monopoly markups identify the price sensitivity parameter α as in Gentzkow (2007).[28]

The relationship between the share of a town's available newspapers that are Republican and Z_t identifies the parameters μ_ρ^0 and μ_ρ^1, and the variance of unobserved ideology σ_ν^{town} is identified by spatial correlation in circulation as outlined in Section IIIC. Given these parameters, Γ_s is identified by the strength of the relationship (shown in Table 3) between the relative circulation of Republican papers and the relative number of Republican papers. Given the other parameters, Γ_d is then identified by the extent of overlap in the readership of newspapers with different affiliations.

The average relative circulation of Republican papers identifies μ_ν^{town}. The parameter σ_ζ, which governs the importance of measurement error in circulation, is then identified by the variance of residual circulation.

Although this heuristic discussion of identification treats the different steps as separable, the demand parameters are in fact jointly determined and jointly estimated.

VI. Supply Estimation

Taking the demand parameters estimated in Section V as given, we estimate the remaining parameters by maximum likelihood using our market-level data on newspaper entry and affiliation choices.

To implement the spatial identification strategy outlined in Section IIIC, we assume that ρ_m is unobserved and may be correlated within the pairs of neighboring markets defined in Section IB. We assume that $\rho_m = \text{logit}^{-1}(\text{logit}(Z_m) + \nu_m)$, with ν_m distributed normally with mean μ_ν^{mkt} and standard deviation σ_ν^{mkt}. We assume that the analogue of equation (10) holds for ν_m and Z_m.

We set the number of potential entrants J^{max} to 6, which is 1 more than the maximum number of newspapers observed in any market in our data. In simulations of our baseline model with $J^{max} = 10$, we find that fewer than 1 percent of markets have more than 6 entrants.

The econometrician observes Z_m, population S_m, the number of entering newspapers J_m, and the affiliation choices τ_m. The conditional likelihood of the data for market m given ρ_m and $J_m < J^{max}$ is

$$(13)\quad L_m(\rho_m) = \begin{cases} 1 - G_m(V(J_m + 1, \rho_m)) & \text{if } J_m = 0 \\ \left[G_m(V(J_m, \rho_m)) - G_m(V(J_m + 1, \rho_m))\right] P(\boldsymbol{\tau}_m, \rho_m) & \text{if } J_m > 0, \end{cases}$$

[28] We use supply conditions to identify the price coefficient because we lack compelling exclusion restrictions but we have reasonably good information on variable markups for the typical newspaper. We use the first-order condition from monopoly markets rather than oligopoly markets so that our estimate of the price coefficient do not depend on conduct assumptions, though of course our approach still relies on strong assumptions such as uniform (and observed) marginal costs, the parametric structure we have assumed for consumer demand, and the assumptions about the game between newspapers and advertisers.

where G_m is the CDF of κ_m/S_m. Here we make explicit that both $V(\,)$ and $P(\,)$ depend on ρ_m and so drop the m subscripts. The unconditional log likelihood of the data is

$$\ln L = \sum_{(m,m')} \ln \int_{\rho_m,\rho_{m'}} L_m(\rho_m)\, L_{m'}(\rho_{m'})\; dF^{mkt}(\rho_m,\, \rho_{m'} | Z_m,\, Z_{m'})\,, \tag{14}$$

where $F^{mkt}(\,)$ is the conditional joint distribution of ρ_m and $\rho_{m'}$ and the sum is taken over all pairs of neighboring markets.

We estimate the remaining parameters $\left\{a_l,\, \sigma_\xi,\, \mu_\nu^{mkt},\, \sigma_\nu^{mkt},\, \mu_\kappa^0,\, \mu_\kappa^1,\, \sigma_\kappa\right\}$ by maximizing equation (14), taking as given the demand parameters $\left\{\alpha,\, \underline{\beta},\, \overline{\beta},\, \Gamma_d,\, \Gamma_s\right\}$ estimated as described in Section V.[29]

A. *Identification*

The overall share of newspapers choosing a Republican affiliation pins down μ_ν^{mkt}, and the variance of unobserved ideology σ_ν^{mkt} is identified by spatial correlation in affiliation choices as outlined in Section IIIC.

Given these parameters and the demand parameters, the correlation between entrant and incumbent affiliations (shown in Table 4) identifies the diminishing returns in advertising, captured by the parameter a_l. The intuition is that, because the demand estimates reported below imply that overlap in readership is greater between newspapers of the same affiliation than newspapers of a different affiliation, lower values of a_l correspond to a stronger incentive to differentiate in order to soften advertising competition, so a_l is identified by the extent to which newspapers differentiate more than would be expected from the substitution and price effects predicted from the demand system. Entry patterns also contribute to the identification of a_l, as they are informative about the extent to which per-newspaper profits decline with the number of newspapers.

The scale term σ_ξ is identified by residual variation in newspapers' affiliation choices.

The correlation between the number of newspapers and the market's population determines μ_κ^0 and μ_κ^1, and the extent of variation in the number of newspapers conditional on population determines σ_κ.

Although this heuristic discussion of identification treats the different steps as separable, the supply parameters are in fact jointly determined and jointly estimated.

VII. Results

A. *Parameter Estimates and Determinants of Diversity*

Tables 5 and 6 report estimates of demand and supply parameters, respectively, along with asymptotic standard errors. In the online Appendix, we present Monte

[29] We approximate the integral in the likelihood using 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.

TABLE 5—PARAMETER ESTIMATES (*Demand model*)

Price coefficient (α)	0.1798
	(0.0032)
Mean utility for different-affiliation paper ($\underline{\beta}$)	−0.2906
	(0.0676)
Mean utility for same-affiliation paper ($\overline{\beta}$)	0.8137
	(0.0759)
Substitutability between same-type papers (Γ_s)	0.5645
	(0.0669)
Substitutability between different-type papers (Γ_d)	0.3004
	(0.0469)
Standard deviation of log of measurement error (σ_ζ)	0.7017
	(0.0077)
Mean of unobservable shifter of fraction Republican (μ_ν^{town})	0.0466
	(0.0422)
Standard deviation of unobservable (σ_ν^{town})	0.2783
	(0.0135)
Parameters governing share of town's newspapers that are Republican	
μ_ρ^0	−0.0714
	(0.0850)
μ_ρ^1	1.9952
	(0.0336)
Calibrated parameters	
Marginal cost (MC)	8.1749
Spatial correlation of unobservable $\left(\frac{\text{cov}(\nu_t, \nu_{t'})}{\text{var}(\nu_t)}\right)$	0.7233
Number of towns	12,188
Number of newspapers	670
Number of newspaper-towns	28,779

Notes: Table shows maximum likelihood estimates of demand model parameters with asymptotic standard errors in parentheses. See Section V for details.

Carlo experiments and experiments with random starting values for both sets of parameters.

The qualitative patterns in both sets of parameters accord with economic intuition and the descriptive evidence in Tables 3 and 4. On the demand side, households prefer newspapers whose affiliations match their own. Bundles of newspapers produce less utility than the sum of the utilities produced by the component papers alone, and these diminishing returns are greater for same-type newspapers than for opposite-type newspapers. There is substantial unobserved heterogeneity in household ideology across towns, which in turn is correlated with the fraction of available newspapers that are Republican. On the supply side, advertising rates are lower for overlapping readers than for singleton readers, and unobserved heterogeneity is less important.[30]

[30] The fact that unobservables are less important in the supply model than in the demand model may come from the fact that county vote share is a better proxy for the ideology of large markets than of small towns. In the online Appendix we show that unobserved heterogeneity matters in the sense that estimates of key demand parameters change meaningfully when we omit unobservable heterogeneity from the model.

Table 6—Parameter Estimates (*Supply model*)

Advertising revenue per reader of non-singleton bundles (a_l)	7.4447
	(1.2626)
Standard deviation of affiliation cost shocks (σ_ξ)	0.2277
	(0.0298)
Mean of unobservable shifter of fraction Republican (μ_ν^{mkt})	−0.0114
	(0.0184)
Standard deviation of unobservable (σ_ν^{mkt})	0.1523
	(0.0684)
Parameters governing the distribution of fixed costs	
μ_κ^0	8.7354
	(0.4860)
μ_κ^1	−0.6448
	(0.0618)
σ_κ	0.3607
	(0.0345)
Calibrated parameters	
Advertising revenue per reader of singleton bundles (a_h)	13.4707
Spatial correlation of unobservable $\left(\frac{\text{cov}(v_m, v_{m'})}{\text{var}(\nu_m)}\right)$	0.7217
Number of markets	1,910
Number of newspapers	1,338

Notes: Table shows maximum likelihood estimates of supply model parameters with asymptotic standard errors in parentheses adjusted for the uncertainty in demand parameters (Murphy and Topel 1985). See Section VI for details.

Our model implies that readership overlaps more between papers of the same affiliation than papers of different affiliations, a fact consistent with evidence reported in the online Appendix from our readership surveys. For example, in data simulated from our model for two-paper markets, the average readership overlap for same-affiliation papers is 17 percent, compared to 14 percent for opposite-affiliation papers. This results from the strong taste for like-minded news ($\overline{\beta} - \underline{\beta}$) outweighing the greater substitutability of same-affiliation papers ($\Gamma_s > \Gamma_d$).[31] As noted above, it implies that advertising competition will increase incentives to differentiate politically.

The estimated parameters of the fixed cost distribution appear reasonable. In simulation we find that the mean fixed cost of monopoly newspapers is $9.03 per copy, as against $7.73 in the Inland Press data. The concept measured by the model incorporates sunk costs and opportunity costs that may not be reflected in financial data, so it is intuitive that the estimated fixed costs are somewhat higher than those in the Inland Press data. The model implies that fixed costs per capita decline very slowly with the size of the market: a 10 percent increase in population reduces fixed costs per capita by only six cents. This is consistent with the Inland Press data, which show essentially no relationship between fixed costs per copy and the number of copies sold.

[31] The large difference between $\overline{\beta}$ and $\underline{\beta}$ is in turn driven by the strong relationship between vote shares and the relative circulation of Republican papers.