A Spatial Theory of News Consumption and Electoral Competition*

Jimmy Chan
Johns Hopkins University

Wing Suen
The University of Hong Kong

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Abstract. This paper introduces a model in which rational voters select news sources with ideological positions similar to their own. We find that extreme media outlets do not influence political outcomes, and that new entry always makes party policies more centrist. In an optimal media, diversity of viewpoints is more important than unbiased reporting. A slightly partisan media outlet, which is trusted by the supporters of a party, is more effective than a completely centrist one in inducing the party to adopt less partisan policies. In a commercial media market, voter welfare is typically higher under duopoly than under monopoly.

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1 Introduction

The news media industry is unlike any other industry in that its output—news—influences political outcomes. For many voters, the mass media are the main source of political information. A recent survey in the United States finds that 65 percent of the respondents regularly read newspapers and 80 percent regularly watch television news programs.[1] Because of its role in the political process, the news media industry is one of the most tightly regulated. In many countries, there are restrictions on market concentration and foreign ownership, and mainstream news media, especially television news, are often required to provide equal coverage to all major electoral candidates.[2]

While a large majority of voters watch television news or read daily newspapers, many of them pay little attention to the content—only about half of the respondents in the survey cited above can correctly name the current Secretary of State. Because of the short attention span of news consumers, media outlets must apply some principles to select a small fraction of information to convey to its consumers. Thus, no media outlet can be truly "neutral." As Walter Lippmann put it in his seminal work on the media and public opinion:

> Every newspaper when it reaches the reader is the result of a whole series of selections as to what items shall be printed, in what position they shall be printed, how much space each shall occupy, what emphasis each shall have. There are no objective standards here.[3]

A central question in the study of media influence on politics concerns the principles the media use to select news. It is often claimed that the media should be "unbiased" or have "diverse" viewpoints. While these notions are intuitively appealing, their meanings are unclear. Should the media adopt the viewpoint of the median voter, or should they represent different viewpoints? How diverse should they be? The answers to these questions affect our attitude toward media regulation. One of the main arguments

[1] The Biennial Survey of Media Consumption, The Pew Research Center for the People and the Press, 2002.

[2] In the United States, the Federal Communication Commission (FCC) revoked the so called "fairness doctrine" in 1987, but it is unclear whether the rule still applies. Several channels, for fear of violating FCC rules, canceled plans to run films starring Arnold Schwarzenegger in California ahead of the election in 2003 to recall Governor Gray Davis because Schwarzenegger was a candidate in the election. See Dorf (2003) for details.

[3] Lippman (1997, p. 223)

in the United States against the relaxation of the ownership rules of media companies is that doing so may reduce program diversity.

To fully understand the political role of the media, we must take into account of the fact that consumers are not passive receivers of news. The first column of Table 1 lists the ratio of Republicans to Democrats among regular followers of several popular news and current affairs programs (normalized by the ratio of Republicans to Democrats in the sample). A ratio greater than one indicates that a show is relatively more popular among Republicans. The Fox Cable News Channel is generally regarded to be more conservative than the Cable News Network (CNN) and the national broadcast networks (e.g., Groseclose and Milyo 2004; Kull, Ramsay, and Lewis 2004), and Table 1 shows that Fox indeed attracts a more conservative core audience than CNN and the nightly news of the broadcast networks. This table also shows that the National Public Radio is more popular among Democrats, while the two conservative talk shows, *The Rush Limbaugh Radio Show* and *The O'Reilly Factor,* attract a mostly Republican audience. The second column of Table 1 shows the same pattern when we replace Republicans with white evangelical Christians, who tend to be socially conservative and Republicans. Since religious beliefs are unlikely to be caused by news consumption, these figures suggest that the positive correlation between the ideological stances of the news sources and those of their audiences is at least in part caused by self-selection.

The purpose of this paper is to construct a model of news consumption and electoral competition that captures the tendency of news consumers to consume news from media outlets whose ideological positions are close to their own. Using this model, we examine the media's influence on party policies, derive the media's optimal editorial positions, and analyze voter welfare under different market structures.

Our model consists of an electoral campaign and a media market. In the electoral campaign, two political parties compete by adopting either a liberal or a conservative policy as platform. Voters' preferences over the two policies depend on a one-dimensional state variable, which summarizes all information regarding the desirability of the policies. Before they vote, voters learn about the state through the media. We capture the limited capacity of a media outlet by the assumption that it can report only whether the state exceeds a certain threshold. Intuitively, the threshold represents the editorial position or principle a media outlet uses to select news. A media outlet with a high reporting threshold is more conservative in the sense that it is more likely to report that the state is below its threshold (lower states favor the conservative policy). The editorial position of a media

Table 1
Audience Composition of Several News Sources in the United States

News Sources	% Rep ÷ % Dem[a]	% WEC ÷ % non-WEC[b]
national nightly news (ABC, CBS, NBC)	0.98	1.06
Cable News Network	1.00	1.10
Fox Cable News Network	1.27	1.21
National Public Radio	0.86	0.77
The O'Reilly Factor	3.34	1.30
The Rush Limbaugh Radio Show	7.90	1.27

Note: In the sample, 935 respondents are Republicans and 957 are Democrats; 760 are white evangelical Christians and 2242 are not.
[a] The figures in the first column are the fraction of Republicans who regularly watch or listen to the shows divided by the fraction of Democrats who do the same.
[b] The figures in the second column are the fraction of white evangelical Christians who regularly watch or listen to the shows divided by the fraction of non-whites or non-evangelical Christians who do the same.
Source: Biennial Media Consumption Survey, The Pew Research Center for the People and the Press, 2002.

outlet determines the informational content of its reports and, hence, the voting behavior of its consumers. Since coarse information from like-mined sources is more valuable for informing voting decisions than information from other sources (Suen, 2004), voters consume news from media outlets whose editorial positions are the closest to their own ideological preferences. This captures the news consumption pattern shown in Table 1.

News media affect not only voting behavior. By informing voters which policy better serves their interests, the media also indirectly make the parties more responsive to the needs of the voters. A main advantage of our approach is that it explicitly models the effects of the media on party policies. In our model, the editorial position of a media outlet affects political outcomes through three channels:

- *Direct effect.* When a media outlet changes its editorial position, it directly affects the voting behavior of its readers in some states.

- *Readership effect.* A change in editorial position also affects a media outlet's readership. As a media outlet becomes more conservative, it attracts conservative readers from more conservative media outlets while losing liberal readers to outlets that are more liberal.

- *Policy effect.* Since a media outlet's editorial position affects voting behavior, it indirectly alter the incentives of the parties to choose a certain policy.

The first two effects tend to work in opposite directions. As a media outlet becomes a stronger champion of a certain policy, it drives out undecided moderate readers and attracts like-minded readers who would have supported the policy without reading the news. Although media outlets with extreme views may attract a loyal readership, their influence is limited since they are merely preaching to the converted.

The policy effect of the media is not monotone. When a relatively moderate media outlet adopts a more liberal editorial position, it attracts more liberal voters, who otherwise would have supported the liberal party unconditionally, to read its news. This effect causes the liberal party to adopt the liberal policy *less* often. At some point, however, the editorial position of the media outlet eventually becomes a binding constraint on the policy choice of the liberal party. The liberal party then always chooses the policy favored by the media outlet for fear of losing the votes from consumers of this media outlet. Beyond that point, as the editorial position of the media outlet becomes even more liberal, the liberal party will have to adopt the liberal policy *more* often.

A welfare analysis of the media should include all three effects. Since a slightly partisan media outlet may be more effective than a completely centrist one in inducing a party to adopt less partisan policies, bias reporting by individual media outlets may not be as harmful to democracy as some media critics describe. In fact, we find that regardless of the number and editorial positions of the incumbent newspapers, a new entrant can only make party policies (weakly) more centrist. For a fixed number of media outlets, voter welfare is maximized when the outlets have a diverse set of editorial positions. The optimal editorial positions depend on both the preferences of voters as well as that of the political parties. Everything else equal, the media should take more liberal positions when the parties are liberal.

In recent years, the news media industry has become more commercialized. The trend is particularly pronounced in network news. In the 1960s and 1970s, news was viewed by the networks as a form of public service.

But as a result of deregulation and ownership changes, the importance of profit has grown significantly. In 1999, a thirty-second advertisement on the *NBC Nightly News* costs on average $54,200.[4] In order to understand how the profit motive shape the news content, we use our model to compare editorial positions under monopoly and duopoly in a commercial media market where each individual media outlet chooses an editorial position to maximize the size of its audience. We find that although both media outlets choose the same editorial position under duopoly, the chosen position is in general different from the one chosen by a monopoly. The duopoly position tends to result in higher voter welfare when the policy effect is weak. We also find that two media outlets under joint ownership produce greater variety in editorial content than two competing media outlets. This result has been anticipated by Steiner (1952), and it receives some empirical support from the work of George (2001). What we show in this example, however, is that greater variety does not always bring about greater welfare when the policy effect is taken into account. Although our example is too stark a model to capture all the complexities in the real world, it serves as a useful reminder about the special status of the media industry in modern democracies.

2 Related Literature

The economic analysis of the role of information in political competition begins with Downs (1957). Stromberg (2004a) constructs a formal model of electoral competition in which the mass media affect public policy since they provide a channel through which politicians convey campaign promises to the electorate. He shows that the technology of the mass media induces media firms to provide more news to large groups and to groups that are more valuable to advertisers, thereby creating an incentive for politicians to bias public policy in favor of these groups. Stromberg (2004b) offers some evidence regarding the impact of radio ownership on the distribution of New Deal relief programs. The main difference between Stromberg's model and ours is that we assume that the preferences of voters are ordered along a one-dimensional space. We shift attention away from distributional issues and focus instead on the spatial aspects (i.e., left versus right) of political competition.

There is a growing theoretical literature on the economics of news. Mullainathan and Shleifer (2005) consider a model where the media slant the news to satisfy biased readers who prefer news that conform to their existing

[4] On the changing nature of network news, see Hamilton (2004), Chapter 6.

beliefs. They analyze the effects of competition and beliefs heterogeneity on average media bias. Balan, DeGraba and Wickelgren (2004) compare the levels of "ideological persuasion" under monopoly and under duopoly in a model where owners of media outlets directly choose the amount of persuasion for their outlets. Anderson and McLaren (2004) examine similar issues using a rational-choice model where the media manipulate the beliefs of news consumers by hiding information. Baron (2004) suggests that media owners may tolerate bias reporting in exchange for paying lower wages to ideologically-driven journalists.

Our model is different from the ones mentioned above in that it explicitly models the process of electoral competition. This allows us to study the media's effect on party policies. Another crucial difference is that all the papers mentioned above assume an objective notion of unbiasedness. As a result, in their models media bias is bad by supposition, and there is no normative reason for the media to contain diverse viewpoints (since all outlets should be unbiased). Since in our model every media outlet must report selectively, whether a media outlet is biased can only be defined with respect to the policy preferences of a specific group of news consumers. It is therefore natural in our model that media outlets should adopt different editorial positions.

Finally, our model is related to Chan and Suen (2004). The key difference between that model and the present one concerns with the structure of the policy space. Since Chan and Suen (2004) are mainly interested in the extent to which parties can signal the state through policy platforms, they allow for a rich set of signals by making the policy space continuous. They show that even then the media may still affect political outcomes through its effect on party policies. The present model, by assuming a binary policy space, provides a more complete picture of the political role of the media, capturing both their effect on party policies, as well as that on voting behavior. For this reason, the present model is better suited for welfare analysis and the study of the industrial organization of the media market.

3 The Model

3.1 Electoral Competition

Two political parties, L and R, compete for an electoral office. There are two feasible policies, namely l and r. There is a continuum of voters of unit mass. The policy preference of a voter j is represented by the utility function

$$v_j(y,\theta) = \begin{cases} \theta - b_j & \text{if } y = l, \\ 0 & \text{if } y = r; \end{cases} \tag{1}$$

where θ, which is uniformly distributed on $[0,1]$, denotes the state of the economy. The parameter b_j measures voter j's preference for policy r. We refer to b_j as voter j's ideal position—voter j prefers l to r if and only if $\theta \geq b_j$. Voters' ideal positions follow an atomless distribution F on the support $[0,1]$. The median position is b_m (i.e., $F(b_m) = 0.5$). While voters have diverse policy preferences, they share a common party preference measured by δ. Let y_i denote party i's policy. The total utility of voter j is $v_j(y_L, \theta)$ if party L is elected and is $v_j(y_R, \theta) + \delta$ if party R is elected.

The policy preference of party $i \in \{L, R\}$ takes the form:

$$u_i(y,\theta) = \begin{cases} \theta - \beta_i & \text{if } y = l, \\ 0 & \text{if } y = r. \end{cases}$$

The parameter $\beta_i \in (0,1)$ denotes party i's ideal position—other things equal, party i prefers policy l to r if and only if $\theta \geq \beta_i$. The parties' policy preferences are systematically different from that of the median voter. In particular, we assume $\beta_L < b_m < \beta_R$. For convenience, we refer to party L's preference as liberal and party R's as conservative. In addition to policy payoffs, a party receives a rent $d > 0$ when it holds office. Party i's total utility is $u_i(y,\theta) + d$ when elected, and $u_i(y,\theta)$ when not.

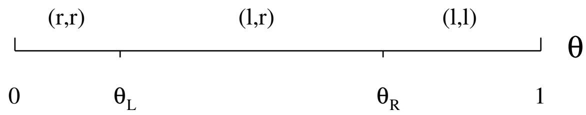
Voters' common party preference δ has an atomless distribution π that is symmetric across zero and has zero mean on the support $[\underline{\delta}, \overline{\delta}]$. When the parties choose policies, they know θ, F, and π, but not the actual value of δ. The parties' uncertainty over δ means that they cannot predict with certainty the electoral outcome given party policies.

A strategy for party $i \in \{L, R\}$ is a function that assigns a policy y_i to each state θ; it is monotone if it prescribes policy l if and only if θ exceeds some cut-point. Since the payoff to policy l is increasing in θ for both parties, we focus on equilibria in which both parties' strategies are monotone.

3.2 Mass Media and Voter Behavior

Before they vote, voters may acquire information about θ through the media. As it is not our main objective to explain voters' news consumption behavior, we do not try to model voters' time-allocation decision as a utility maximization problem. Instead, we stipulate that voters follows a news

Figure 1



consumption rule (which we introduce below). Taking this rule as the starting point, we characterize the optimal behavior of the political parties and explore the political influence of the media.

Since the amount of time voters are willing to spend on news is limited, news reports must be highly condensed. We capture this information constraint by the assumption that news reports must take the form of binary messages. Specifically, we assume there are n media outlets, which, for convenience, we will refer to as newspapers. Each newspaper k can report only whether θ is less than some cut-point θ_k, which we refer to as newspaper k's "editorial position." Intuitively, a newspaper's editorial position represents the criteria it uses to judge whether a piece of information is newsworthy. For example, suppose θ depends on a large number of factors, and a newspaper only has space to report one. Then an editorial policy θ_k in our model is equivalent to a rule that reports an element favoring policy l when θ is greater than θ_k and an element favoring policy r when θ is less than θ_k. Since voters' preference for policy l is increasing in θ, we say media outlet k reports l if $\theta \geq \theta_k$ and r if $\theta < \theta_k$. A newspaper can commit to any editorial position. But once chosen, the position is fixed and known to all voters. In reality, a media outlet's editorial reputation is an important aspect of its product characteristics and is hard to change.

We focus on equilibria in which both parties choose monotone strategies. Let θ_L and θ_R denote the cut-points of parties L and R, respectively. Since party L likes policy l better than party R does, we also assume $\theta_L < \theta_R$. Under these policies, the state space is divided into three regions:

$$(y_L, y_R) = \begin{cases} (l, l) & \text{if } \theta \leq \theta_L, \\ (l, r) & \text{if } \theta \in (\theta_L, \theta_R], \\ (r, r) & \text{if } \theta > \theta_R. \end{cases}$$

See Figure 1.

Voters vote for the party that maximizes their expected utility. A voter j, whose expectation over θ is $\tilde{\theta}_j$, votes for party L if and only if

$$I(y_L, y_R)(\tilde{\theta}_j - b_j) \geq \delta, \tag{2}$$

where

$$I(y_L, y_R) = \begin{cases} 1 & \text{if } (y_L, y_R) = (l, r), \\ 0 & \text{if } y_L = y_R. \end{cases}$$

Voter j prefers policy l to r when $\tilde{\theta}_j$ is greater than $b_j + \delta$. In the following, we refer to $b_j + \delta$ as voter j's "indifference position."

Voters' posterior beliefs over θ are consistent with Bayes' rule whenever the rule is well-defined. In events where Bayes' rule is not defined, we assign specific values to these beliefs in order to ease exposition. The specific values of these off-equilibrium beliefs are not important to our results.

Information about θ matters only when the parties choose different policies. Consider the case where party L chooses l and party R chooses r. If voter j does not read any newspaper, then his only information, based on the party strategies, is that θ is between θ_L and θ_R. If he reads newspaper k, then he also knows whether or not θ exceeds θ_k. When $\theta_k \in (\theta_L, \theta_R)$, voter j updates his expectation over θ via Bayes' rule. When $\theta_k \leq \theta_L$, the newspaper is expected to report l when party L chooses l and party R chooses r. While an l report from such a newspaper is not informative, an r report indicates that party L has deviated. In the latter case, Bayes' rule is not defined, and we assume the voter would believe θ is exactly θ_k.[5] Similarly, we assume voter j would believe θ is θ_k after reading an l report from a newspaper with editorial position $\theta_k \geq \theta_R$. To summarize, voter j's expectation of θ, conditional on different parties' policies and newspaper k's report, is

$$\tilde{\theta}_j(e) = \begin{cases} 0.5(\theta_L + \theta_R) & \text{if } e = 0, \\ 0.5(\max\{\theta_k, \theta_L\} + \max\{\theta_k, \theta_R\}) & \text{if } e = l_k, \\ 0.5(\min\{\theta_k, \theta_L\} + \min\{\theta_k, \theta_R\}) & \text{if } e = r_k; \end{cases} \tag{3}$$

where $e = 0$ denotes the event that voter j does not read any newspaper, and $e = x_k$ the event that voter j learns that newspaper k reports $x \in \{l, r\}$.[6]

The editorial positions of the n newspapers are denoted by $\theta_1 \leq \theta_2 \leq \ldots \leq \theta_n$. We assume the sole reason voters consume campaign news is to cast an informed vote, and they only read newspaper when party L chooses l and party R chooses r.[7] When $(y_L, y_R) = (l, r)$, a voter j with indifference position $b_j + \delta$ less than $0.5(\theta_L + \theta_R)$ will vote for party L if he does not

[5]In principle the voter may believe θ is of any value less than θ_k.

[6]Since voters never observe $(y_L, y_R) = (r, l)$ on the equilibrium path under monotone party strategies, their beliefs over θ in this event cannot be derived from the Bayes' rule. We assume in this case that $\tilde{\theta}_j = b_m$ and, hence, the median voter is indifferent between l and r.

[7]Voters' news consumption behavior off the equilibrium path when $(y_L, y_R) = (r, l)$

read newspapers, and a newspaper is of value to him only if an r report can change his vote from L to R. Similarly, a newspaper is of value to a voter with indifference position greater than $0.5\,(\theta_L + \theta_R)$ only if it can change his vote from R to L when it reports l.

Define the value of newspaper k to voter j as

$$V_j(k) = \begin{cases} \max\{0, (\theta_k - \theta_L)(b_j + \delta - 0.5(\theta_k + \theta_L))\} & \text{if } b_j + \delta \le 0.5(\theta_L + \theta_R), \\ \max\{0, (\theta_R - \theta_k)\,(0.5(\theta_k + \theta_R) - b_j - \delta)\} & \text{otherwise.} \end{cases}$$

The value $V_j(k)$ is the gain in expected utility for voter j when he, assuming that his vote is decisive, votes for the party whose policy the newspaper reports rather than the party he would have voted for in the absence of information. We assume that in the event $(y_L, y_R) = (l, r)$, voters read the newspaper that has the highest non-negative value and whose editorial position lies between $[\theta_L, \theta_R]$.

Since any newspaper whose editorial position lies outside $[\theta_L, \theta_R]$ is not read, we assume in this section that $\theta_1 \ge \theta_L$ and $\theta_n \le \theta_R$. Write θ_0 for θ_L and θ_{n+1} for θ_R. Suppose all newspapers have distinct positions. Define for $k \in \{1, \ldots, n\}$ the "territory" of newspaper k as

$$T_k = [0.5\,(\theta_{k-1} + \theta_k)\,, 0.5\,(\theta_k + \theta_{k+1})]\,. \tag{4}$$

For any two newspapers $k < k'$, $V_j(k) \ge V_j(k')$ if $b_j + \delta \le 0.5\,(\theta_k + \theta_{k'})$. Hence, a voter j reads newspaper k if and only if $b_j + \delta$ belongs to T_k. Let $q\,(b_j, \delta) \in \{1, \ldots, n\}$ denote the newspaper choice of a voter with policy preference b_j and party preference δ when the parties choose different policies. We have

$$q\,(b_j, \delta) = \begin{cases} k & \text{if } b_j + \delta \in T_k, \\ 0 & \text{otherwise;} \end{cases} \tag{5}$$

where $q = 0$ means not reading newspapers.[8] When two newspapers have the same position, assume that each captures half of the readers in their common territory.

Equations (5), (3), and (2) fully characterize the beliefs and voting behavior of the voters when $(y_L, y_R) = (l, r)$. Since a voter reads a newspaper only if the value of the newspaper is non-negative, (2) implies that a voter always votes for the party reported by the newspaper he reads. Since $q\,(b_j, \delta)$ is the most informative newspaper for voter j, for any newspaper

affects neither their votes (given their beliefs that $\tilde{\theta} = b_m$) nor the incentives of newspapers to adopt a particular editorial position.

[8] According to (5), voters with $b+\delta \in [\theta_1, 0.5(\theta_1 + \theta_2)]$ read newspaper 1 when $\theta_1 = \theta_L$. Similarly, voters with $b + \delta \in [0.5(\theta_{n-1} + \theta_n), \theta_n]$ read newspaper n when $\theta_n = \theta_R$.

$k \neq q(b_j, \delta)$, voter j would rather vote for the party reported by $q(b_j, \delta)$ than the one reported by k when the two report differently. Thus, voters who seek to minimize the cost of reading news and who care only about casting the right vote would have no reason to read more than one newspaper. Even if they did, the argument above means that their voting behavior would remain unchanged.

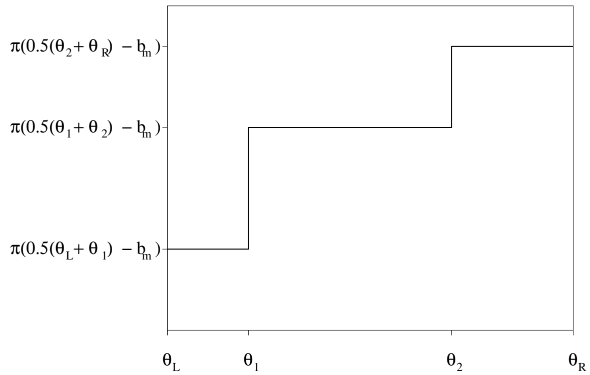
While our rule of news consumption is not derived from utility maximization (as a single vote is never decisive and the cost side is not modeled), we feel that it provides a reasonable foundation for the study of media influence on politics. It is a common assumption in the political economy literature that voters participate and vote for the party they like better in two-party elections even though the pivotal probability of a single vote is practically zero. Our news consumption rule is an extension of that assumption—if the goal of the voters is to vote for the better party, then it is natural to assume that they select media outlets that will help them figure out which party is actually better. More importantly, the news consumption rule is consistent with actual consumption behavior: A large fraction of voters consume some political news, and they tend to pick media outlets that share their political views. The reason why they behave in this way is not important for our purposes. Our results will be unchanged, for example, if consumers simply "like" media outlets that share their political views à la Mullainathan and Shleifer (2005). Obviously, in reality a consumer's choice of media outlet is affected by factors other than ideologies. Allowing for that possibility would not fundamentally affect our results.

3.3 Political Equilibrium

To summarize, the political process proceeds as follows. First, θ is realized. Each party proposes a policy $y \in \{l, r\}$ on the basis of θ. Then δ is realized. Voters decide whether to consume news according to (5) after they observe (y_L, y_R) and δ. The election is conducted. Voters vote according to (2). The party that receives a majority of votes wins and implements its proposed policy.

By (5), if a voter with policy preference b reads newspaper k, then any voter with policy preference $b' < b$ must read a newspaper $k' \leq k$. If newspaper k reports l, newspaper k' must also report l. Since a voter always votes for the party reported by the newspaper he reads, if a voter with policy preference b votes for party L, then a voter with policy preference $b' < b$ must also vote for L. Due to this single-crossing property, the outcome of the election is determined by the vote of the median voter.

Figure 2



Let

$$k^*(\theta) \equiv \max\{k \in \{0, 1, \ldots, n\} \mid \theta_k \leq \theta\}$$

denote the newspaper with the most conservative editorial position among those that report l in state θ. Since voters always vote for the party reported by the newspaper they read, party L is elected when the median voter is a reader of a newspaper $i \leq k^*(\theta)$; that is, when $b_m + \delta \leq 0.5(\theta_{k^*(\theta)} + \theta_{k^*(\theta)+1})$. Hence, party L's probability of election is an increasing step function in θ, with jump points at θ_k, $k = 1, \ldots, n$. See Figure 2.

When the parties choose the same policy, or when party L chooses r and party R chooses l, each party is elected with probability 0.5. When party L chooses l and party R chooses r in state θ, party L is elected with probability $\pi(\delta^*(\theta))$, where

$$\delta^*(\theta) \equiv 0.5(\theta_{k^*(\theta)} + \theta_{k^*(\theta)+1}) - b_m.$$

Let $U_i(y_L, y_R, \theta, \theta_L, \theta_R)$ denote party i's expected payoff in θ as a function of the parties policies (y_L, y_R) and their overall strategies (θ_L, θ_R). (Note that δ^* depend on (θ_L, θ_R).) For $i \in \{L, R\}$,

$$\begin{aligned} U_i(l, l, \theta, \theta_L, \theta_R) &= 0.5d + \theta - \beta_i, \\ U_i(r, r, \theta, \theta_L, \theta_R) &= 0.5d, \\ U_i(r, l, \theta, \theta_L, \theta_R) &= 0.5(d + \theta - \beta_i); \end{aligned}$$

and

$$\begin{aligned} U_L(l, r, \theta, \theta_L, \theta_R) &= \pi(\delta^*(\theta))(d + \theta - \beta_L), \\ U_R(l, r, \theta, \theta_L, \theta_R) &= (1 - \pi(\delta^*(\theta)))d + \pi(\delta^*(\theta))(\theta - \beta_R). \end{aligned}$$

Definition 1 *A pair of monotone strategies θ_L and θ_R, $\theta_L < \theta_R$, is a Nash equilibrium of the electoral game if, given that voters expect the parties to adopt (θ_L, θ_R), neither party has incentives to deviate from its own strategy in any state; that is, for each i, $j \in \{L, R\}$, $i \neq j$, $y_i \in \{l, r\}$, and $\theta \in [0,1]$,*

$$U_i(\sigma_i(\theta), \sigma_j(\theta), \theta, \theta_L, \theta_R) \geq U_i(y_i, \sigma_j(\theta), \theta, \theta_L, \theta_R),$$

where, for $i \in \{L, R\}$,

$$\sigma_i(\theta) = \begin{cases} l & \text{if } \theta > \theta_i, \\ r & \text{if } \theta \leq \theta_i. \end{cases}$$

So far, it is assumed that the equilibrium is monotone. In fact, in any equilibrium in which the parties' strategies are not identical and in which the probability that a party proposing l is elected over one proposing r is increasing in θ, the parties' strategy must be monotone, and party L's cut-point must be lower than party R's. A formal proof of this statement is provided in Appendix A. There are non-monotone equilibria in which the parties choose the same strategy.[9] But these equilibria require strong assumption on voters off-equilibrium beliefs. Furthermore, in these equilibria the news media obviously would play no role as the parties' policies are always identical.

4 Equilibrium Party Policies

In this section we seek to understand how the media can use their control on voter information to influence party positions. To set up a benchmark for the subsequent analysis, we first consider the case where voters directly observe θ. Since voters have full information about θ, the parties' policy decisions in each state can be analyzed independently as a 2×2 game described by the payoffs shown in Table 2.

Since $\pi(\theta - b_m) \geq 0.5$ if and only if $\theta \geq b_m$, policy l is a strictly dominant strategy for party L when $\theta \in [b_m, 1]$, and policy r is a strictly dominant strategy for party R when $\theta \in [0, b_m]$. Since $\pi(\theta - b_m)$ increases in θ, there is a unique pair $\left(\theta_L^{FI}, \theta_R^{FI}\right)$, with

$$\beta_L < \theta_L^{FI} < b_m < \theta_R^{FI} < \beta_R,$$

[9] For example, it is an equilibrium for both parties to always choose l if voters never elect a party that chooses r off the equilibrium path.

Table 2

Payoff Table for Full Information Game

		R: l	R: r
L	l	$0.5d + \theta - \beta_L$, $0.5d + \theta - \beta_R$	$\pi\left(\theta - b_m\right)\left(\theta - \beta_L + d\right)$, $\pi(\theta - b_m)\left(\theta - \beta_R - d\right) + d$
	r	$\left(1 - \pi(b_m - \theta)\right)\left(\theta - \beta_L - d\right) + d$, $\left(1 - \pi(b_m - \theta)\right)\left(\theta - \beta_R + d\right)$	$0.5d$, $0.5d$

such that

$$\pi\left(\theta_L^{FI} - b_m\right)\left(\theta_L^{FI} - \beta_L + d\right) = 0.5d, \tag{6}$$

$$\left(1 - \pi\left(\theta_R^{FI} - b_m\right)\right)\left(d - \theta_R^{FI} + \beta_R\right) = 0.5d. \tag{7}$$

In state θ_i^{FI}, $i = \{L, R\}$, party i is indifferent between the two policy platforms. Since the payoff for proposing policy l is higher in higher states, party i is better off proposing policy l if and only if $\theta \geq \theta_i^{FI}$. We thus establish the following result:

Proposition 1 *When voters observe θ, there is a unique equilibrium in which each party $i \in \{L, R\}$ proposes l if and only if $\theta \geq \theta_i^{FI}$.*

Next, we consider the other benchmark case where voters observe only party strategies. In this case, a party's probability of election in any state depends on voter's expectation of the parties' overall strategy. To analyze this situation, define the functions $\rho_L(x)$ and $\rho_R(x)$ for $x \in [0, 1]$ by the equations

$$\pi(0.5(\rho_L(x) + x) - b_m)(\rho_L(x) - \beta_L + d) = 0.5d; \tag{8}$$

$$(1 - \pi(0.5(\rho_R(x) + x) - b_m))(d - \rho_R(x) + \beta_R) = 0.5d. \tag{9}$$

It is straightforward to check that ρ_L and ρ_R are well-defined and are both decreasing functions. To simplify the subsequent exposition, we assume $\rho_L(1) > 0$ and $\rho_R(0) < 1$.[10]

Equations (8) and (9) are the imperfect-information analogue of (6) and (7). For example, $\rho_L(x)$ is the state in which party L is indifferent between policy platforms l and r when party R chooses r and the median voter's

[10] This is a fairly weak assumption, which holds so long as $|b_m - 0.5|$ is not "too" large. The assumption ensures that in the case where voters observe only party policies, the parties' equilibrium cut-points are strictly between 0 and 1.

expectation of θ is $0.5(\rho_L(x)+x)$. Note that the full-information cut-points θ_L^{FI} and θ_R^{FI} satisfy the conditions

$$\theta_L^{FI}=\rho_L\left(\theta_L^{FI}\right) \text{ and } \theta_R^{FI}=\rho_R\left(\theta_R^{FI}\right).$$

When voters observe only party policies, they know only that θ is between θ_L and θ_R when the parties disagree. Conditional on $(y_L,y_R)=(l,r)$, voters' expectation of θ is $0.5\left(\theta_L+\theta_R\right)$. Since the payoff from choosing l is increasing in θ, a necessary and sufficient condition for (θ_L,θ_R) to be an equilibrium is that each party must be indifferent between the two policy platforms at its own cut-point; that is, (θ_L,θ_R) must satisfy the condition

$$\theta_L=\rho_L\left(\theta_R\right) \text{ and } \theta_R=\rho_R\left(\theta_L\right).$$

Proposition 2 *When voters observe only (y_L,y_R) and not θ, there exists a unique monotone equilibrium, and the equilibrium cut-points θ_L^{NI} and θ_R^{NI} satisfy the condition*

$$\rho_L\left(\theta_R^{NI}\right)=\theta_L^{NI}<\theta_L^{FI}<\theta_R^{FI}<\theta_R^{NI}=\rho_R\left(\theta_L^{NI}\right).$$

Proposition 2 underlines the importance of information in electoral competition. When voters observe only party strategies, they cannot vote correctly for the party whose policy is better for their welfare. As a result, parties have less incentive to adopt the policy that maximizes the utility of the median voter, and the party equilibrium cut-points are farther apart than they are in the full-information case.

Having established the benchmark cases of full information and no information, we now turn to the main focus of this section: the determination of political equilibrium when voters are partially informed by the media. In this and the following sections, most of the insights about the political equilibrium, voter welfare, and media competition can be obtained from a model with two media outlets. We therefore focus on the case of two newspapers in the remainder of the paper.

The news consumption rule described in the earlier section implies that a newspaper with editorial position outside the range $[\theta_L,\theta_R]$ attracts no readers. We say that such a newspaper is *ineffective* because its existence does not affect political outcomes. The following proposition provides a sufficient condition for a newspaper to be ineffective.

Proposition 3 *Any newspaper with editorial position $\theta_k<\theta_L^{NI}$ or $\theta_k>\theta_R^{NI}$ is ineffective.*

Proposition 3 implies that in any political equilibrium, a newspaper with editorial positions more extreme than the no-information cut-points θ_L^{NI} or θ_R^{NI} always give the same report whenever the parties' proposed policies differ. Precisely because their reports are so predictable, they have no information value to news consumers and therefore cannot influence political outcomes in our model where voters interpret the news rationally.

From here on, we confine our attention to newspapers with editorial positions in the range $[\theta_L^{NI}, \theta_R^{NI}]$. Note, however, that depending on the editorial positions of all newspapers in the market, a newspaper with $\theta_k \in [\theta_L^{NI}, \theta_R^{NI}]$ may still be ineffective. We leave the full characterization of the political equilibrium, including whether a newspaper is ineffective or not, to Appendix B. In the text, we focus on describing the case in which both newspapers are effective in equilibrium.

Proposition 4 *Suppose there are two newspapers with editorial positions $\theta_1, \theta_2 \in [\theta_L^{NI}, \theta_R^{NI}]$. If $\theta_1 > \rho_L(\theta_2)$ and $\theta_2 < \rho_R(\theta_1)$, then both newspapers are effective in a unique monotone equilibrium with policy cut-points given by*

$$\theta_L = \begin{cases} \rho_L(\theta_1) & \text{if } \theta_1 \geq \theta_L^{FI}; \\ \theta_1 & \text{if } \theta_1 < \theta_L^{FI}, \end{cases}$$

and

$$\theta_R = \begin{cases} \rho_R(\theta_2) & \text{if } \theta_2 \leq \theta_R^{FI}; \\ \theta_2 & \text{if } \theta_2 > \theta_R^{FI}. \end{cases}$$

The proof of this proposition is subsumed under a more general proposition for the n-newspaper case in Appendix B. Proposition 4 shows that there are two types of equilibrium policy cut-point for party L, depending on whether the newspaper to the left has an editorial position greater than or less than θ_L^{FI}. If $\theta_1 \geq \theta_L^{FI}$, we say that newspaper 1 is *moderate*. In this case, the equilibrium cut-point is an "interior solution" that satisfies $\theta_L = \rho_L(\theta_1) \leq \theta_1$. To see why this is an equilibrium strategy for party L, notice that newspaper 1 (and newspaper 2 as well) will report r when party L chooses policy l in state θ_L. In that state, only the *core supporters* of party L (i.e., people with $b_j + \delta \leq 0.5(\theta_L + \theta_1)$, who vote for party L without reading newspapers) would vote for L. The probability that the median voter is among this group of core supporters is $\pi(0.5(\theta_L + \theta_1) - b_m)$. Party L is indifferent between policy l and policy r when θ_L satisfies

$$\pi(0.5(\theta_L + \theta_1) - b_m)(\theta_L - \beta_L + d) = 0.5d.$$

By definition, the solution to this equation is $\theta_L = \rho_L(\theta_1)$.

The second type of equilibrium cut-point obtains when $\theta_1 < \theta_L^{FI}$. In this case, we say that newspaper 1 is *leftist*. (Similarly, we say that newspaper 2 is *moderate* if $\theta_2 \leq \theta_R^{FI}$ and is *rightist* if $\theta_2 > \theta_R^{FI}$.) We cannot have $\theta_L < \theta_1$, since party L would gain by choosing r in states slightly greater than θ_L. Instead, the equilibrium is a "corner solution," with $\theta_L = \theta_1$. Suppose $\theta \leq \theta_L$. If party L deviates to policy l, then newspaper 1 will report r, and only the core supporters of party L will vote for it. The gain for party L is

$$\pi(\theta_L - b_m)(\theta_L - \beta_L + d) - 0.5d.$$

Since $\theta_L < \theta_L^{FI}$, this expression is strictly negative. Next, suppose $\theta > \theta_L$. If party L chooses l, newspaper 1 reports l, so all the core supporters of party L *as well as all readers of newspaper* 1 will vote for L. The expected payoff from choosing l at a state slightly above θ_L is

$$\pi(0.5(\theta_1 + \theta_2) - b_m)(\theta_1 - \beta_L + d).$$

This expression is greater than $0.5d$ for all $\theta_1 > \rho_L(\theta_2)$. Thus party L again has no incentive to deviate.[11]

The equilibrium described in Proposition 4 has several interesting properties. First, for any combination of (θ_1, θ_2), the equilibrium cut-point of each party always lies between its full-information and no-information benchmarks. Introducing the media into our model of political competition helps partially to bring about greater policy convergence toward the center.

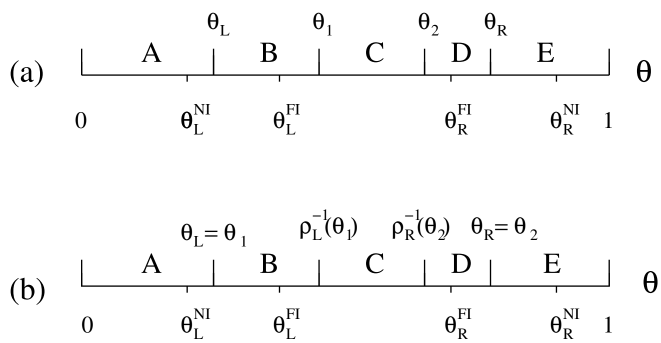
Second, an effective newspaper need not have information value in equilibrium. Consider a corner solution with $\theta_L = \theta_1$. Since newspaper 1 always reports l when the policies are (l, r), its report has no information value. Nevertheless it is effective in preventing party L from deviating to policy r in states slightly above θ_L.

Third, the equilibrium policy cut-point of party L is determined solely by the editorial position of the more liberal newspaper (i.e., newspaper 1). This result obtains because policy cut-points are determined by the size of the core supporters of a party. Marginal changes in θ_2 only affect the news consumption behavior of those who are originally indifferent between newspaper 1 and newspaper 2. Because this group of individuals do not constitute the core supporters of party L, their behavior does not affect θ_L.[12]

[11] If $\theta_1 < \rho_L(\theta_2)$, then newspaper 1 will be ineffective in equilibrium.

[12] Changes in θ_2 does not affect the probability of election for party L when the state is $\theta = \theta_L$. Nevertheless, θ_2 is not completely inconsequential for party L since it affects the probability of election in some other states.

Figure 3



Fourth, party policies are not monotone with respect to newspaper editorial positions. When newspaper 1 is moderate, moving θ_1 to the right would shift $\theta_L = \rho_L(\theta_1)$ to the left. The reason is that voters with indifference positions near $0.5(\theta_L + \theta_1)$ stop reading newspaper 1 as θ_1 increases. In a sense, newspaper 1 alienates its fringe readers on the left when it becomes more conservative. As a result, these fringe readers join the ranks of the core supporters of party L, which encourages party L to adopt a more liberal policy cut-point. The analysis is different when newspaper 1 is leftist. In that case, $\theta_L = \theta_1$ and the two moves in the same direction. Recall that in a corner solution, the editorial position of newspaper 1 acts as a binding constraint on the policy of party L. Party L strictly prefers policy r to policy l when the state is θ_L. Nevertheless it chooses policy l in states slightly above θ_L, because doing so helps it win the votes of readers of newspaper 1. If newspaper 1 becomes more conservative, it no longer supports policy l in states slightly above θ_L. So the incentive for party L to choose l in those states disappears, and party L moves its policy cut-point to the right as well.

We can extend the analysis to allow for multiple newspapers. The characterization of the political equilibrium in the n-newspaper case is relegated to Appendix B. Here, we simply illustrate the main ideas by considering the effect of newspaper entry in a market with two existing media outlets.

Panel (a) of Figure 3 depicts the case when policy cut-points are "interior solutions." If the editorial position θ_e of the entrant newspaper is in region A or E of the figure, this newspaper will simply be ignored and it will be ineffective. If θ_e is in region B (i.e., $\theta_e \in [\theta_L, \theta_1]$), the new entrant will attract some readers from the core supporters of party L. This reduces the incentive of party L to choose policy l, and hence pulls θ_L toward the center. If θ_e is in region C (i.e., $\theta_e \in [\theta_1, \theta_2]$), the new entrant takes away readers from the existing newspapers 1 and 2, but does not affect the mass of the core supporters of either party. Therefore, it has no effect on equilibrium policy cut-points. Finally, if θ_e is in region D, the new entrant attracts readers from the core supporters of party R and induces θ_R to shift toward the center.

Panel (b) depicts the case when policy cut-points are "corner solutions." Again, an entrant newspaper with θ_e in regions A and E will be ineffective. If entry occurs in region B, with an editorial position sufficiently close to θ_1 (i.e., $\theta_e \in [\theta_1, \rho_L^{-1}(\theta_1)]$), the readership of newspaper 1 is sufficiently curtailed that it is no longer effective in preventing party L from choosing r in states slightly above θ_L. As a result, θ_L moves to the right and newspaper 1 becomes ineffective following the new entry. On the other hand, if θ_e is farther away from θ_1, newspaper 1 still maintains a large enough readership base to prevent party L from deviating to r. So, entry in region C has no effect on equilibrium cut-points. Finally, if θ_e is in region D, entry shifts θ_R to the left and renders newspaper 2 ineffective.

This discussion of the two cases involving interior solutions and corner solutions leads to the following general conclusion.

Proposition 5 *Regardless of the number and editorial positions of the incumbent newspapers, a new entrant can only make party policies (weakly) more centrist.*

This proposition is a direct consequence of the characterization of political equilibrium in Appendix B, and its formal proof is therefore omitted.

5 Voter Welfare

In this section we examine the relationship between newspaper editorial positions and voter welfare. Suppose there are two effective newspapers with editorial positions

$$\theta_0 \equiv \theta_L^*(\theta_1) \leq \theta_1 \leq \theta_2 \leq \theta_R^*(\theta_2) \equiv \theta_3.$$

When the state is $\theta < \theta_L^*$, both parties propose policy r, and party L is elected if $\delta \leq 0$. When the state is $\theta > \theta_R^*$, both parties propose policy l. Again, party L is elected if $\delta \leq 0$. When $\theta \in [\theta_{k-1}, \theta_k]$, $k = 1, 2, 3$, the parties propose different policies, and party L is elected if the median voter reads a newspaper more liberal than newspaper $k-1$; that is, if

$$\delta \leq \delta_k \equiv 0.5(\theta_{k-1} + \theta_k) - b_m.$$

Integrating over θ and δ, the expected utility for a voter with policy preference b is

$$W(\boldsymbol{\theta}, \boldsymbol{\delta}; b) = \sum_{k=1}^{3} \int_{\theta_{k-1}}^{\theta_k} \left(\pi\left(\delta_k\right)\left(\theta - b\right) + \left(1 - \pi\left(\delta_k\right)\right) E[\delta \mid \delta > \delta_k]\right) d\theta$$
$$+ \int_0^{\theta_L^*(\theta_1)} 0.5E[\delta \mid \delta > 0]\, d\theta + \int_{\theta_R^*(\theta_2)}^{1} \left(\theta - b + 0.5E[\delta \mid \delta > 0]\right) d\theta,$$

where $\boldsymbol{\theta} \equiv (\theta_0, \theta_1, \theta_2, \theta_3)$ and $\boldsymbol{\delta} \equiv (\delta_1, \delta_2, \delta_3)$. Let $b_{ave} \equiv \int b \; dF(b)$ denote the mean voter ideal cut-point. Since W is linear in b, the aggregate voter utility is equal to $W(\boldsymbol{\theta}, \boldsymbol{\delta}; b_{ave})$.

The editorial position of a newspaper can affect voter welfare through the following channels:

Direct effect. Suppose newspaper k moves its editorial position from θ_k to $\theta_k' > \theta_k$. Since the newspaper reports r instead of l in states between θ_k and θ_k', its readers would vote for party R instead of L in those states. This would change the election outcome if the median voter is a reader of newspaper k (i.e., if $\delta \in [\delta_k, \delta_{k+1}]$). The effect on voter welfare is, for $k = 1, 2$,

$$\frac{\partial W}{\partial \theta_k} = \int_{\delta_k}^{\delta_{k+1}} \left(-\theta_k + b_{ave} + \delta\right) d\pi. \tag{10}$$

This effect is positive if, conditional on the median voter being a reader of the newspaper, the mean voter prefers party R to party L in state θ_k.

Policy effect. The parties' policies in a state determine the policy choices that are available to the voter in that state. If party L moves θ_L to $\theta_L' > \theta_L$, then only policy r can be implemented in states between $[\theta_L, \theta_L')$. Write $\delta_L \equiv \delta_1 = 0.5\left(\theta_L + \theta_1\right) - b_m$ and $\delta_R \equiv \delta_3 = 0.5\left(\theta_2 + \theta_R\right) - b_m$. The welfare effects due to policy changes are:

$$\frac{\partial W}{\partial \theta_L} \frac{\partial \theta_L^*}{\partial \theta_1} = \left[\pi(\delta_L)(b_{ave} - \theta_L^*) - \int_{\delta_L}^{0} \delta \, d\pi\right] \frac{\partial \theta_L^*}{\partial \theta_1}, \tag{11}$$

$$\frac{\partial W}{\partial \theta_R} \frac{\partial \theta_R^*}{\partial \theta_2} = \left[(1 - \pi(\delta_R))(b_{ave} - \theta_R^*) - \int_{0}^{\delta_R} \delta \, d\pi\right] \frac{\partial \theta_R^*}{\partial \theta_2}. \tag{12}$$

Readership effect. The change in editorial position of a newspaper affects also the composition of its readership. As the newspaper becomes more conservative, it would lose readers with indifference position at $0.5(\theta_{k-1}+\theta_k)$ to the more liberal newspaper $k-1$, while gaining readers with indifference position at $0.5(\theta_k+\theta_{k+1})$ from the more conservative newspaper $k+1$. Since both groups of readers would then be consulting more liberal newspapers, the first group vote for party L instead of R when $\theta \in [\theta_{k-1}, \theta_k]$, and the second vote for party L instead of R when $\theta \in [\theta_k, \theta_{k+1}]$. The effects on voter welfare are:

$$\frac{\partial W}{\partial \delta_L}\frac{\partial \delta_L}{\partial \theta_1} + \frac{\partial W}{\partial \delta_2}\frac{\partial \delta_2}{\partial \theta_1} =$$
$$0.5(b_m - b_{ave})\left(\pi'(\delta_L)\left(1 + \frac{\partial \theta_L^*}{\partial \theta_1}\right)(\theta_1 - \theta_L) + \pi'(\delta_2)(\theta_2 - \theta_1)\right), \tag{13}$$

and

$$\frac{\partial W}{\partial \delta_2}\frac{\partial \delta_2}{\partial \theta_2} + \frac{\partial W}{\partial \delta_R}\frac{\partial \delta_R}{\partial \theta_2} =$$
$$0.5(b_m - b_{ave})\left(\pi'(\delta_2)(\theta_2 - \theta_1) + \pi'(\delta_R)\left(1 + \frac{\partial \theta_R^*}{\partial \theta_2}\right)(\theta_R - \theta_2)\right). \tag{14}$$

We say that a vector of editorial positions $\boldsymbol{\theta^*} \equiv (\theta_1^*, \theta_2^*)$ is *optimal* if it maximizes $W(\boldsymbol{\theta}, \boldsymbol{\delta}; b_{ave})$, taking into the account the dependence of $\boldsymbol{\delta}$ on $\boldsymbol{\theta}$. In models of political economy, since electoral outcomes are determined by the median voter, it is a well-known problem that welfare analysis is difficult when there is a divergence of interests between the mean voter and the median voter. To avoid this common problem and to emphasize instead the unique features that arise from our model, we assume for the welfare analysis that the mean voter is also the median voter, i.e., $b_{ave} = b_m$.

Consider the readership effect first. Equations (13) and (14) shows that the readership effect is zero when $b_{ave} = b_m$. A change in the composition of the readership of newspapers affects the election outcome only when it changes the newspaper choice of the median voter. But a marginal change in editorial position would make the median voter switch from one newspaper to another only if the median voter is initially indifferent between the two. Hence, the readership effect is zero if the mean voter is also the median voter. We therefore only need to consider the direct effect and the policy effect.

For newspaper 1, since $\theta_L^* < b_m$, the term in square brackets of the policy effect (11) is positive. Since the median voter strictly prefers policy

r in state θ_L^*, he is better off when party L moves its cut-point toward the center. If newspaper 1 is leftist, $\partial\theta_L^*/\partial\theta_1 = 1$ and, hence, the policy effect is positive. Since the direct effect (10) is also positive at $\theta_1 = \theta_L$, aggregate voter welfare strictly increases as θ_1 moves to the right. Similar reasoning suggests that if newspaper 2 is rightist, then voter welfare strictly increases as θ_2 moves to the left. Thus, the optimal position of the two newspapers must lie in the region $[\theta_L^{FI}, \theta_R^{FI}]$. In other words, moderate newspapers are better than leftist or rightist newspapers from the standpoint of aggregate welfare.

For $\theta_1 \in [\theta_L^{FI}, \theta_R^{FI}]$, the policy effect (11) is negative as $\partial\theta_L^*/\partial\theta_1 = \rho_L' < 0$. Furthermore, the direct effect (10) is also negative at $\theta_1 = \theta_2$. This means that if the two newspapers have the same editorial position, voter welfare can be raised by moving θ_1 to the left (or moving θ_2 to the right). It is never optimal for different newspapers to speak with the same voice; voters benefit from a media industry with a diversity of viewpoints.

Finally, note that the direct effect (10) of a change in editorial position is equal to zero when

$$\theta_k - b_m = E\left[\delta \mid b_m + \delta \in T_k\right], \tag{15}$$

where T_k is newspaper k's territory as defined by (4). Newspaper k affects the outcome of election only when the median voter is a reader of that newspaper, in which case the median voter's preference for party R is on average $E\left[\delta \mid b_m + \delta \in T_k\right]$. If newspaper positions did not affect party policies, the condition (15) means that an optimal newspaper k should report l in a state if and only if conditional on the newspaper's report being decisive, the median voter on average prefers policy l in that state. We say that such a newspaper is *conditionally unbiased* for the median voter. In our model, however, the policy effect (11) of θ_1 is negative in the region $[\theta_L^{FI}, \theta_R^{FI}]$. At the conditionally unbiased position, therefore, the total effect of a leftward shift in θ_1 would increase voter welfare. Hence, the optimal θ_1^* must satisfy the condition that

$$\theta_1^* - b_m < E\left[\delta \mid b_m + \delta \in T_1\right]. \tag{16}$$

Similarly, the optimal position for newspaper 2 must satisfy

$$\theta_2^* - b_m > E\left[\delta \mid b_m + \delta \in T_2\right]. \tag{17}$$

The conditions (16) and (17) mean that the newspapers on the left should be conditionally biased in favor of party L, while the newspaper on the right should be conditionally biased for party R. The reason is that policy cut-points are determined by a party's core supporters. By moving the editorial positions closer to these party core supporters, the newspapers attract them to stay informed, thereby exerting a moderating influence on the parties' policy choices.

The following proposition summarizes the properties of the optimal positions of the media when the mean voter and the median voter coincide.

Proposition 6 *Suppose $b_{ave} = b_m$. Then the optimal editorial positions are:*

1. Moderate: $\theta_k^* \in [\theta_L^{FI}, \theta_R^{FI}]$ for $k = 1, 2$.

1. Diverse: $\theta_1^* \neq \theta_2^*$.

3. Conditionally biased: θ_1^* satisfies (16) and θ_2^* satisfies (17).

Furthermore, if the density function π' is log-concave, the optimal editorial positions are also:

4. Monotone in party preferences: θ_k^* is increasing in β_i for $k = 1, 2$ and $i = L, R$.

We have already established Conditions 1 to 3. To understand the monotonicity result (Condition 4), note that the optimal position of a boundary newspaper balances the trade-off between the need to provide information to the voters and the need to induce the parties to move their policy cut-points toward the center. The terms of this trade-off is affected by the parties' ideological positions. Suppose, for example, that party L becomes more extreme (i.e., β_L decreases). Other things equal, party L would choose a lower cut-point θ_L. A lower cut-point makes the policy effect (11) relatively more important as the cost to the median voter from having policy l in state θ_L rises. As a result, the optimal position for newspaper 1 must shift to the left to constrain party L from pursuing partisan policies. Moreover, as newspaper 1 moves to the left, some of its readers switch to read newspaper 2. To provide useful information to these relatively liberal voters, the optimal response is for newspaper 2 to move its editorial position to the left as well.

Our discussion in this section suggests that media bias need not be such a threat to democracy as it is sometimes perceived. Proposition 6 says that editorial positions should be moderate, but it does not say that all newspapers should be "unbiased." Even if one could define a unique editorial position that would be commonly agreed to be "unbiased" or "objective," it would be more important to have a media industry with a diversity of biases than to have every media outlet share the same "objective" viewpoint. The role of the media is not merely to provide information to voters. Once the effect of media presence on equilibrium policy choices is recognized, Proposition 6 shows that some degree of media bias (relative to the conditionally unbiased position) is optimal. Moreover, our monotonicity result highlights the fact that optimal editorial positions cannot be defined without regard to the political environment. Editorial positions that remain fixed when party preferences shift systematically to the left or to the right do not best serve the interests of the electorate.

6 Commercial Media

In this section, we consider how editorial positions are determined when media firms are primarily motivated by commercial interests. Since advertising revenue for media firms depends on how many readers or viewers they attract, while the cost of content is largely fixed, we assume for simplicity that the objective of a newspaper is to maximize the size of its (expected) readership. Recall that voter j reads newspaper k if and only if $b_j + \delta \in T_k$. Let

$$F^*(x) = \int_{\underline{\delta}}^{\overline{\delta}} F(x - \delta) d\pi$$

be the distribution of $b_j + \delta$. Then, the expected readership of newspaper k is given by:

$$R_k = F^*(0.5(\theta_k + \theta_{k+1})) - F^*(0.5(\theta_k + \theta_{k-1})).$$

As in any product market, the choice of editorial positions (product characteristics) depends on the industry structure of the media. Since our main focus is the relationship between the mass media and electoral politics, we explore this relationship with some illustrative simple industry structures in the following subsections.

6.1 Monopoly versus Duopoly

Consider the simplest case of a monopoly firm operating one newspaper (newspaper 1). The readership R_1 of this newspaper depends on the cut-points θ_L and θ_R of the political parties, and these cut-points in turn are affected by the editorial position θ_1. We can model this relationship either as a "Cournot" game in which θ_1, θ_L and θ_R are chosen simultaneously, or as a "Stackelberg" game in which newspaper 1 takes into account its effect on party policies when it chooses the editorial position. Since in reality both party preferences and the media editorial positions evolve gradually, we feel that it is more appropriate to model the interaction between the media and the parties as a "Cournot" game.

When newspaper 1 moves its editorial position to the right, it gains readers whose indifference positions are near $0.5(\theta_1 + \theta_R)$ while it loses readers whose indifference positions are near $0.5(\theta_L + \theta_1)$. Given θ_L and θ_R, θ_1 must satisfy

$$f^*(0.5(\theta_L + \theta_1)) = f^*(0.5(\theta_1 + \theta_R)) \tag{18}$$

at an interior solution. We have the following proposition:

Proposition 7 *Suppose f^* is single-peaked at some point $b_0 \in (\theta_L^{FI}, \theta_R^{FI})$. If*

$$f^*(\theta_L^{FI}) < f^*(0.5(\theta_L^{FI} + \rho_R(\theta_L^{FI}))), \tag{19}$$

$$f^*(\theta_R^{FI}) < f^*(0.5(\rho_L(\theta_R^{FI}) + \theta_R^{FI})); \tag{20}$$

then there exists a unique monotone equilibrium $\theta_1^m \in (\theta_L^{FI}, \theta_R^{FI})$ in which θ_1^m satisfies (18) with $\theta_L = \rho_L(\theta_1^m)$ and $\theta_R = \rho_R(\theta_1^m)$.

Since f^* is a convolution of the density f of voter ideal points and the density π' of party preferences, a sufficient condition for f^* to be single-peaked is that the latter two densities are both log-concave (e.g., Dharmadhikari and Joag-dev, 1988). Conditions (19) and (20) of Proposition 7 are used to ensure an interior equilibrium with $\theta_L < \theta_1 < \theta_R$. If condition (19) fails, for example, it is an equilibrium to have $\theta_L = \theta_1 = \theta_L^{FI}$ and $\theta_R = \rho_R(\theta_L^{FI})$, because the monopoly firm has no incentive to move its editorial position to the right.[13]

When the media market is a duopoly, one newspaper can invade the territory of the other newspaper by changing its editorial position. A form of Hotelling competition ensues. Each newspaper wants to establish an editorial position near the median of θ_L and θ_R. More precisely, we have the following result:

Proposition 8 *Suppose f^* is single-peaked. There exists a unique monotone equilibrium with $\theta_1 = \theta_2 = \hat{\theta} \in (\theta_L^{FI}, \theta_R^{FI})$ and $\theta_i = \rho_i(\hat{\theta})$ for $i = L, R$ if and only if $\hat{\theta}$ satisfies:*

$$F^*(0.5(\theta_R + \hat{\theta})) - F^*(\hat{\theta}) = F^*(\hat{\theta}) - F^*(0.5(\theta_L + \hat{\theta})), \tag{21}$$

[13] It has no incentive to move its editorial position to the left either, because doing so would mean losing all readers.

and

$$f^*(\hat{\theta}) \geq \max\{f^*(0.5(\theta_L + \hat{\theta})), f^*(0.5(\theta_R + \hat{\theta}))\}. \tag{22}$$

In equilibrium, the editorial positions of both newspapers converge to $\hat{\theta}$. Equation (21) requires that the expected size of readership has to be the same for the two newspapers. Condition (22) requires that each newspaper has no incentive to unilaterally move its editorial position away from $\hat{\theta}$.

In general the equilibrium editorial position θ_1^m under monopoly differs from the equilibrium position $\hat{\theta}$ under duopoly. More importantly, equilibrium editorial positions react very differently to changes in the political environment under the two alternative market structures. Consider, for example, the effect of an increase in β_L. Other things equal, party L chooses a more moderate position θ_L in response. As θ_L increases, a monopoly newspaper loses readers whose indifference positions are near $0.5(\theta_1 + \theta_L)$. When f^* is single-peaked, such a change means that the density of readers on the left fringe of the monopoly newspaper's territory exceeds the density of readers on the right fringe. The monopoly newspaper therefore shifts its editorial position θ_1^m to the left in response. In the case of duopoly, on the other hand, an increase in β_L reduces the readership of newspaper 1 relative to that of newspaper 2. This induces newspaper 1 to shift its editorial position to the right, and newspaper 2 follows in response. Therefore, the equilibrium editorial position $\hat{\theta}$ moves to the right. We summarize this result in the following proposition.

Proposition 9 *When f^* is single-peaked and equilibrium exists in both the monopoly and duopoly cases, $\partial\theta_1^m/\partial\beta_L < 0$ and $\partial\hat{\theta}/\partial\beta_L > 0$. If the density function f is symmetric and unimodal about* 0.5*, then*

$$\begin{aligned} \theta_1^m < 0.5 < \hat{\theta} \quad \textit{when} \quad \beta_L + \beta_R > 1, \\ \theta_1^m > 0.5 > \hat{\theta} \quad \textit{when} \quad \beta_L + \beta_R < 1. \end{aligned}$$

A media monopoly exacerbates the party asymmetry by moving away from the more extreme position, while a duopoly counteracts it by moving toward the extreme position. As a result, party policies are more symmetric under duopoly than under monopoly. Recall that optimal media positions should move in the same direction as β_L. Proposition 9 implies that $\hat{\theta}$ responds in the same direction to β_L as the optimal position, while θ^m responds in the "wrong" direction. In general voter welfare under duopoly may not be higher than that under monopoly, as $\hat{\theta}$ may "overshoot" the optimal position. One can however establish that voter welfare is higher under duopoly than under monopoly under some specific conditions.

Proposition 10 *If the density function f is symmetric and unimodal about 0.5, and if the distribution function π is uniform on $[-\sigma, \sigma]$ (with $\sigma > 0.5$), then voter welfare is higher under duopoly than under monopoly.*

To understand why this is true, suppose $\beta_L + \beta_R > 1$. Since party preferences are tilted to the right, Proposition 9 implies that $\hat{\theta} > 0.5 > \theta_1^m$. Under the assumed conditions of Proposition 10, the density function f^* is symmetric and unimodal about 0.5.[14] Hence, equation (21) for the duopoly equilibrium implies that

$$\theta_R - \hat{\theta} > \hat{\theta} - \theta_L.$$

However, when π is uniform, the conditionally unbiased position for a single newspaper satisfies

$$\theta_R - \theta_1 = \theta_1 - \theta_L.$$

Thus, the direct effect of an increase in θ_1 is positive for all $\theta_1 \leq \hat{\theta}$. The proof of Proposition 10 establishes that the direct effect always dominates the policy effect when the two effects differ in sign. More generally, we expect the duopoly welfare to be higher when the policy effect is relative unimportant.

6.2 Independent versus Consolidated Ownership

In the previous subsection, we assume that a monopoly media firm operates one newspaper only. However regulation of the media industry is often concerned about the effect of monopoly control over multiple media outlets. This subsection addresses the differences between independent and joint control of media outlets.

When there are two newspapers, the case of independent ownership is just the case of duopoly described in the earlier subsection. Now, suppose these two newspapers are consolidated under unified ownership. Expected total readership of the two newspapers is given by

$$R_1 + R_2 = F^*(0.5(\theta_1 + \theta_L)) - F^*(0.5(\theta_2 + \theta_R)).$$

[14] The restriction that $\sigma > 0.5$ is used to ensure that $\pi(\delta_L)$ and $1 - \pi(\delta_R)$ are strictly between 0 and 1.

Note that voters with indifference positions $b+\delta \in [\theta_1, \theta_2]$ either read newspaper 1 or newspaper 2. When the two newspapers are jointly owned, the monopoly owner has no incentive to cater to the preferences of these moderate voters. Instead, the incentive is to cater to the fringe voters so as to expand the set of voters who choose to read newspapers in order to inform their voting decisions. Thus, instead of convergence toward the center, the two editorial positions tend to diverge to the fringes. We have the following result.

Proposition 11 *When a monopoly operates two newspapers, editorial positions and party positions constitute an equilibrium if and only if* $\theta_L = \theta_1 \in [\theta_L^{NI}, \theta_L^{FI}]$ *and* $\theta_R = \theta_2 \in [\theta_R^{FI}, \theta_R^{NI}]$.

Proposition 11 does not pin down a unique equilibrium. The multiplicity of equilibrium can be resolved if we assume that the monopoly firm takes into account of its effect on party policies when it chooses its editorial positions (i.e., if we assume that the monopoly is a "Stackelberg leader"). In that case, the readership maximizing equilibrium is obviously $\theta_1 = \theta_L^{NI}$ and $\theta_2 = \theta_R^{NI}$.

In a way, the result that monopoly tends to produce greater divergence in editorial position is reminiscent of Steiner's (1952) model, in which monopoly leads to greater program variety. However, there is a crucial difference between the present result and Steiner's result when it comes to welfare evaluation. In Steiner's model, which deals mainly with entertainment programs, greater program variety generally leads to better match with consumers' tastes and therefore higher consumer welfare. In our model, greater divergence in editorial position also affects the political equilibrium by producing a greater divergence between θ_L and θ_R. Indeed, the (Stackelberg) monopoly outcome is the same as the no information outcome, which maximizes the divergence between θ_L and θ_R. Since policy divergence is generally bad for the mean voter, the externality induced by the policy shift effect would tilt the balance against monopoly ownership in the media market.

7 Conclusion

A number of commentators in the United States worry that the emergence of media outlets with extreme political views may lead to more polarized party politics. We find that it is not the case in our model. Since voters interpret news rationally, media outlets whose editorial positions are more extreme than the party cut-points would have no influence on political outcomes. Holding constant the editorial positions of the incumbent media outlets, a new entry always causes the parties to move their cut-points (weakly) closer to the political center.

If the only role of the media were to provide information to voters, the editorial positions of media outlets should be conditionally unbiased (i.e., conditional on the median voter being a reader of that newspaper, each newspaper should support a policy if and only if it is in the interest of the median voter to support that policy). However, we find that “unbiasedness” is not an unblemished blessing, because an important role of the media in our model is to affect policy choices by political parties. News outlets which are biased for a certain party helps to attract the core supporters of that party to become informed. Since party policies are farther from the center when a party has many uninformed core supporters, media outlets which are biased for a certain party can have a moderating influence on its policies, provided that the degree of bias is not too great.

We conclude with a few comments on the limitations of our model of media competition. First, equilibrium with commercial media may not exist when there are more than two media outlets (a common problem in Hotelling models). Second, in reality political news are bundled with non-political news (e.g., sports and business). As a result, consumers’ news consumption may be influenced by factors other than political ideologies. Third, the production of news is not modeled. The collection of news is costly, and competition between media outlets may affect the quality of news. Finally, the contents of a media outlet may be influenced by its communication technology. For example, broadcast news which have a high fixed cost may need to target a wider audience than local radio news. Incorporating some of these features will make the model more relevant, but the challenge is to do it in such a way that keeps the model tractable.

Appendices

A. Monotone Strategies

Lemma 1 *In any equilibrium σ of the election game, there is no θ such that $\sigma_L(\theta) = r$ and $\sigma_R(\theta) = l$.*

Proof. Let $p(y_L, y_R, \theta)$ denote party L's probability of winning the election when the state is θ and when parties L and R choose y_L and y_R, respectively. Suppose, by way of contradiction, that $\sigma_L(\theta) = r$ and $\sigma_R(\theta) = l$ for some θ. Since party L prefers r to l,

$$-p(r,l,\theta)\theta - \beta_L \geq (0.5 - p(r,l,\theta))\, d. \tag{23}$$

Since party R prefers l to r,

$$(0.5 - p(r,l,\theta))\, d \geq -(1 - p(r,l,\theta))\,(\theta - \beta_R). \tag{24}$$

Combining (23) and (24), we have

$$-p(r,l,\theta)(\theta - \beta_L) \geq -(1 - p(r,l,\theta))\,(\theta - \beta_R). \tag{25}$$

When $\theta \leq \beta_L$, (24) requires $p(r,l,\theta) < 0.5$, while (25) requires $p(r,l,\theta) > 0.5$.

When $\theta \in (\beta_L, \beta_R)$, (23) requires $p(r,l,\theta) > 0.5$, while (24) requires $p(r,l,\theta) < 0.5$.

Finally, when $\theta > \beta_R$, (23) requires $p(r,l,\theta) > 0.5$, while (25) requires $p(r,l,\theta) < 0.5$.

Hence, there is no θ where (23), (24), and (25) hold simultaneously. ■

Lemma 2 *Suppose $\sigma_L(\theta) = l$ and $\sigma_R(\theta) = r$ for some θ in an equilibrium σ of the election game. If $p(l,r,\theta)$ is increasing in θ, then (1) for all $\theta' < \theta$, $\sigma_L(\theta') = l$ implies $\sigma_R(\theta') = r$, and (2) for all $\theta'' > \theta$, $\sigma_R(\theta'') = r$ implies $\sigma_L(\theta'') = l$.*

Proof. We prove part 1. Since, by supposition, party R prefers r to l in θ,

$$(1 - p(l,r,\theta))\,(d - \theta + \beta_R) \geq 0.5d.$$

As $p(l,r,\theta)$ increases in θ, for $\theta' < \theta$

$$\left(1 - p(l,r,\theta')\right)\left(d - \theta' + \beta_R\right) > (1 - p(l,r,\theta))\,(d - \theta + \beta_R) \geq 0.5d.$$

Hence, in equilibrium in any $\theta' < \theta$ party R chooses r if party L chooses l. The proof for part 2 is similar and hence omitted. ■

Proposition 12 *In any equilibrium in which $\sigma_L \neq \sigma_R$ and in which $p(l,r,\theta)$ is increasing in θ, the party strategies must be monotone. Furthermore, party L's cut-point must be lower than party R's.*

Proof. By Lemma 1, $\sigma(\theta^*) = (l,r)$ for some θ^*. For any $\theta' > \theta^*$, $\sigma_L(\theta') = l$ if $\sigma_R(\theta') = l$ (Lemma 1), and $\sigma_L(\theta') = l$ if $\sigma_R(\theta') = r$ (Lemma 2). Hence $\sigma_L(\theta') = l$ for $\theta' > \theta^*$. Similarly, $\sigma_R(\theta'') = r$ for $\theta'' < \theta^*$. Let $\theta_L \equiv \inf\{\theta' \leq \theta^* \mid \sigma_L(\theta') = l\}$ and $\theta_R \equiv \sup\{\theta' \geq \theta^* \mid \sigma_R(\theta') = r\}$. Then it follows that for each $i \in \{L,R\}$, $\sigma_i(\theta) = l$ for all $\theta > \theta_i$ and $\sigma_i(\theta) = r$ for all $\theta < \theta_i$. Finally, note that by construction, $\theta_L \leq \theta_R$. ■

B. Political Equilibrium with n Newspapers

Proposition 13 *Suppose there are n newspapers with editorial positions $\theta_L^{NI} \leq \theta_1 \leq \ldots \leq \theta_n \leq \theta_R^{NI}$. Denote $\rho_L^*(x) = \max\{\rho_L(x), x\}$ and $\rho_R^*(x) = \min\{\rho_R(x), x\}$. Then there is a unique monotone equilibrium with equilibrium cut-points*

$$\theta_L^* = \max\{\rho_L^*(\theta_k),\ k = 1,\ldots,n\},$$
$$\theta_R^* = \min\{\rho_R^*(\theta_k),\ k = 1,\ldots,n\}.$$

Proof. Let $\theta_L^a \equiv \max\{\theta_k, k = 1,\ldots,n \mid \theta_k < \theta_L^{FI}\}$ and $\theta_L^b \equiv \min\{\theta_k, k = 1,\ldots,n \mid \theta_k \geq \theta_L^{FI}\}$. By definition,

$$\theta_L^* = \begin{cases} \theta_L^a & \text{if } \theta_L^a > \rho_L\left(\theta_L^b\right), \\ \rho_L\left(\theta_L^b\right) & \text{if } \theta_L^a \leq \rho_L\left(\theta_L^b\right). \end{cases}$$

Suppose $\theta_L^* = \theta_L^a$. Since $\theta_L^a < \theta_L^{FI}$, party L's optimal response is to choose r when $\theta < \theta_L^a$. Since $\theta_L^a > \rho_L(\theta_L^b)$, party L's optimal response is to choose l when $\theta \geq \theta_L^a$.

Suppose $\theta_L^* = \rho_L(\theta_L^b)$. Then, party L is indifferent between platforms l and r in state θ_L^*. Since the utility it receives when l is implemented and the probability that it gets elected by choosing l are both increasing in θ, it is optimal for party L to choose r when $\theta < \theta_L^*$ and l when $\theta \geq \theta_L^*$. Thus, θ_L^* is optimal. The case for party R can be proved similarly.

For any $\theta_L > \theta_L^*$, there exists some $\theta_k > \theta_L^{FI}$ such that there is no $\theta_{k'} \in (\theta_L, \theta_k)$ and that $\rho_L(\theta_k) < \theta_L$. Suppose the party strategies are $\theta_L^* < \theta_L < \theta_R$. Then, party L would be strictly better off to deviate and choose

l in a state slightly less than θ_L. Similarly, for any $\theta_L < \theta_L^*$, there is some θ_k such that there is no $\theta_{k'} \in (\theta_L, \theta_k)$ and $\rho(\theta_k) > \theta_L$. Hence, if the party strategies are $\theta_L < \theta_L^* < \theta_R$, party L would be strictly better off to deviate and choose r in a state greater than θ_L. Hence there is no equilibrium with $\theta_L \neq \theta_L^*$. The case for party R can be proved similarly. ■

C. Omitted Proofs

Proof of Proposition 2. Under $\left(\theta_L^{NI}, \theta_R^{NI}\right)$, it follows from the definition of (8) and the fact that the payoff from policy l increases in θ that it is optimal for party L to choose r when $\theta < \theta_L^{NI}$ and l when $\theta \in [\theta_L^{NI}, \theta_R^{NI})$. Recall that voters believe $\tilde{\theta} = b_m$ when $(y_L, y_R) = (r, l)$. Hence, when $\theta \geq \theta_R^{FL}$, party L's probability of election is 0.5 no matter whether it chooses l or r. Since party L prefers l to r when $\theta \geq \theta_R^{FL}$, it is optimal to choose l. Thus, $\left(\theta_L^{NI}, \theta_R^{NI}\right)$ is an equilibrium.

In any equilibrium the parties' cut-points must satisfy (8) and (9). Define $\psi(x) \equiv \rho_L\left(\rho_R(x)\right)$. The equilibrium cut-point θ_L^{NI} is given by the fixed point of ψ. Since ρ_L and ρ_R are decreasing in x, f is increasing in x. By assumption,

$$\psi(0) = \rho_L(\rho_R(0)) > \rho_L(1) > 0.$$

Furthermore,

$$\psi(\theta_R^{FI}) = \rho_L(\rho_R(\theta_R^{FI})) = \rho_L(\theta_R^{FI}) < \theta_R^{FI}.$$

Since ψ is continuous, there exists some $x^* \in (0, \theta_R^{FI})$ such that $x^* = \psi(x^*)$. Furthermore, since both ρ_L and ρ_R have a slope less than one in absolute value, we have $\psi' < 1$, which establishes that equilibrium is unique. ■

Proof of Proposition 3. Let there be a newspaper with editorial position $\theta_1 < \theta_L^{NI}$. If this newspaper is effective, we must have $\theta_1 \geq \theta_L$.

Consider first the case $\theta_1 > \theta_L$. Since $\rho_L(\theta_1) > \theta_L^{NI} > \theta_L$, party L strictly prefers policy r to policy l in state θ_L, this cannot be an equilibrium.

Consider next the case $\theta_1 = \theta_L$. Since the function $\rho_L(\rho_R(x))$ has a slope less than one, and since $\theta_1 < \theta_L^{NI} = \rho_L(\rho_R(\theta_L^{NI}))$, we have $\rho_L(\rho_R(\theta_1)) > \theta_1$. Now, if $\theta_2 \leq \rho_R(\theta_1)$, then $\rho_L(\theta_2) > \theta_1$. This in turn implies that party L strictly prefer policy r to l in states slightly greater than θ_1. So $\theta_L = \theta_1$ cannot be an equilibrium if $\theta_2 \leq \rho_R(\theta_1)$.

Suppose $\theta_2 > \rho_R(\theta_1)$. Since this condition implies that $\theta_2 > \theta_R^{NI}$, the previous argument applied to party R establishes that newspaper 2 can be effective in equilibrium only if $\theta_1 < \rho_L(\theta_2)$. But then party L has an incentive to choose r in states slightly greater than θ_1. So this cannot be an equilibrium either. ■

Proof of Proposition 6. Conditions 1 to 3 have already been established in the text. We only prove the monotonicity result.

Consider first the case in which $\theta_1^* > \theta_L^{FI}$. Let $W^*(\theta_1, \theta_2) = W(\boldsymbol{\theta}, \boldsymbol{\delta}(\boldsymbol{\theta}); b_{ave})$. The partial derivative $W_1^* = \partial W^*/\partial\theta_1$ is simply the sum of (10) and (11). Differentiate W_1^* respect to β_L, we get

$$\frac{\partial W_1^*}{\partial \beta_L} = \left(1 + \frac{\partial \theta_L^*}{\partial \theta_1}\right) 0.25\pi'(\delta_L)(\theta_1 - \theta_L)\frac{\partial \theta_L^*}{\partial \beta_L} - \pi(\delta_L)\frac{\partial \theta_L^*}{\partial \theta_1}\frac{\partial \theta_L^*}{\partial \beta_L} + \left[\pi(\delta_L)(b_m - \theta_L) - \int_{\delta_L}^{0} \delta d\pi\right] \frac{\partial}{\partial \beta_L}\left(\frac{\partial \theta_L^*}{\partial \theta_1}\right).$$

The first term in this expression is positive, since $\partial\theta_L^*/\partial\theta_1 > -1$ and $\partial\theta_L^*/\partial\beta_L > 0$. The second term is positive, because $\partial\theta_L^*/\partial\theta_1 < 0$. Finally, note that in an interior solution,

$$\frac{\partial \theta_L^*}{\partial \theta_1} = -\frac{0.25d\pi'(\delta_L)/\pi(\delta_L)}{0.25d\pi'(\delta_L)/\pi(\delta_L) + \pi(\delta_L)}.$$

As β_L increases, δ_L rises and so the term $\partial\theta_L^*/\partial\theta_1$ increases when π is log-concave. Hence, the third term is also positive. We thus have $\partial W_1^*/\partial\beta_L > 0$. Moreover, it is easy to see that $\partial W_2^*/\partial\beta_L = 0$, since both the direct effect (10) and the policy effect (12) of θ_2 are independent of β_L. In vector notation, if we let the column vector $\mathbf{h}_L = (\partial W_1^*/\partial\beta_L, \partial W_2^*/\partial\beta_L)'$, then $\mathbf{h}_L \geq \mathbf{0}$.

From equations (10), (11), and (12), the cross partial derivative of W^* is given by:

$$W_{12}^* = 0.25\pi'(\delta_2)(\theta_2 - \theta_1) > 0.$$

Since the off-diagonal elements of the Hessian matrix of W^* are non-negative, the Hessian matrix must be negative semi-definite at an interior solution. It then follows that the inverse of the Hessian matrix, denoted $\mathbf{H}^{-1}$, is totally negative (e.g., Takayama, 1985, Theorem 4.D.3). By the implicit function theorem, we have

$$(\partial\theta_1^*/\partial\beta_L, \partial\theta_2^*/\partial\beta_L)' = -\mathbf{H}^{-1}\mathbf{h}_L > \mathbf{0}.$$

Next, consider the case in which $\theta_1^* = \theta_L^{FI}$. Since $\partial\theta_L^{FI}/\partial\beta_L > 0$, θ_1^* must increase when β_L increases. Moreover,

$$\frac{\partial \theta_2^*}{\partial \beta_L} = \frac{\partial \theta_2^*}{\partial \theta_1} = -{W_{22}^*}^{-1} W_{12}^* > 0.$$

Similar reasoning establishes that $\partial\theta_k^*/\partial\beta_R > 0$ for $k = 1, 2$. ■

Proof of Proposition 7. In an interior equilibrium, the readership-maximizing editorial position θ_1^m must satisfy the first-order condition (18), and the cut-points θ_L and θ_R must be the best responses to θ_1^m. We therefore require

$$f^*(0.5(\theta_1^m + \rho_R(\theta_1^m))) - f^*(0.5(\theta_1^m + \rho_L(\theta_1^m))) = 0. \tag{26}$$

Given conditions (19) and (20), the intermediate value theorem ensures that a solution $\theta_1^m \in (\theta_L^{FI}, \theta_R^{FI})$ to equation (26) exists. Note that $0 > \rho_i'(\theta_1) > -1$ for $i = L, R$. Hence, $0.5(\theta_1 + \rho_R(\theta_1))$ and $0.5(\theta_1 + \rho_L(\theta_1))$ are both increasing in θ_1. Since f^* is single-peaked, $f^*(0.5(\theta_1 + \rho_R(\theta_1))) - f^*(0.5(\theta_1 + \rho_L(\theta_1))) < 0$ for all $\theta_1 > \theta_1^m$ and $f^*(0.5(\theta_1 + \rho_R(\theta_1))) - f^*(0.5(\theta_1 + \rho_L(\theta_1))) > 0$ for all $\theta_1 < \theta_1^m$. The interior equilibrium is unique.

Moreover, $f^*(\theta_L^{FI}) < f^*(0.5(\theta_L^{FI} + \rho_R(\theta_L^{FI})))$ implies $f^*(\theta_1) < f^*(0.5(\theta_1 + \rho_R(\theta_1)))$ for all $\theta_1 \in [\theta_L^{NI}, \theta_L^{FI}]$. Hence, there is no boundary equilibrium in which $\theta_1 = \theta_L$ when conditions (19) and (20) hold. Similar reasoning suggests that there is no boundary equilibrium in which $\theta_1 = \theta_R$ either. ■

Proof of Proposition 8. First, suppose there is an equilibrium in which $\theta_2 > \theta_1$. Then, since newspaper 2 does not want to lower θ_2, we must have

$$f^*(0.5(\theta_1 + \theta_2)) \leq f^*(0.5(\theta_2 + \theta_R)).$$

Since f^* is single-peaked, and since $\theta_L < \theta_2$, this inequality in turn implies

$$f^*(0.5(\theta_L + \theta_1)) < f^*(0.5(\theta_1 + \theta_2)).$$

Hence, newspaper 1 would want to deviate by choosing an editorial position to the right of θ_1. This argument establishes that $\theta_1 = \theta_2$ in any equilibrium.

Next, consider the equation

$$[F^*(0.5(\rho_R(\hat{\theta}) + \hat{\theta})) - F^*(\hat{\theta})] = [F^*(\hat{\theta}) - F^*(0.5(\hat{\theta} + \rho_L(\hat{\theta})))]. \tag{27}$$

The intermediate value theorem ensures that a solution $\hat{\theta} \in (\theta_L^{FI}, \theta_R^{FI})$ to (27) exists. At $\theta_2 = \hat{\theta}$ and holding θ_L and θ_R fixed, (22) and the single-peakedness of f^* imply that R_1 is increasing for $\theta_1 \in (\theta_L^{FI}, \hat{\theta})$ and is decreasing for $\theta_1 \in (\hat{\theta}, \theta_R^{FI})$. Hence $\theta_1 = \theta_2 = \hat{\theta}$ is indeed an equilibrium. Conversely, if (22) is violated, at least one newspaper could increase the size of its readership by unilaterally deviating from $\hat{\theta}$. Since there is no equilibrium with $\theta_1 \neq \theta_2$, this means that there equilibrium does not exist when there is no $\hat{\theta}$ that satisfies (22).

To show that equilibrium is unique, note that (22) implies

$$f^*(\hat{\theta}) > \max\{0.5(1+\rho_L'(\hat{\theta}))f^*(0.5(\hat{\theta}+\theta_L)), 0.5(1+\rho_R'(\hat{\theta}))f^*(\hat{\theta}+\theta_R))\}. \quad (28)$$

This inequality implies that the left-hand-side of (27) is decreasing while the right-hand-side is increasing at $\hat{\theta}$. By the single-peakedness of f^*, both the left-hand-side and the right-hand-side of (27) are single-peaked. Thus there is only one solution to (27) which satisfies the requirement that left-hand-side is decreasing and the right-hand-side is increasing. ■

Proof of Proposition 9. Equilibrium in the monopoly case is characterized by equation (26). Differentiate this equation with respect to β_L, we get

$$\left((1+\rho_R'){f^*}'_R - (1+\rho_L'){f^*}'_L\right)\frac{\partial \theta_1^m}{\partial \beta_L} - {f^*}'_L\frac{\partial \theta_L^*}{\partial \beta_L} = 0,$$

where ${f^*}'_R$ denotes ${f^*}'(0.5(\theta_1+\theta_R))$ and ${f^*}'_L$ denotes ${f^*}'(0.5(\theta_1+\theta_L))$. Since f^* is single-peaked, equation (26) implies that ${f^*}'_R < 0$ and ${f^*}'_L > 0$. Furthermore, $\partial\theta_L/\partial\beta_L > 0$. Hence, we have $\partial\theta_1^m/\partial\beta_L < 0$.

In the duopoly case, equilibrium is characterized by equation (27). Differentiate this equation with respect to β_L, we obtain

$$\left[(0.5(1+\rho_R')f_R^* - \hat{f}^*) - (\hat{f}^* - 0.5(1+\rho_L')f_L^*)\right]\frac{\partial \hat{\theta}}{\partial \beta_L} + 0.5 f_L^*\frac{\partial \theta_L^*}{\partial \beta_L} = 0,$$

where $f_R^* = f^*(0.5(\hat{\theta}+\theta_R))$, $f_L^* = f^*(0.5(\hat{\theta}+\theta_L))$, and $\hat{f}^* = f^*(\hat{\theta})$. The term in brackets is negative by (28). Thus, $\partial\hat{\theta}/\partial\beta_L > 0$. ■

Proof of Proposition 10. When $\beta_L+\beta_R = 1$, symmetry of f^* about 0.5 implies that $\hat{\theta} = \theta_1^m = 0.5$. Therefore aggregate welfare is the same under duopoly and under monopoly.

Suppose $\beta_L+\beta_R > 1$. Proposition 9 implies that $\hat{\theta} > 0.5 > \theta_1^m$. We show that the function $W^*(\theta_1) = W(\boldsymbol{\theta}, \boldsymbol{\delta}(\boldsymbol{\theta}), b_{ave})$ is increasing in θ_1 for all $\theta_1 \in [\theta_1^m, \hat{\theta}]$. The proof proceeds in several steps.

Step 1. Since f^* is symmetric about 0.5, equation (18) implies that $\delta_L+\delta_R = 0$ at $\theta_1 = \theta_1^m$. Since $\delta_L+\delta_R$ is increasing in θ_1, this in turn implies that $\delta_L+\delta_R \geq 0$ for all $\theta_1 \geq \theta_1^m$.

Step 2. Since f^* is symmetric and unimodal about 0.5, and since $\hat{\theta} > 0.5$, equation (21) implies that $\theta_R - \theta_1 > \theta_1 - \theta_L$ at $\theta_1 = \hat{\theta}$. Furthermore, since the left side of the inequality is decreasing in θ_1 while the right side of the inequality is increasing in θ_1, the inequality is true for all $\theta_1 \leq \hat{\theta}$.

Step 3. The derivative of W^* with respect to θ_1 is the sum of the direct effect (10) and the policy effects (11) and (12). When π is a uniform distribution on $[-\sigma, \sigma]$ (with $\sigma > 0.5$), the direct effect (10) is equal to

$$\frac{1}{4\sigma}(\delta_R - \delta_L)(0.5(\theta_R + \theta_L) - \theta_1).$$

The last term in this expression is positive for all $\theta_1 \leq \hat{\theta}$ by step 2 above. Hence, the direct effect of an increase in θ_1 is positive in the range $[\theta_1^m, \hat{\theta}]$.

Step 4. Since the uniform distribution π is symmetric and log-concave, and since $\delta_L \geq -\delta_R$ by step 1, we have $\pi(\delta_L) > 1 - \pi(\delta_R)$ and $\pi'(\delta_L)/\pi(\delta_L) < \pi'(\delta_R)/(1 - \pi(\delta_R))$. Therefore, $\partial\theta_R/\partial\theta_1 < \partial\theta_L/\partial\theta_1$. This implies that the sum of the policy effects (11) and (12) is greater than

$$\left[(1 - \pi(\delta_R))(\theta_R - 0.5) - \pi(\delta_L)(0.5 - \theta_L) + \int_{\delta_L}^{\delta_R} \delta d\pi\right]\left(-\frac{\partial\theta_R}{\partial\theta_1}\right). \tag{29}$$

If the expression in brackets is positive, then both the direct effect and the policy effects are positive. So we must have $\partial W^*/\partial\theta_1 > 0$. When the expression in brackets is negative, since $\partial\theta_R/\partial\theta_1 > -1$, the expression in (29) must be greater than the bracketed term itself. Adding this term to the direct effect (10), the total effect of an increase in θ_1 is greater than

$$(\pi(\delta_R) - \pi(\delta_L))(0.5 - \theta_1) + (1 - \pi(\delta_R))(\theta_R - 0.5) - \pi(\delta_L)(0.5 - \theta_L). \tag{30}$$

If $\delta_L < 0$, equation (30) can be re-written as

$$(0.5 - \pi(\delta_L))(1 - \theta_1) + \pi(\delta_L)\theta_L + 2\delta_R(1 - \pi(\delta_R)),$$

which is positive since $\delta_L < 0$ implies $\pi(\delta_L) < 0.5$. If $\delta_L \geq 0$, equation (30) can be re-written as

$$(0.5 - (1 - \pi(\delta_R)))(1 - \theta_1) + (1 - \pi(\delta_R))\theta_R + 2\delta_L\pi(\delta_L),$$

which is positive since $\delta_R > 0$ implies $1 - \pi(\delta_R) < 0.5$. Hence, regardless of the sign of the bracketed term in (29), $\partial W^*/\partial\theta_1 > 0$ for $\theta_1 \in [\theta_1^m, \hat{\theta}]$.

When $\beta_L + \beta_R < 1$, we have $\theta_1^m > 0.5 > \hat{\theta}$. In step 1, we have $\delta_L + \delta_R \leq 0$ for $\theta_1 \leq \theta_1^m$. In step 2, we have $\theta_R - \theta_1 < \theta_1 - \theta_L$ for $\theta_1 \geq \hat{\theta}$. In steps 3 and 4, we show that the direct effect of an increase in θ_1 is negative and that the direct effect dominates the policy effect if the policy effect is positive. Hence, W^* is monotonic decreasing as θ_1 increases from the duopoly position $\hat{\theta}$ to the monopoly position θ_1^m. ■

Proof of Proposition 11. When $\theta_L = \theta_1 \in [\theta_L^{NI}, \theta_L^{FI}]$, total readership is reduced by either a rightward move or a leftward move in editorial position (recall that readership of newspaper 1 is zero if $\theta_1 < \theta_L$). Hence total readership is maximized by setting $\theta_1 = \theta_L$. Conversely, when $\theta_L < \theta_1$, total readership can be increased by lowering θ_1. So there is no equilibrium in which $\theta_L < \theta_1$. ■

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