 0.13 |
| Subsidy for second entrant | 949 | 583 | 239 | 0.42 | 139 | 0.77 | 0.21 | 0.28 |

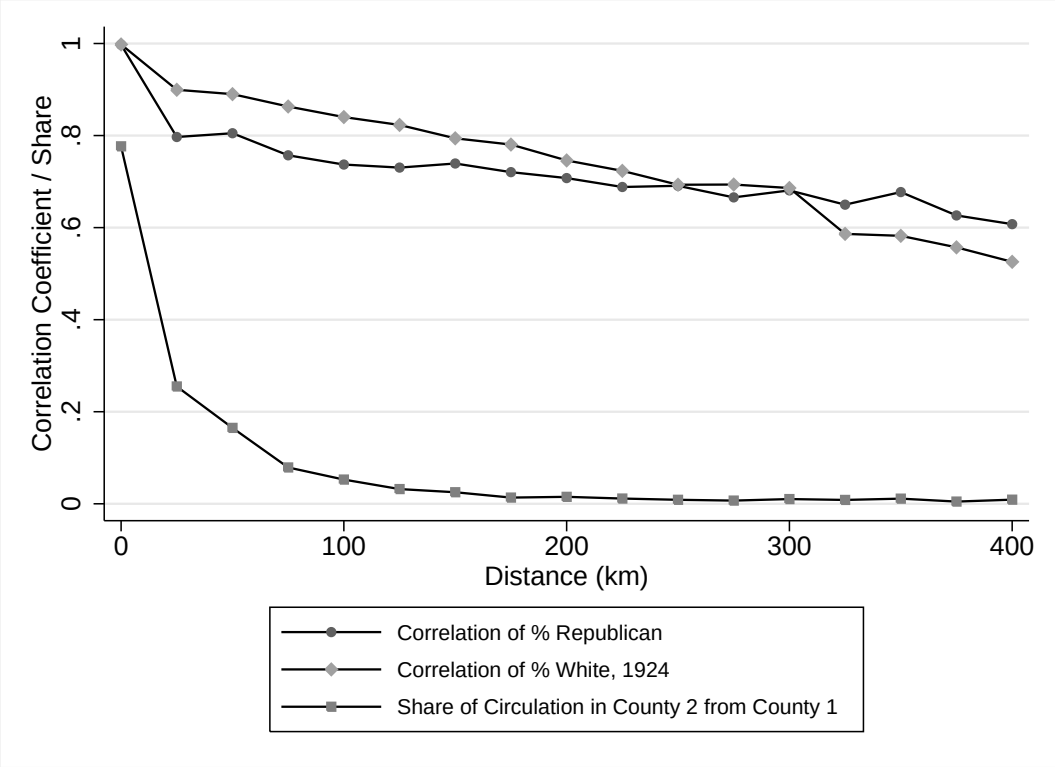
Notes: Table shows averages over 5 counterfactual simulations using the model estimates reported in tables 6 and 7. We define a market to have diverse papers if there is at least one Republican-affiliated paper and one Democrat-affiliated paper in this market. Collusion is defined as setting prices or ad rates to maximize the joint (total) profits of all entering newspapers. Markets simulated to have five or more newspapers are treated as having five newspapers.

**Table 11:** Government Policy and Welfare

| | Average Price in Multi-Firm Markets | Average Ad Revenue in Multi-Firm Markets | Total Cons. Surplus (per Household) | Total Firm Profit (per Household) |
|---|---|---|---|---|
| | | *(All values are in 1924 dollars)* | | |
| Baseline | 6.26 | 10.33 | 3.25 | 0.28 |
| Collusion | | | | |
| Pricing only | 7.94 | 10.71 | 2.86 | 0.29 |
| Advertising only | 5.55 | 11.39 | 4.65 | 0.37 |
| Joint operating agreements | 5.98 | 11.44 | 4.45 | 0.41 |
| Subsidies | | | | |
| Eliminate postal subsidy | 6.96 | 10.55 | 2.02 | 0.15 |
| Subsidy for second entrant | 6.18 | 10.45 | 3.53 | 0.10 |

Notes: Table shows averages over 5 counterfactual simulations using the model estimates reported in tables 6 and 7. We define a market to have diverse papers if there is at least one Republican-affiliated paper and one Democrat-affiliated paper in this market. Collusion is defined as setting prices or ad rates to maximize the joint (total) profits of all entering newspapers. Markets simulated to have five or more newspapers are treated as having five newspapers.

**Figure 1:** Spatial Decay in Newspaper Shipments and Demographic Correlations




Notes: The first two lines show the correlation coefficient of fraction Republican and fraction white for counties located in the same state, at different centroid distances. Republican vote share is the average Republican share of the two-party vote in presidential elections from 1868-1928. The third line shows the share of newspaper circulation in county 2 accounted for by newspapers headquartered in county 1, for counties located at different centroid distances. Only counties containing at least one sample market are included.

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# Appendices

## A Robustness

In appendix table 1, we show how our key results vary with alternative values of the calibrated parameters. The columns of the table show (1) share of multi-paper markets that are diverse in our baseline model, (2) share of multi-paper markets that are diverse when firms ignore their competitors, (3) share of all markets that are diverse in our baseline model, and (4) share of all markets that are diverse when firms form joint operating agreements.

The first row of the table repeats the results from our main specifications for reference.

The second row of the table increases marginal cost by 10 percent.

The third row of the table decreases marginal cost by 10 percent.

**Appendix Table 1:** Robustness checks

| | % of multi-paper markets w/ diverse papers | | % of news markets w/ diverse papers | |
|---|---|---|---|---|
| | Baseline | Firms ignore competitors | Baseline | JOAs |
| Preferred estimate | 0.58 | 0.32 | 0.15 | 0.28 |
| Increase marginal cost by 10% | 0.58 | 0.31 | 0.15 | 0.29 |
| Decrease marginal cost by 10% | 0.58 | 0.31 | 0.15 | 0.28 |

Notes: See appendix A for details.