NBER WORKING PAPER SERIES

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Working Paper 18234
http://www.nber.org/papers/w18234

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
July 2012

We are grateful to Alan Bester, Tim Conley, Christian Hansen, Kevin Murphy, E. Glen Weyl, and numerous seminar participants for advice and suggestions, and to our dedicated research assistants for important contributions to this project. This research was funded in part by the Initiative on Global Markets, the George J. Stigler Center for the Study of the Economy and the State, the Ewing Marion Kauffman Foundation, the Centel Foundation / Robert P. Reuss Faculty Research Fund, the Neubauer Family Foundation and the Kathryn C. Gould Research Fund, all at the University of Chicago Booth School of Business, the Social Sciences and Humanities Research Council of Canada, and the National Science Foundation. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

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NBER Working Paper No. 18234
July 2012
JEL No. L11,L52,L82

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.

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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: relaxation of antitrust rules, limits on joint ownership, and explicit subsidies. 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). 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).

In this paper, we study the economic forces that determine equilibrium ideological diversity in newspaper markets. We formulate a model of entry and product positioning, with competition for both consumers and advertisers. We present 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 use the estimated model to decompose the incentives that affect equilibrium 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. 2011), 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 markets remain fiercely competitive today, few afford researchers a large cross-section of experiments that can be used to study competitive interactions.

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 substi-

tutable than newspapers with different affiliations. The model allows 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.

We begin with descriptive evidence on the determinants of newspapers' affiliation choices. Circulation data show that consumers have a strong taste for newspapers whose ideology matches their own. 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. Circulation data also show that newspapers with the same affiliation are closer substitutes than newspapers with different affiliations. 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 newspapers, for the town's overall taste for news, and for non-political attributes of both newspapers and towns.

In the context of our model, these features of consumer demand should induce newspapers to match the tastes of local consumers and to differentiate from their competitors. Our raw data provide evidence of both patterns. 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 estimated model fits these descriptive patterns well.

We use the estimated model to measure the importance of competitive forces relative to other incentives in shaping the ideological diversity of the news market. We measure diversity by the number of markets with at least one newspaper affiliated with each party, the proportion of households living in diverse markets, and the share of households reading at least one newspaper affiliated with each party. We find that the incentive to differentiate from competitors in order to attract more readers and soften price and advertising competition (Mullainathan and Shleifer 2005) increases diversity significantly, offsetting a strong incentive to cater to the tastes of majority consumers (George and Waldfogel 2003). The net effect of these opposing forces is that equilibrium diversity is nearly as large as it would be if newspapers' affiliations were chosen to be representative of those of the local population.

Next, we compare the market outcomes to those that would be chosen by a social planner maximizing economic welfare, but ignoring any externalities from diversity. Relative to the social planner benchmark, market entry is inefficiently low, market prices are inefficiently high, and the market incentive to differentiate

politically from competitors is inefficiently weak. Thus, there is no conflict between the policy goals of maximizing economic welfare and preserving diversity in the marketplace of ideas. Policies aimed at the latter goal are likely to also be beneficial from the perspective of the former.

The first policy we evaluate is relaxation of antitrust rules. Allowing firms to set circulation prices jointly has negative effects on economic welfare and mixed effects on diversity. Prices in multi-paper markets rise by a fourth, readership falls significantly, and entry increases only slightly. Softer price competition reduces the incentive to differentiate. Losses to consumer surplus and advertiser profit are only partly offset by a small gain in firm profit, and the share of households who read diverse papers falls by roughly a fourth.

Allowing firms to set advertising prices jointly has a very different effect, increasing both economic welfare and diversity. Advertising prices rise, but circulation prices fall, as higher advertising revenue effectively reduces marginal costs. Entry increases dramatically. The incentive to differentiate from competitors weakens, but only slightly. Consumer surplus increases by almost half, significant profit is transferred from advertisers to firms, and the share of households who read diverse papers more than doubles.

When firms are allowed to form "joint operating agreements" in which they set both circulation and advertising prices jointly, as has been permitted selectively under US law since the Newspaper Preservation Act of 1970, the advertising effect dominates, and both economic surplus and diversity increase.

The second policy we consider is regulation of joint ownership. In our model, allowing the potential entrants in a market to be co-owned has three effects. First, it allows newspapers to jointly set circulation and advertising prices. Second, it allows newspapers to internalize business-stealing effects of their entry and affiliation decisions. Third, it subjects newspapers to a common, rather than independent, shock to their cost of choosing different affiliations. We find that the net effect of joint ownership significantly reduces firm entry, which in turn reduces both economic welfare and diversity.

The final policies we consider are explicit subsidies. Motivated by the structure of existing policies, we consider two types of subsidies: a fixed cost subsidy to second entrants (similar to a policy currently in force in Sweden), and a marginal cost subsidy to all newspapers (similar to postal subsidies which were long provided to US newspapers). For each type of subsidy, we compute the magnitude of subsidy that maximizes total surplus. We find that both types of subsidies can increase economic welfare and diversity. The marginal cost subsidy in particular produces the same benefits as allowing advertising collusion, and among the policies we consider it is the most effective at increasing both economic welfare and ideological diversity.

Our work builds on other 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.

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.

Topically, 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. 2011), and that in most times and places incumbent parties exert at most a limited influence on newspapers' political affiliations (Gentzkow et al. 2012). We note, however, that Petrova (2011) 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 lays out the logic of our strategy for estimating the incentive to differentiate in the presence of unobserved consumer heterogeneity. Section 7 details our econometric assumptions and explains how we implement our estimator. Section 8 discusses model identification. Section 9 presents estimates and counterfactual simulations. Section 10 concludes.

2 Data

2.1 Cross-section of Daily Newspaper Markets

We construct a cross-section of daily newspaper markets as of 1924 that serves as the basis of our analysis of newspapers' entry and affiliation decisions.

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.* In appendix C we present an analysis of the sensitivity of our findings to tightening the population bounds for the sample and to excluding markets close to very large cities.

We take data on daily newspapers from the US Newspaper Panel introduced in Gentzkow et al. (2011). 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. (2011) 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 from our sample 142 newspapers whose only affiliation is Independent and 36 newspapers that never declare an affiliation of any kind. In appendix C we present results for the subsample of markets that do not contain an independent newspaper in 1924 and the subsample that do not contain an unaffiliated newspaper in 1924.

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. (2011). 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. In appendix C we present results excluding markets in the South, where the Democrats were dominant.

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.

As we detail below, formal estimation of our model requires identifying pairs of geographically proximate markets. We construct such pairs as follows. We identify all pairs of markets in which both markets are located in the same state and are between 100 and 400 kilometers apart. Among all such 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.

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. As far as we know this is the first effort to digitize a full ABC newspaper 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 compute total circulation by town across all editions of the same paper and average circulation by town across all 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. Not all newspapers are represented in the ABC data. In appendix C we present results excluding towns for which newspapers headquartered nearby are not represented in the data. We also present results from a sample that includes towns that are themselves the headquarters of a daily newspaper.

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. 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.

As we detail below, formal estimation of our model requires identifying pairs of geographically proximate towns. We construct such pairs using the same algorithm that we use to construct pairs of markets (see section 2.1).

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 Affiliations

The median newspaper in our 1924 cross-section entered its market prior to 1896. At that time it was common for newspapers to choose an explicit affiliation with either the Democratic or the Republican party (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 was a strong predictor of its political content. This is suggested by pronouncements of the papers themselves. 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). Content differences are documented in Hamilton (2006), Gentzkow et al. (2006), Kaplan (2002), and Summers (1994) among other studies. Quantitative content analysis on our newspaper panel reported in Gentzkow et al. (2011) shows that Republican presidential candidates are mentioned relatively more frequently in Republican papers.

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).

We will model a newspaper's political affiliation as a fixed, binary characteristic. This decision is motivated, first, by evidence suggesting that papers of the same affiliation were relatively homogeneous in their content, hewing closely to the party line. Newspaper proprietor Horace Greeley writes in his autobiography: "A Democratic, Whig, or Republican journal is generally expected to praise or blame, like or dislike, eulogize or condemn, in precise accordance with the views and interest of its party" (1872, 137). According to Kaplan (2002), "In professing allegiance to a party, the Detroit press assumed specific obligations. The individual journal was the organ of the political community, and commissioned with the task of expressing the group's ideas and its interests" (23). In the rare event that a newspaper deviated from the party line, they could be severely punished.[1] Consistent with this narrative evidence, Gentzkow et al. (2011) show that the political orientation of voters strongly predicts the affiliations of local papers, but is only weakly correlated with their content conditional on affiliation.

[1] Kaplan (2002, 58-61) discusses the case of the Democratic *Detroit Free Press*, which in 1872 refused to endorse Horace Greeley, the Democratic nominee for the presidency. The paper was widely criticized by party leaders, loyal partisan readers, and competitors. "Influential Democrats" threatened to start a competing Democratic paper in response. Ultimately, the rebellious owners of the *Free Press* were bought out by loyal interests, and the paper switched to supporting Greeley.

Our modeling of affiliation is also supported by evidence suggesting that papers that declare an affiliation but later switch to become Independent are not noticeably less partisan in their content than papers which retain their party affiliation. Gentzkow et al. (2011) show that differences in Republican candidate mentions between originally Republican and originally Democratic papers is similar whether or not their current affiliation is Independent.

Finally, our assumption is motivated by the fact that the group of newspapers that never declare a Republican or Democratic affiliation includes many specialized commercial papers (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. In appendix C we show that our results are robust to excluding markets with such Independent papers from our sample.

Although this evidence suggests that the assumption of binary types is reasonable, it is nevertheless an approximation. The historical record provides examples of content differences among papers of the same affiliation, particularly on issues where disagreements between factions within the party were significant (Summers 1994, 43-58). In the online appendix, we present evidence on the extent to which newspapers of a given affiliation adjust their content in response to changes in consumer preferences or the competitive landscape. There is qualitative evidence consistent with such adjustment, but the precision of the exercise is limited. To the extent that our binary affiliations are a coarse summary of a more continuous space of political content, caution is needed in linking our results to effects on underlying content. Our results capture diversity at the level of party affiliations, not intra-party factions or shadings.

We will not explicitly model the non-political attributes, such as time of day or quality, that Scripps identifies as important dimensions of differentiation. Consistent with Scripps' prediction, among newspapers in two-paper markets in our data, the majority of those that have the same affiliation publish at different times of day, and the majority of those that have different affiliations publish at the same time of day. Our model of affiliation choices should therefore be thought of as taking as given newspapers' opportunity to differentiate optimally on non-political dimensions given their political affiliations.

4 Model

4.1 Overview

We consider a cross-section of markets, each of which has $\bar{J}$ 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, and an advertising price a_j. We denote the vectors of types and circulation prices chosen by all entering newspapers by τ 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 ρ and assume that ρ 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 κ 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 ξ_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 θ.

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 Γ for every pair of newspapers with the same affiliation and by α 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. In appendix C we present results from a demand model with a richer specification of substitution patterns and from a model in which we allow utility to depend on distance to the newspaper's home market.

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

θ 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

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

We let $q_0(\theta)$ denote the share of households purchasing no newspaper.

4.3 Advertising Prices

There exists a unit mass of potential advertisers. If a household sees an advertiser's advertisement in k different newspapers, the advertiser receives a benefit of $a_h + (k-1)a_l$, where $0 \leq a_l \leq a_h$. If $a_l = a_h$, an advertiser's payoff is proportional to the number of impressions its advertising receives. If $a_l < a_h$, the model exhibits diminishing returns beyond the first impression. If $a_l = 0$, an advertiser cares only about whether or not a household is reached by its advertisement. The difference between a_l and a_h therefore captures the extent of diminishing returns in advertising impressions.

After circulation prices are chosen, each newspaper simultaneously declares an advertising price. After advertising prices are posted, each advertiser simultaneously decides whether or not to advertise in each newspaper.

Denote the share of firm $j's$ readers who read only newspaper j by ψ_j. In any pure strategy equilibrium, all advertisers advertise in all newspapers. Newspaper $j's$ equilibrium advertising price per reader, a_j, is given by

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

Each newspaper charges advertisers for the incremental value of the impressions it delivers (Armstrong 2002, Anderson et al. 2011). Because of diminishing returns in the value of impressions, a newspaper's advertising revenue per reader is increasing in the fraction of its readers who read it exclusively.

4.4 Circulation Prices

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

$$p_j^* \in \arg\max_{p_j} (p_j + a_j(p_j, p_{\sim j}) - MC) q_j(p_j, p_{\sim j}). \tag{7}$$

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 τ_{j^-} and τ_{j^+} denote vectors of affiliations of newspapers with indices less than and greater than j, respectively. Newspaper j's expected variable profit upon choosing τ_j is:

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

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 τ^* such that each τ_j^* satisfies:

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

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 τ_{j^-}, newspaper j chooses affiliation τ_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 τ 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

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

Here, the conditional expectation $\mathrm{E}\left(\left(v_j - \xi_j(\tau_j)\right)|\tau\right)$ 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,

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

for $J^* \in \left\{2,...,\overline{J}-1\right\}$. If $V(1) < \frac{\kappa}{S}$ then $J^* = 0$ is an equilibrium, and if $V\left(\overline{J}\right) > \frac{\kappa}{S}$ then $J^* = \overline{J}$ is an equilibrium.

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 ρ, 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 ρ, S, and (possibly town-specific) fixed and variable costs of transportation. We do not explicitly model this function, but control for the endogeneity of affiliations flexibly in estimation.

5 Descriptive Evidence

Before turning to formal estimation, we present descriptive evidence 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) includes fixed effects for the exact number of Republican and Democratic papers available in the town to control carefully for the configuration of the choice set. Specification (5) includes 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.

The two effects illustrated by specification (3) are robust to a number of alternative specifications. Specification (4) shows that the effect of household ideology is present when we control carefully for the configuration of the choice set. Specification (5) shows that using county fixed effects to control carefully for household characteristics further increases the estimated substitution effects, confirming that unobserved heterogeneity in household ideology likely leads us to underestimate the importance of substitution effects. In the online appendix, we show that both the effect of household ideology and the effect of substitutes are robust to a specification with both newspaper and town fixed 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.

Figure 1 illustrates the key patterns in specification (3) of table 3 graphically. The relative readership of Republican papers is increasing in the Republican vote share. In addition, for any vote share, the average Republican paper garners more readership when the majority of its competitors are Democratic.

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.

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.

The two effects illustrated by specification (3) of table 4 are robust to a number of alternative specifications. In appendix A we exploit the panel nature of our data to show that the correlation between household ideology and newspaper affiliation decisions is not driven by reverse causality from newspaper content to voter behavior, and to perform additional sensitivity analysis.

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.

Figure 2 illustrates the key patterns in specification (3) of table 4 graphically. Panel A shows that the probability of the first entrant choosing a Republican affiliation is increasing in the Republican vote share in the market. Panel B shows that the probability of the second entrant choosing a Republican affiliation is increasing in the Republican vote share and is lower when the first entrant's affiliation is Republican.

6 Estimating the Incentive to Differentiate

The preceding section shows that newspapers strategically choose affiliations to match consumer ideology but avoid competitor positions. If an econometrician fails to observe consumer ideology, these forces oppose one another and lead to an underestimate of the strength of the incentive to differentiate.

To see this, consider the following reduced-form approximation of our economic 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 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 5 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. A 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.

The logic of our approach rests crucially on the assumption that spatial correlation in affiliation choices reflects correlation in household ideology rather than competitive interactions among spatially proximate newspapers. We minimize such interactions by requiring that paired markets be between 100 and 400 kilometers apart. Figure 3 illustrates. 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.[2]

[2]Common ownership of newspapers in different markets is another possible source of correlation. In appendix C we show that removing the small number of market pairs with common ownership makes little difference to our results.

7 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.

7.1 Supply Model

Index markets by $m \in \{1,...,M\}$. Our identification strategy will exploit spatial correlation of ρ_m across markets. We assume that each market is paired with a single neighboring market and that ρ_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 ρ_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 μ_δ and variance σ_δ^2. Let η_m be a market-specific unobservable distributed i.i.d. normally across markets with mean 0 and variance σ_η^2. The distributions of $\delta_{n(m)}$ and η_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:

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

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

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

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

i.e. that $\frac{\kappa_m}{S_m}$ is distributed logistic with mean $\mu_\kappa^0 + \mu_\kappa^1 \log(S_m)$ and dispersion parameter σ_κ. In appendix C we present results from a specification that adds greater flexibility to the dependence of $\frac{\kappa_m}{S_m}$ on S_m.

The observed data consist of the affiliation vector τ_m, the number of firms J_m, the population S_m, and the observed share Republican Z_m. (Note that we do not incorporate information on observed prices in the likelihood function.)

We set the number of potential entrants $\overline{J}$ to 6, which is one more than the maximum number of firms observed in any market in our data.

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

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

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

In fact the econometrician does not observe ρ_m. Therefore the likelihood L_n for a given pair n of markets m and m' integrates over the joint distribution of ρ_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 ρ_m and $\rho_{m'}$. The log likelihood of the data is then the sum of the log of L_n across all pairs.

7.2 Demand Model

Following Gentzkow (2007), we estimate the price coefficient α from firms' first order conditions. For any candidate value of the other parameters of the model, we choose α so that the predicted average price of monopoly newspapers in markets with equal shares of Republicans and Democrats matches the observed value in the data. This strategy is possible because we treat marginal costs as observable. It is appealing in our context because we lack credible instruments for prices.

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 ρ_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 ρ_t to equal those for ρ_m. (That is, we allow the analogues of σ_δ, σ_η, μ_δ, and R to differ.)

As with markets, let J_t denote the number of newspapers available in town t and τ_t denote their affiliations. Let S_t denote town population. We treat J_t as nonstochastic in estimation. In appendix C we show that our results are robust to modeling J_t as a random variable whose distribution depends on S_t and ρ_t.

To address the endogeneity of τ_t with respect to ρ_t, we allow that the share of Republican papers in a town is a stochastic function of ρ_t. We assume that:

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

independently across newspapers j in town t. 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. In appendix C we present results from a specification that adds greater flexibility to the dependence of $\Pr(\tau_{tj} = R)$ on ρ_t.

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 ζ_{jt} is measurement error with $\log \zeta_{jt} \sim N\left(0, \sigma_\zeta\right)$ 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 observes ρ_t in each town. Then the likelihood $L_t(\rho_t)$ of a given town t is:

$$L_t(\rho_t) = \frac{1}{\tilde{\sigma}_{\zeta_t}} \phi \left(\frac{\frac{\sum_j \mathbf{1}_{\tau_{tj}=R} \log\left(\hat{Q}_{jt}/q_j\right)}{\sum_j \mathbf{1}_{\tau_{tj}=R}} - \frac{\sum_j \mathbf{1}_{\tau_{tj}=D} \log\left(\hat{Q}_{jt}/q_j\right)}{\sum_j \mathbf{1}_{\tau_{tj}=D}}}{\tilde{\sigma}_{\zeta_t}} \right) \Pr(\tau_t | \rho_t, J_t) \tag{20}$$

where ϕ denotes the standard normal PDF and

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

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

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

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

7.3 Implementation

7.3.1 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. Appendix C

presents evidence on the sensitivity of our findings to variation in calibrated moments.

7.3.2 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 constrain all standard deviations and the parameter Γ to be positive. (When Γ is negative, 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 $Z_t \in [0.45, 0.55]$.[3]

We choose starting values either at zero or at a value (typically one) reflecting the expected order of magnitude of the parameter.

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 κ 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.[4] 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.

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

8 Identification

In this section, we present a heuristic overview of the features of the data that identify the model's parameters.

8.1 Supply Model

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

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

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

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, as outlined in section 6. These assumptions also identify σ_δ and σ_η, 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 σ_ξ in cost shocks ξ are identified as an unexplained residual in newspapers' affiliation choices. The mean of the unobservable μ_δ 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 μ_κ^0, μ_κ^1 and σ_κ 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.

8.2 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 α.

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 Γ. Given utility parameters, the parameter σ_ζ , 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 μ_ρ^0 and μ_ρ^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 Γ.

We address this issue by exploiting the spatial correlation in circulation, in a manner similar to that outlined in section 6 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 σ_δ and σ_η, 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. For this reason, we require that paired towns are far enough away from one another that paired towns typically have non-overlapping sets of newspapers available.

9 Results

9.1 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 dislike higher prices. Households prefer newspapers whose affiliations match their own. Same-type newspapers are substitutes in demand. There is substantial unobservable heterogeneity in household ideology across towns, which in turn is correlated with the fraction of available newspapers that are Republican. (In appendix B we show that this heterogeneity matters in the sense that estimates of several key parameters change significantly when we omit the unobservables from the model.)

Table 7 reports estimates of supply model parameters. Again, the qualitative patterns match expectations. Consistent with our economic model, advertising rates are lower for overlapping readers than for singleton readers, implying that advertising competition enhances the incentive to differentiate politically. We find some evidence of unobservable heterogeneity in household ideology, but it is less important than on the demand side, and we cannot reject the null hypothesis that the standard deviation of the unobservable is zero.

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.

9.2 Determinants of Diversity

Table 8 assesses how market forces determine the extent of political diversity in equilibrium. For our baseline model and a series of counterfactuals, we perform 5 independent simulations of the affiliation choices of all newspapers in our empirical sample. In these counterfactuals, we hold the number of newspapers in each market fixed to isolate the drivers of affiliation choices.

We define a newspaper market to be diverse if it has at least one Republican paper and one Democratic paper. We report the average across simulations of the number of markets with diverse papers, the share of households in a market with diverse papers, and the share of households reading at least one paper of each type. In our baseline model, 140 markets have diverse papers. This is slightly more than half of all multi-paper markets. Twenty-two percent of households live in a market with diverse papers, and 3.6 percent actually read at least one paper of each affiliation on a typical day.

In our first counterfactual, we assume that each entering newspaper chooses its affiliation as if it expected to be a monopolist in the market. Comparing this case to the baseline provides a measure of the total effect of competition on diversity. The number of multi-paper markets that are diverse falls by nearly 40 percent, to 87. The share of households in a market with diverse papers falls to 14 percent, and the share of household reading diverse papers falls to 2.2 percent. This establishes one of our main results: the economic incentive to differentiate 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* households. Comparing this case to the baseline captures the extent to which catering to consumer tastes tends to reduce diversity. Measures of diversity increase in this case by between a third and a half.

In our third counterfactual, we assume that each entering firm chooses its affiliation as if $\xi = 0$. The cost shocks ξ are simply a residual in the model, but one can interpret them as capturing the personal political preferences of owners, along with other idiosyncratic factors. Eliminating such factors would reduce the number of diverse markets from 140 to 106: a nontrivial reduction, but not as large as the effect of ignoring competitors.

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 access to and readership of diverse papers are very close to the baseline values. Thus, the net effect of competition, catering to consumer tastes, and idiosyncratic preferences of owners, is newspapers that are broadly representative of their consumers.

9.3 Equilibrium and Welfare-Maximizing Outcomes

In the first column of table 9, we report market structure, prices, and welfare for our baseline model.[5] As in table 8, each reported value is the average over five simulations. We also repeat the baseline diversity statistics from table 8 in the final three rows for comparison with what follows.

Of the 958 markets in our baseline simulation with at least one newspaper, 249 have two or more. Thirty-eight percent of households read at least one newspaper. The average annual subscription price of competitive newspapers is \$6.22 (in 1924 dollars), and the average advertising revenue per reader per year is \$10.37. Total surplus is \$4.26 per household per year, which breaks down into \$3.35 of consumer surplus, \$0.40 of newspaper profit, and \$0.51 of advertiser profit.

In the final two columns of table 9, we compare these equilibrium outcomes to those that would be chosen by a social planner whose goal is to maximize total surplus. Importantly, we do not assume that the social planner internalizes any political externalities associated with ideological diversity. These simulations therefore allow us to evaluate whether there is any tradeoff between the objectives of maximizing economic welfare and preserving diversity in the marketplace of ideas.

The second column of table 9 holds the number of newspapers fixed at baseline values, but allows the social planner to choose affiliations, circulation prices, and advertising prices. The social planner chooses substantially lower prices than occur in market equilibrium, with an average price in multi-paper markets of only \$0.33, leading the share of households reading newspapers to increase by about half. The social planner also chooses more ideological diversity than occurs in market equilibrium: the number of markets with diverse papers increases from 140 to 182 under the social planner, and the share of households reading diverse papers increases by a factor of three.

The third column of table 9 allows the social planner to control newspapers' entry decisions as well as post-entry outcomes. The results show that in market equilibrium the equilibrium number of newspapers falls well short of the social optimum. The social planner increases the number of markets with at least one paper from 958 to 1910 and the number of markets with multiple papers from 249 to 1884. Increased entry further increases diversity: the number of households in markets with diverse papers rises to 92 percent, and more than half of households read diverse papers on any given day. The source of insufficient entry here is the distortion formalized by Spence (1975): in markets with fixed costs, entrants do not internalize the effect of entry on the surplus of inframarginal consumers.[6]

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[5] We define consumer surplus as total realized utility divided by the marginal utility of money:

$$\int_i U(B_i)/\alpha$$

where B_i is the utility-maximizing bundle for household i and α is the price coefficient in our demand system. We define advertiser surplus as the total value of advertisements placed less total advertising expenditures:

$$S\left((a_h - a_l)(1-q_0) + a_l \sum_j q_j - \sum_j q_j a_j\right)$$

We define total surplus as the sum of consumer surplus, advertiser surplus, and firm profits.

[6] This force is especially powerful in our setting because fixed costs are large, the share of surplus captured in firm profits is low, and the countervailing business-stealing externality highlighted in Mankiw and Whinson (1986) is relatively small. For early discussions of the tendency toward inefficient entry in concentrated markets see Hotelling (1938) and the work of Jules Dupuit as

The results in table 9 show that there is no conflict between the goal of maximizing economic welfare and the goal of maintaining diversity in the marketplace of ideas. Policies that increase entry, as well as policies which promote diversity conditional on entry, would likely be economically desirable even if the political externalities to diversity were small.

9.4 Competition Policy

In table 10, we turn to the first of our policy counterfactuals: relaxation of antitrust rules. The most prominent such policy in the United States is the Newspaper Preservation Act of 1970, which allows newspapers in the same market to form "joint operating agreements" (Busterna and Picard, 1993). Papers in such agreements are allowed to make joint decisions about prices and advertising rates (and combine many of their back-office operations), on the condition that they remained editorially independent.

We model joint operating agreements by assuming that all entering newspapers choose their prices and advertising rates to maximize the sum of their profits.[7] We assume that entry and affiliations continue to be made non-cooperatively. We assume that papers in joint operating agreements keep all of their own subscription revenue and that they share advertising revenue in proportion to their circulations.[8]

The first column of table 10 repeats our baseline results for reference. The second and third columns show the separate effects of allowing joint setting of circulation prices and advertising rates respectively.

Allowing price collusion reduces economic welfare and has little effect on diversity. Average prices in multi-paper markets rise significantly, from \$6.22 to \$7.92. Advertising revenue per reader increases slightly, as a consequence of less overlap in newspaper readership. The number of markets with two or more newspapers rises modestly from 249 to 277. Most of the gain to firms is offset by this increase in competitiveness, so total firm profit increases only slightly, while consumer surplus and advertiser profit both fall significantly. Additional entry also offsets the reduced incentive to differentiate due to softer price competition, and so effects on diversity are modest: the share of households with access to diverse papers rises slightly, while the share reading them falls by a fourth.

Advertising collusion, on the other hand, causes large increases in both economic welfare and diversity. Advertising revenue per reader increases from \$10.37 to \$11.41. The increase in advertising revenue leads

summarized in Ekelund and Hebert (1999, 159-191).

[7] Formally, we define a collusive price of newspaper j as the j^{th} element of a 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 per-reader advertising revenue 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.

[8] These assumptions are a reasonable match to the revenue-sharing arrangements of joint operating agreements authorized under the Newspaper Preservation Act (Busterna and Picard, 1993). In some cases a newspaper's share of revenue is a "sliding" function of the newspaper's contribution to revenue or to total advertising sales. In other cases, the revenue sharing rule is fixed in advance, but in such cases is usually related to the initial capital investment of the newspapers, and hence to their financial health at the time of the agreement. In both types of arrangements, a newspaper with a greater circulation will generally be entitled to a greater share of the joint venture's revenue.

firms to reduce circulation prices to consumers, consistent with the well-known "seesaw principle" in two-sided markets (Rochet and Tirole 2006). Entry increases dramatically, with the number of markets with multiple papers almost doubling, from 249 to 458. These factors together cause consumer surplus and firm profit to increase by a half and a third respectively. Although some of this is a transfer from advertisers, total surplus increases increases from \$4.26 to \$5.37 per household per year. The large increase in entry more than offsets the reduced incentive to differentiate due to reduced advertising competition, and so diversity rises on all measures: the number of markets with diverse papers doubles, the share of households with access to diverse papers increases by 60 percent, and the share of households reading diverse papers more than doubles.

Joint operating agreements combine the effects of price and advertising collusion. The effects of the latter dominate the effects of the former, with both economic welfare and diversity increasing, though by less than under advertising collusion alone. Total surplus per household rises from \$4.26 to \$4.83, and the share of households reading diverse papers rises to 6.8 percent.

It is worth stressing that the two-sided nature of media markets substantially changes the evaluation of policy instruments. Price and advertising collusion are frequently treated as symmetric in the policy debate,[9] while in fact the two are very different. Joint setting of prices amounts to a tax on marginal readership and only a modest spur to entry, while joint setting of advertising rates amounts to a subsidy to marginal readership and a massive spur to entry. In a world where entry, readership, and diversity are all inefficiently low, permitting advertising collusion may be a surprisingly attractive policy to a regulator concerned with both economic welfare and democracy.

9.5 Ownership Regulation

In the final column of table 10, we evaluate the effect of relaxing ownership regulation. In the United States, and in most other countries of the world, the government limits the ability of individual firms to control multiple media outlets in the same market.

We consider a counterfactual at the opposite extreme, where all potential entrants in a given market are jointly owned. In the last stage, entering firms set collusive circulation and advertising prices as in joint operating agreements. At the affiliation choice stage, entrants share a common cost shock ξ and the common owner chooses a vector of affiliations to maximize total profits. At the entry stage, the common owner chooses the number of newspapers to maximize expected total profits. We continue to assume that the draw on ξ is not known at the entry stage, and compute the expected values $V(J)$ by numerically integrating the ξ via Monte Carlo simulation.

The results show that joint ownership significantly reduces both welfare and diversity. Entry is significantly reduced, with the number of markets with multiple newspapers falling from 249 to 167. Circulation and advertising prices both rise, and newspaper readership falls. Total surplus per household falls from \$4.26 to \$3.76, with consumer and advertiser surplus falling, and firm profit rising. The number of markets with diverse papers, the share of households in markets with diverse papers, and the share of households

[9] See, e.g., the discussion of the debate surrounding the Newspaper Preservation Act of 1970 in Oppenheim and Shields (1981, 187-189).

reading diverse papers all fall by about a third.

The effect of joint ownership on affiliation choices is subtle. Note that most of the drop in diversity is a consequence of reduced entry; the share of multi-paper markets with diverse papers remains roughly stable. This reflects two offsetting effects on differentiation. On the one hand, allowing newspapers to internalize the effect of their affiliation choices on their competitors significantly increases the incentives to differentiate (Sweeting 2010). On the other hand, the fact that we assume jointly owned newspapers share a common cost shock ξ significantly increases the within-market correlation of affiliation choices, providing a strong force in the other direction.

9.6 Subsidies

The final policy we evaluate is newspaper subsidies. We base our counterfactuals on two real policies: a fixed cost subsidy in Sweden, which favors a local market's "second papers" (i.e., papers with lower circulation than the largest paper in the market; see Gustaffson et al. 2009), and postal subsidies in the United States, which at the time of our study constituted a meaningful subsidy to the delivery costs of many newspapers (Kielbowicz 1994). We model the first by assuming that second and subsequent entrants earn expected profits $V(j)+K$ where K is the amount of the subsidy and $j \geq 2$. We model the second by assuming that all firms' marginal cost is equal to $MC-K$ where K is the amount of the subsidy. We calculate the total cost of each subsidy as $(1+\lambda)$ times the dollar amount transferred to firms, where λ is the marginal cost of public funds. We set $\lambda = 0.3$ (Einav et al. 2010, Poterba 1996). We compute the level of each subsidy that maximizes total surplus.

Table 11 shows the results. The surplus-maximizing fixed cost subsidy amounts to a payment of $\$13,598$ per year to the average second or subsequent entrant. As expected, this causes a large increase in the number of newspapers, and nearly all markets with at least one entrant become multi-paper markets. This increased competition leads to increases in the welfare of consumers and advertisers and no meaningful change in firm profit. Subtracting the cost of the subsidy itself, we find an increase in total surplus per household from \$4.26 to \$4.99. Diversity increases dramatically, with the number of diverse markets rising from 140 to 517 and the share of households reading diverse papers tripling to 11 percent.

The surplus-maximizing marginal cost subsidy amounts to an average payment of \$7 per copy per year. Of all the policies we consider, this one is the most effective in increasing economic welfare and diversity, both because it promotes entry in markets that previously had no papers, and because it increases readership conditional on the number of papers. The number of markets with any paper rises from 958 to $1,896$, and the number with multiple papers rises to $1,396$. Prices fall substantially, and the share of households reading a paper rises to 0.77. The welfare of consumers, firms, and advertisers rises dramatically. After deducting the cost of the subsidy, total surplus per household rises from \$4.26 to \$6.60 per year. Sixty-five percent of households have access to diverse papers, and 21 percent read diverse papers on a given day.

10 Conclusions

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.

We estimate a model of newspapers' choice of political affiliation that matches these key facts. We use the model to evaluate the economic determinants of ideological diversity and to evaluate several important policies. We find that competitive incentives are a crucial driver of ideological diversity. We show that there is no conflict between the goal of maximizing economic welfare and the goal of preserving ideological diversity. We find that accounting for the two-sided nature of the market is critical for evaluating competition policies, that permitting advertising collusion is a surprisingly effective tool for increasing both welfare and diversity, and that permitting outright joint ownership reduces welfare and diversity. We also show that subsidies of the kind commonly employed by governments to encourage the growth and diversity of media markets can increase economic welfare.

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Table 1: Summary Statistics for 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: 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 for 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: 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(circ) of R papers - Average log(circ) of D papers					
	(1)	(2)	(3)	(4)	(5)
Republican vote share	0.8634		0.9702	0.9663	
	(0.1913)		(0.1984)	(0.2061)	
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)
Fixed effects for:					
Choice set configuration				X	
County					X
R2	0.0104	0.0009	0.0133	0.0250	0.5685
Number of counties	1215	1215	1215	1215	1215
Number of towns	4287	4287	4287	4287	4287

Notes: Data are from the demand estimation sample. The dependent variable 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. Fixed effects for choice set configuration are unique fixed effects for each possible combination of (Number of Republican papers, Number of Democratic papers). Standard errors in parentheses are clustered at the county level.

Table 4: Determinants of Newspaper Affiliation

Dependent variable: Dummy for newspaper choosing R affiliation			
	(1)	(2)	(3)
Republican vote share	2.1824		2.3350
	(0.0557)		(0.0611)
Number of Republican incumbents		-0.0145	-0.1483
		(0.0310)	(0.0332)
Number of Democratic incumbents		-0.0168	0.1308
		(0.0380)	(0.0304)
R2	0.3561	0.0003	0.3816
Number of markets	950	950	950
Number of newspapers	1338	1338	1338

Notes: Data are from the supply estimation sample. The unit of analysis is the newspaper. Republican vote share is the average Republican share of the two-party vote in presidential elections from 1868-1928. The number of Republican/Democratic incumbents is the number of sample newspapers of the given affiliation that entered prior to the newspaper in question. Standard errors in parentheses are clustered at the market level.

Table 5: Affiliation Choices in Own and Neighboring Markets

Share of second entrants choosing R 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 (α)	0.1802
	(0.0025)
Mean utility for different-affiliation paper ($\underline{\beta}$)	-0.1887
	(0.0592)
Mean utility for same-affiliation paper ($\overline{\beta}$)	0.7639
	(0.0664)
Substitutability between same-type papers (Γ)	0.2438
	(0.0561)
Standard deviation of log-measurement error (σ_q)	0.6995
	(0.0077)
Mean of unobservable shifter of fraction Republican (μ_δ)	0.0945
	(0.0545)
Standard deviation of unobservable ($\sqrt{\sigma_\delta^2 + \sigma_\eta^2}$)	0.2859
	(0.0133)
Parameters governing share of town's newspapers that are Republican	
μ_ρ^0	-0.1680
	(0.1098)
μ_ρ^1	2.0006
	(0.0338)
Calibrated parameters:	
Marginal cost (MC)	8.1749
Spatial correlation of unobservable ($R \equiv \frac{\sigma_\delta^2}{\sigma_\delta^2+\sigma_\eta^2}$)	0.7286
Number of towns	12198
Number of 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)	6.5121
	(0.8944)
Standard deviation of affiliation cost shocks (σ_ξ)	0.2005
	(0.0267)
Mean of unobservable shifter of fraction Republican (μ_δ)	-0.0136
	(0.0180)
Standard deviation of unobservable ($\sqrt{\sigma_\delta^2 + \sigma_\eta^2}$)	0.1054
	(0.0874)
Parameters governing the distribution of fixed costs	
μ_κ^0	8.3784
	(0.4538)
μ_κ^1	-0.6092
	(0.0581)
σ_κ	0.3403
	(0.0324)
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 with asymptotic standard errors in parentheses.

Table 8: Determinants of Equilibrium Diversity

	Markets with diverse papers	Share of hhlds in mkt with diverse papers	Share of hhlds reading diverse papers
Baseline	140	0.22	0.036
When choosing affiliation, newspapers:			
Ignore competitors' choices	87	0.14	0.022
Ignore household ideology	208	0.30	0.048
Ignore idiosyncratic cost shocks (ξ)	106	0.17	0.030
Owners chosen at random from local households and newspaper type equals owner type	150	0.23	0.038

Notes: Table shows averages over 5 counterfactual simulations at the parameters reported in tables 6 and 7. A market has diverse papers if it has at least one Republican and one Democratic paper, and a household reads diverse papers if it reads at least one Republican and one Democratic paper. "Baseline" is simulation of the estimated model. "Ignore competitors' choices" is a counterfactual in which each paper chooses its affiliation as if it will be the only paper in the market. "Ignore household ideology" is a counterfactual in which each paper chooses its affiliation as its market were 50 percent Republican ($\rho = 0.5$). "Ignore idiosyncratic cost shocks" is a counterfactual in which each paper chooses its affiliation as if $\xi = 0$. "Owners chosen at random" is a counterfactual in which each paper's affiliation is a random draw from the ideology of households in its market. The number of newspapers is fixed at its baseline value in all counterfactuals.

Table 9: Equilibrium and Surplus-Maximizing Outcomes

	Baseline	Chosen to Maximize Total Surplus:	
		Post-Entry Outcomes	Entry and Post-Entry Outcomes
Markets with newspapers	958	958	1910
Markets with multiple newspapers	249	249	1884
Share of hhlds reading a newspaper	0.38	0.54	0.95
Avg. price in multi-paper markets	6.22	0.33	0.78
Avg. ad rev. per reader in multi-paper markets	10.37	10.73	9.91
Consumer surplus	3.35	6.87	19.55
Firm profit	0.40	2.78	-9.53
Advertiser profit	0.51	0*	0*
Total surplus	4.26	9.65	10.02
Diversity			
Markets with diverse papers	140	182	1590
Share of hhlds in mkt. with diverse papers	0.22	0.28	0.92
Share of hhlds reading diverse papers	0.036	0.123	0.530

* The distribution of surplus between firms and advertisers is indeterminate in these counterfactuals.

Notes: Table shows averages over 5 counterfactual simulations at the parameters reported in tables 6 and 7. A market has diverse papers if it has at least one Republican and one Democratic paper, and a household reads diverse papers if it reads at least one Republican and one Democratic paper. "Baseline" is simulation of the estimated model. In column (2), the number of newspapers is fixed at its baseline value and a social planner chooses affiliations, ad prices, and circulation prices to maximize total surplus, with the constraint that all prices must be weakly positive. In column (3), the social planner also chooses the number of papers in each market. Average price is an annual subscription price. Average ad revenue is reported per reader per year. Surplus and profit numbers are reported in dollars per household.

Table 10: Competition Policy

	Baseline	Allow Price Collusion	Allow Advertising Collusion	Allow Joint Operating Agreements	Allow Joint Ownership
Markets with newspapers	958	958	958	958	961
Markets with multiple newspapers	249	277	458	465	167
Share of hhlds reading a newspaper	0.38	0.36	0.46	0.44	0.35
Avg. price in multi-paper markets	6.22	7.92	5.81	6.83	6.37
Avg. ad rev. per reader in multi-paper markets	10.37	10.72	11.41	11.55	11.89
Consumer surplus	3.35	2.96	4.83	4.25	2.87
Firm profit	0.40	0.41	0.54	0.58	0.89
Advertiser profit	0.51	0.41	0	0	0
Total surplus	4.26	3.77	5.37	4.83	3.76
Diversity					
Markets with diverse papers	140	151	278	282	94
Share of hhlds in mkt with diverse papers	0.22	0.24	0.36	0.36	0.16
Share of hhlds reading diverse papers	0.036	0.028	0.083	0.068	0.022

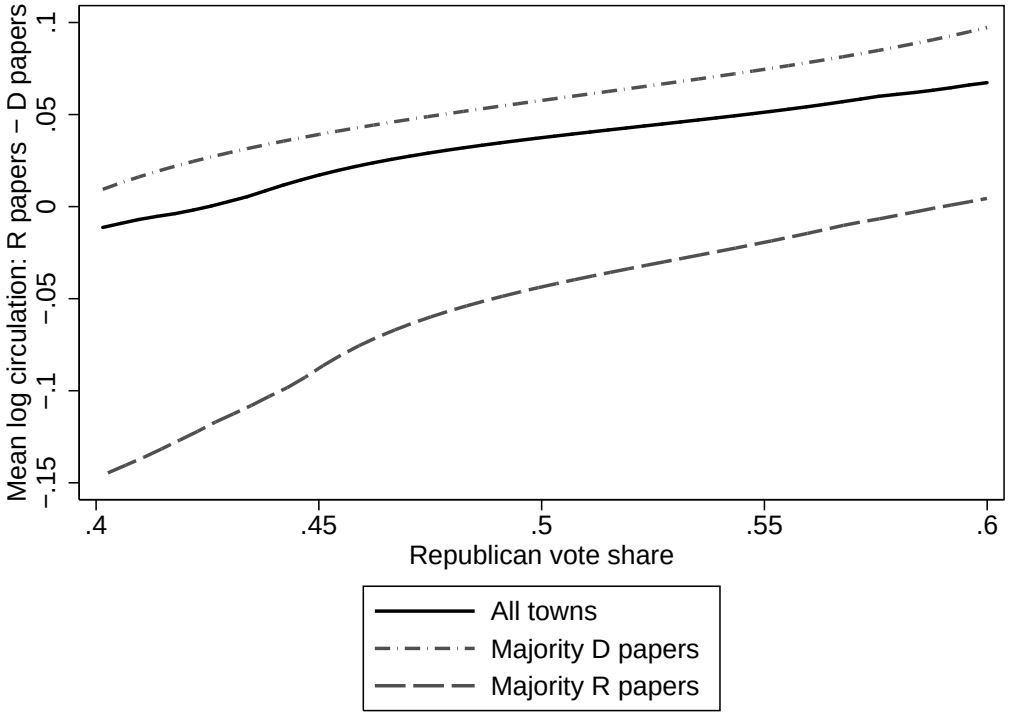
Notes: Table shows averages over 5 counterfactual simulations at the parameters reported in tables 6 and 7. A market has diverse papers if it has at least one Republican and one Democratic paper, and a household reads diverse papers if it reads at least one Republican and one Democratic paper. "Baseline" is simulation of the estimated model. Columns (2)-(4), are counterfactuals in which entering papers set prices, ad rates, or prices and ad rates, respectively, to maximize their total profits. Column (5) is a counterfactual in which all potential entrants in a given market are jointly owned. Joint ownership means that newspapers make entry, affiliation, pricing, and ad rate decisions to maximize joint profits subject to a common affiliation cost shock ξ. Average price is an annual subscription price. Average ad revenue is reported per reader per year. Surplus and profit numbers are reported in dollars per household.

Table 11: Subsidies

	Baseline	Optimal Fixed-Cost Subsidy	Optimal Marginal-Cost Subsidy
Amount of subsidy		$13598 per paper	$7 per reader
Markets with newspapers	958	958	1896
Markets with multiple newspapers	249	845	1396
Share of households reading a newspaper	0.38	0.52	0.77
Avg. price in multi-paper markets	6.22	6.44	4.09
Avg. ad rev. per reader in multi-paper markets	10.37	10.02	9.44
Consumer surplus	3.35	5.45	9.73
Firm profit	0.40	0.37	1.37
Advertiser profit	0.51	1.40	2.53
Cost of subsidy	0.00	2.24	7.03
Total surplus	4.26	4.99	6.60
Diversity			
Markets with diverse papers	140	517	839
Share of hhlds in mkt with diverse papers	0.22	0.51	0.65
Share of hhlds reading diverse papers	0.036	0.105	0.205

Notes: Table shows averages over 5 counterfactual simulations at the parameters reported in tables 6 and 7. A market has diverse papers if it has at least one Republican and one Democratic paper, and a household reads diverse papers if it reads at least one Republican and one Democratic paper. "Baseline" is simulation of the estimated model. Subsidies are chosen to maximize total surplus. "Optimal Fixed-Cost Subsidy" provides a fixed per-household payment to the second and all following entrants. "Optimal Marginal-Cost Subsidy" provides a payment per copy sold to all papers. Average price is an annual subscription price. Average ad revenue is reported per reader per year. Surplus and profit numbers, as well as cost of subsidy, are reported in dollars per household. Cost of subsidy includes a 30% cost of public funds.

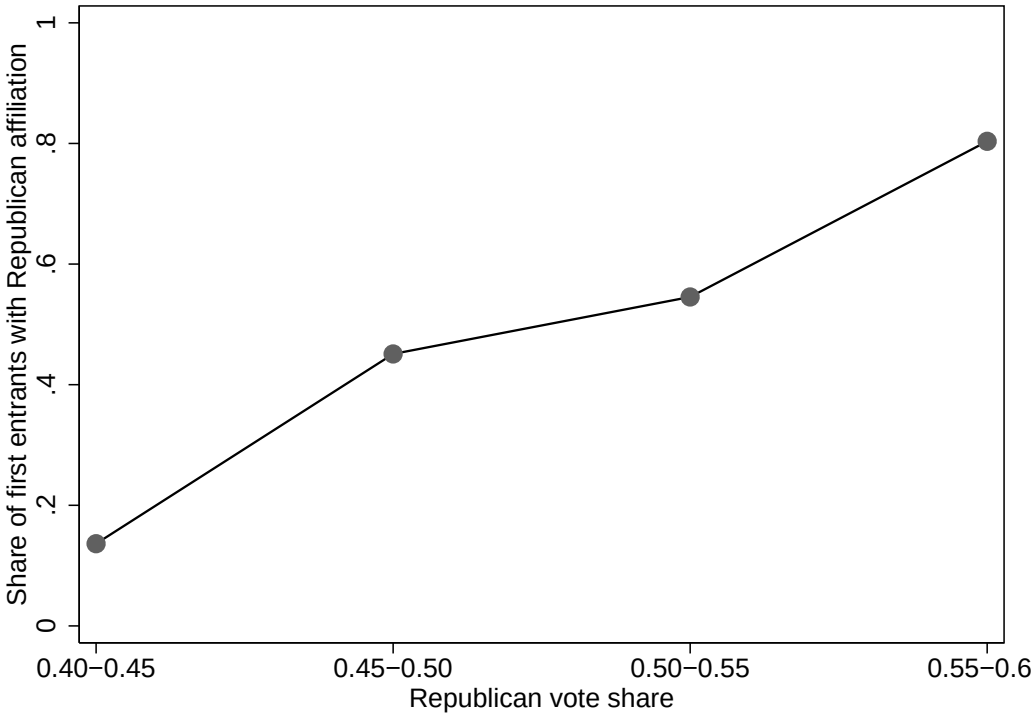
Figure 1: Demand for Partisanship



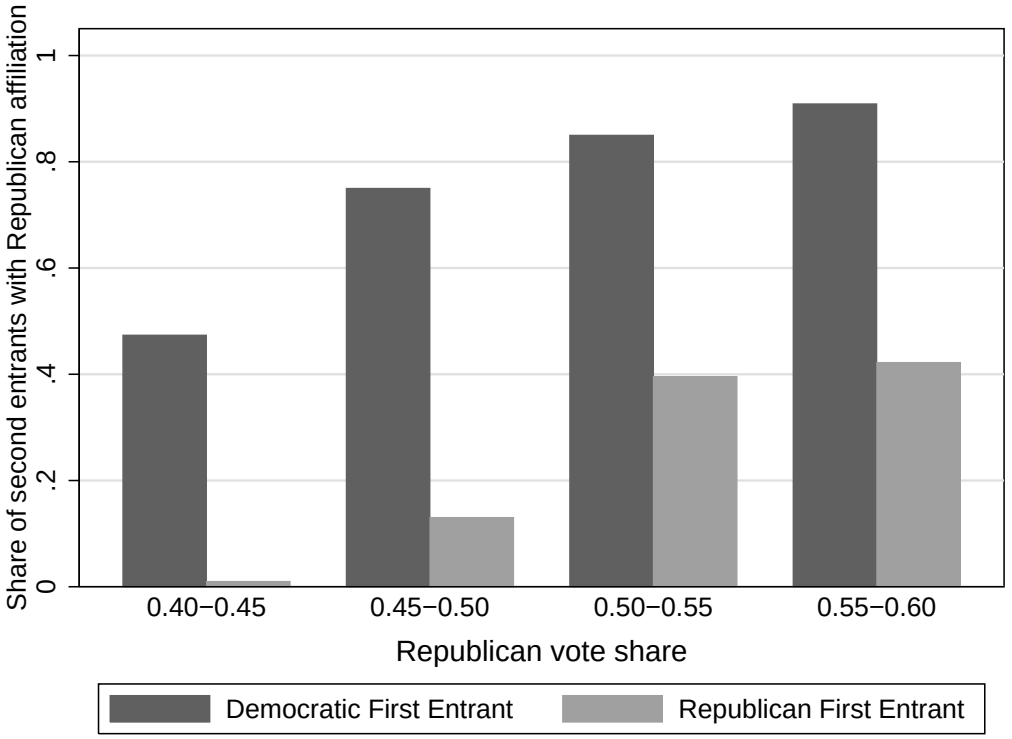
Notes: Data are from demand estimation sample. Republican vote share is the average Republican share of the two-party vote in presidential elections from 1868-1928. The sample includes all towns with at least one Democratic newspaper and at least one Republican newspaper in which the Republican vote share is between 0.4 and 0.6. The plot is a local polynomial plot of degree 0, using the Epanechnikov kernel with a "rule-of-thumb" bandwidth. "Majority R papers" refers to the set of towns in which there are more Republican than Democratic newspapers available. "Majority D papers" refers to the set of towns in which there are more Democratic than Republican newspapers available.

Figure 2: Determinants of Newspaper Affiliations

Panel A: First Entrant Affiliation Choice

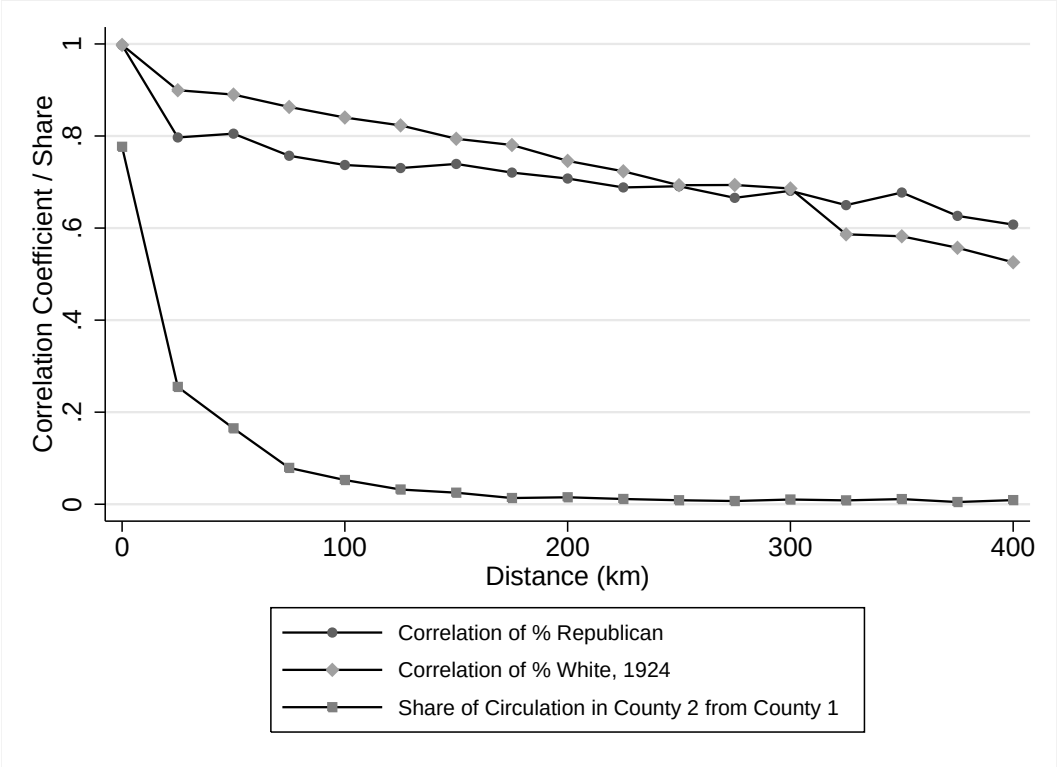


Panel B: Second Entrant Affiliation Choice



Notes: Data are from supply estimation sample. Republican vote share is the average Republican share of the two-party vote in presidential elections from 1868-1928. The sample includes all markets with two or more newspapers in which the Republican vote share is between 0.4 and 0.6.

Figure 3: 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.

Appendices

A Panel Evidence on Determinants of Affiliation

Table 4 presents descriptive statistics for newspapers' choice of affiliation calculated for our main sample, which is a cross-section of markets as of 1924. Appendix table 1 produces analogous summary statistics for our full panel of newspapers, which differs from the main sample in including newspapers that entered and exited prior to 1924.

Column (1) of appendix table 1 shows a specification analogous to specification (3) of table 4. Column (2) of appendix table 1 instruments for our main measure of household ideology with the Republican share of the two-party vote in the presidential election prior to the newspaper's entry. Column (3) includes the lag vote share as a control.

Column (1) of appendix table 1 supports the key qualitative conclusions of specification (3) of table 4. Quantitatively, the specification in the appendix table shows a similar effect of household ideology and a smaller effect of incumbent affiliation. The latter difference is likely due to the fact that the sample in the appendix table includes incumbents not present in 1924, and hence disproportionately likely to be smaller, less successful newspapers.

Column (2) of appendix table 1 shows that the estimated coefficients do not change much when we instrument with the lag of vote share, corroborating the evidence in Gentzkow et al. (2011) that reverse causality from newspaper affiliation to voting was not a major factor during our period of study.

Column (3) of appendix table 1 shows that, conditional on the average Republican vote share, the lag vote share is correlated with newspaper affiliations, but that including it in the model has only a small effect on the explanatory power of the model as measured by the R^2. This finding is consistent with extant evidence that political preferences were highly spatially persistent during the period we study (Glaeser and Ward 2006) and supports our use of the average vote share as the observable proxy for ideology in formal estimation.

B Evidence on Model Specification

Appendix table 2 presents estimates of key parameters from our baseline model and from an alternative model in which we assume there is no unobservable town- or market-level heterogeneity in consumer ideology. Consistent with the findings we report in section 9.1, we find that key demand parameters are very sensitive to excluding unobservable heterogeneity from the model, whereas key supply parameters are less so. Note that we find that the effects of key counterfactuals such as newspapers ignoring competitors' affiliations (see table 8) are not very sensitive to excluding the unobservables from the model.

C Robustness

In appendix table 3, we show how our key results vary with alternative specifications of the model. 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 and third rows explore the sensitivity of our findings to the calibrated value of marginal costs we use, increasing and decreasing the marginal costs by 10 percent relative to the baseline value and re-estimating the model.

The fourth and fifth rows explore the sensitivity of our findings to the calibrated value of a_h we use, increasing and decreasing a_h by 10 percent relative to the baseline value and re-estimating the model.

The sixth row presents estimates from a specification in which we modify the demand model to treat the number of firms available in a town as endogenous. In particular, we model the number of firms J_t in a town t as a Poisson random variable whose log mean is a linear function of $\log(S_t)$, ρ_t, ρ_t^2.

The seventh row adds flexibility to the fixed cost distribution in the supply model by allowing $\frac{\kappa_m}{S_m}$ to be distributed logistic with mean $\mu_\kappa^0 + \mu_\kappa^1 \log(S_m) + \mu_\kappa^2 \log(S_m)^2$.

The eighth row presents estimates from a specification in which we allow greater flexibility in the way in which consumer ideology affects the affiliations of newspapers that are available in a given town. In particular, we assume that for each newspaper j available in town t,

$$\Pr(\tau_j = R) = \text{logit}^{-1}\left(\mu_\rho^0 + \mu_\rho^1 \text{logit}(\rho_t) + \mu_\rho^2 \text{logit}(\rho_t)\right).$$

The ninth and tenth rows extend the model to include an additional substitutability parameter between different-type papers. Letting subscripts s and d refer to same- and different-type papers, we generalize our utility model so that the mean utility of a household of type θ for a bundle B is given by

$$u(\theta, B) = \sum_{j \in B}\left(\underline{\beta}\mathbf{1}_{\theta \neq \tau_j} + \overline{\beta}\mathbf{1}_{\theta=\tau_j} - \alpha p_j\right) - k_s(B)\Gamma_s - k_d(B)\Gamma_d.$$

In the ninth row we estimate Γ_s and Γ_d freely. (These are jointly identified only by functional form, so results should be taken with some caution.) In the tenth row we constrain Γ_d to be equal to one-half of the point estimate of Γ in our baseline specification and estimate Γ_s freely.

The eleventh row extends the demand model to allow the utility from reading a newspaper to depend on distance. Letting $dist_j$ be the distance from a town to the newspaper's home market, in this specification the mean utility of a household of type θ for a bundle B is given by:

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

where α_d is a parameter that we estimate.

The twelfth row tightens the population restrictions defining the universe of potential daily newspaper markets by 25%. This is done by dropping all market pairs containing a market with population smaller than 3,750 or larger than 75,000.

The thirteenth row presents estimates from a subsample of the data in which any market pair containing one or more independent newspapers as of 1924 is excluded.

The fourteenth row presents estimates from a subsample of the data in which any market pair containing one or more unaffiliated newspapers as of 1924 is excluded.

The fifteenth row presents estimates from a subsample of the data in which we exclude any market pair containing a market within 100km of any of the ten most populous cities as of the 1920 Census.

The sixteenth row presents estimates from a subsample of the data in which we drop town pairs for which our town-level circulation data omit a newspaper in at least one town's nearest news market.

The seventeenth row presents estimates from a subsample of the data in which any market pair containing a market in the South is excluded. Because of the dominance of the Democratic party in the South, excluding markets in the South increases estimated diversity at baseline and in all counterfactuals, but the differences between counterfactuals remain similar to our preferred estimate from the full sample.

The eighteenth row presents estimates from a subsample of the data which removes any market pair containing a pair of papers in different markets that are owned by the same chain as of 1932. (Our ownership data are from the 1932 *Editor and Publisher Yearbook*. The earlier annual directories that we use to construct our main sample do not include lists of chain-owned newspapers.)

The nineteenth row presents estimates from an alternate sample in which we include any town that is itself the headquarters of a daily newspaper.

Appendix Table 1: Determinants of Newspaper Affiliation

Dependent variable: Dummy for newspaper choosing Republican affiliation

	(1)	(2)	(3)
Republican vote share	2.1355	2.2353	1.9424
	(0.0558)	(0.0703)	(0.1021)
Number of Republican incumbents	-0.0762	-0.0813	-0.0757
	(0.0124)	(0.0128)	(0.0123)
Number of Democratic incumbents	0.0644	0.0707	0.0644
	(0.0120)	(0.0124)	(0.0120)
Lag Republican vote share			0.2034
			(0.0869)
Instrument with lag vote share?		X	
R2	0.2860	0.2854	0.2871
Number of markets	1336	1336	1336
Number of newspapers	3177	3177	3177

Notes: Data are from US Newspaper Panel from 1872-1928. The unit of analysis is the newspaper. Republican vote share is the average Republican share of the two-party vote in presidential elections from 1868-1928. Lag Republican vote share is the Republican share of the two-party vote in the presidential election prior to the entry of the newspaper. The sample excludes newspapers for which data on Republican share of the two-party vote in the election prior to entry is unavailable. Model (1) is an OLS regression. Model (2) is a 2SLS regression in which the lag vote share is used as an instrument for the Republican vote share. All models include fixed effects for the year of entry (the first presidential election year in which the newspaper is present in the panel). The number of Republican/Democratic incumbents is the number of newspapers of each affiliation present in the year of entry. Standard errors in parentheses are clustered at the market level.

Appendix Table 2: Sensitivity of Parameter Estimates to Omitting Unobservables From Model

	Baseline	No Unobservables
Demand parameters		
$\underline{\beta}$	-0.1887	-0.1298
	(0.0592)	(0.0478)
$\overline{\beta}$	0.7639	0.6984
	(0.0664)	(0.0528)
Γ	0.2438	0.1532
	(0.0561)	(0.0471)
Supply parameters		
a_l	6.5121	6.5974
	(0.8944)	(0.8917)
σ_ξ	0.2005	0.1826
	(0.0267)	(0.0238)

Notes: Column "baseline" presents estimates of a selection of parameters from tables 6 and 7. Column "no unobservables" presents estimates of the same parameters from a model in which we constrain $\sigma_\delta = \sigma_\eta = 0$ in both demand and supply estimation and treat τ_t as nonstochastic in demand estimation.

Appendix Table 3: Robustness Checks

		% of multi-paper markets w/ diverse papers		% of news markets w/ diverse papers	
		Baseline	Firms ignore competitors	Baseline	JOAs
(1)	Preferred estimate	0.56	0.35	0.15	0.29
	Changing Calibrated Values				
(2)	Increase marginal cost by 10%	0.57	0.32	0.17	0.33
(3)	Decrease marginal cost by 10%	0.56	0.35	0.14	0.29
(4)	Increase a_h by 10%	0.58	0.35	0.16	0.30
(5)	Decrease a_h by 10%	0.56	0.29	0.17	0.36
	Modifying Model Specification				
(6)	Endogenous J in demand model	0.56	0.35	0.15	0.29
(7)	Add flexibility to fixed cost distribution	0.58	0.34	0.16	0.32
(8)	Add flexibility to affiliation choice in demand model	0.56	0.35	0.15	0.29
(9)	Add substitutability parameter between different-type papers	0.56	0.35	0.15	0.29
(10)	Constrain different-type substitutability parameter to half of same-type	0.56	0.32	0.15	0.27
(11)	Add distance to headquarters as utility shifter in demand model	0.56	0.35	0.14	0.30
	Modifying Estimation Sample				
(12)	Tighten population cut-offs for markets	0.52	0.28	0.15	0.32
(13)	Remove markets with independent papers	0.57	0.32	0.15	0.29
(14)	Remove markets with unaffiliated papers	0.54	0.32	0.14	0.29
(15)	Remove markets near major cities	0.56	0.28	0.13	0.27
(16)	Remove towns with missing data for nearby newspapers	0.57	0.33	0.15	0.30
(17)	Remove markets in the South	0.58	0.33	0.17	0.32
(18)	Remove market pairs with cross-market co-ownership	0.54	0.30	0.14	0.29
(19)	Include towns which are the headquarters of a daily paper	0.60	0.32	0.15	0.29

Notes: See appendix C for details.