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In this study, the authors investigate the role of advertising in affecting the extent of bias in the media. When making advertising choices, advertisers evaluate both the size and the composition of the readership of the different outlets. The profile of the readers matters because advertisers want to target readers who are likely to be receptive to their advertising messages. The authors demonstrate that when advertising supplements subscription fees, it may serve as a polarizing or moderating force, contingent on the extent of heterogeneity among advertisers in appealing to readers having different political preferences. When heterogeneity is large, each advertiser chooses a single outlet for placing advertisements (single-homing), and greater polarization arises in comparison to when the media outlet relies on subscription fees only for revenues. In contrast, when heterogeneity is small, each advertiser chooses to place advertisements in multiple outlets (multihoming) and reduces polarization results.

Keywords: media competition, bias in news, advertising, two-sided markets

The Impact of Advertising on Media Bias

Bias in news media is well-known (e.g., Groseclose and Milyo 2005; Hamilton 2004) and can be defined as selective omission, choice of words, and varying credibility ascribed to the primary source (Gentzkow and Shapiro 2006). In a recent study, Mullainathan and Shleifer (2005; hereinafter MS 2005) establish a link between subscription fees and media bias. By assuming that readers prefer news consistent with their political opinions and that newspapers can slant toward these opinions, MS show that when the newspapers' sole source of revenue is from subscription fees (i.e., price for news), they slant news toward extreme positions.

For many media outlets, however, 60%–80% of total revenue stems from advertising (Strömberg 2004) rather than subscriptions. Thus, in this study, we aim to complement the work of MS (2005) by recognizing that newspapers rely on revenues that accrue both from subscription fees that readers pay and advertising fees that advertisers pay. We investigate how the existence of these two sources of revenue affect the extent of bias in reporting the newspaper selects.

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To understand the role of advertising in determining the nature of competition between newspapers, we specify in the model the effectiveness of advertisements to enhance consumers' probability of purchase. We argue that this effectiveness, for some products, may depend on the political opinions of readers of the advertisements. It has been long established in the consumer behavior literature that products reflect a person's self-concept (Belk 1988). They provide a way for a person to express his or her self-image, which may be strongly correlated with his or her political opinions. Therefore, we introduce a product-specific variable that measures the extent to which political preferences play a role in enhancing consumers' probability of purchase of the product. While for some products this measure is significant, for others it is trivial. For example, while "green" products (e.g., Toyota Prius, Apple Mac computers) may appeal more to liberals, "American" products (e.g., Chevy truck) may appeal more to conservative consumers. However, there are many products (e.g., automobile tires, insurance policies) for which political opinions do not affect consumers' choices to any great extent.[1] When political preferences play an important role in consumers' purchase decisions, advertising the product can be effective if it targets the correct consumers. An advertisement that reminds consumers

[1]The appeal parameter of the advertised product we introduce in the model assumes a value in the vicinity of zero if political preferences do not play an important role in consumers' purchase decisions.

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that the product is consistent with their political opinions may increase the likelihood that they purchase the product.

In our model, heterogeneity among advertisers with respect to the appeal of their products to consumers having different preferences is distributed over a bounded interval. The length of this interval captures the extent of heterogeneity among advertisers, with longer intervals indicating significant differences in the appeal of products to liberal versus conservative readers. Our model shows that the degree of heterogeneity among advertisers plays a role in determining whether advertisers choose to place advertisements with a single newspaper or with both liberal and conservative newspapers. The literature on two-sided markets has referred to these two possible outcomes as single- and double-homing by advertisers, respectively (e.g., Armstrong 2006). Whereas single-homing arises as the unique equilibrium when the extent of heterogeneity is large, double-homing arises when it is small.

We further investigate the way the advertisers' choices between the newspapers affect the slanting strategies of media outlets. We show that when newspapers rely on both advertising and subscription fees, advertising can serve as a polarizing or moderating force in affecting the newspapers' reporting through two effects. First, adding the advertising market implies that newspapers reduce their reliance on subscribers in favor of advertisers. As a result, they may choose less slanting in their reporting strategies to improve their appeal to moderate readers and, by doing so, offer a larger readership to advertisers. This "readership effect" enables the newspapers to charge higher advertising fees.

However, when newspapers seek to lure advertisers, a second countereffect may arise when advertisers choose to single-home. Specifically, when downward pressures on subscription fees arise as a result of reduced slanting of the newspapers, similar downward pressures on advertising fees appear as well because each newspaper attempts to defend its market share among advertisers. Thus, newspapers may have stronger incentives to polarize to alleviate price competition in both markets. This "incremental pricing effect" to polarize is beyond the traditional attempt of companies to introduce product differentiation to soften price competition in a given market. In the two-sided markets we consider, polarization serves to soften price competition in both markets.

We demonstrate that at the single-homing equilibrium, the incremental pricing effect is stronger than the readership effect, thus leading to intensified bias in reporting. In contrast, at equilibrium with double-homing, the readership effect is the only force present, giving rise to reduced bias at the equilibrium.

There is a growing body of literature on media bias as implied by the media's attempt to appeal to readers' beliefs. In addition to MS (2005), Gentzkow and Shapiro (2006) and Xiang and Sarvary (2007) investigate this type of bias. In Gentzkow and Shapiro, readers who are uncertain about the quality of an information source infer that the source is of higher quality if its reports are consistent with their prior expectations. Xiang and Sarvary assume that there are two types of consumers: those who enjoy reading news consistent with their political opinions and conscientious consumers who care only about the truth. This assumption is different from MS (2005) and the current study, in which each consumer values both some consistency with political opinions and accuracy. Therefore, the reporting strategy of the newspapers depends on the relative weights consumers assign to consistency with their political opinions versus accuracy. In addition, these previous studies on bias assume that the media's sole source of revenue stems from selling news. In contrast, in the current study, we allow the newspapers to earn revenues from advertising fees as well.

Similar to the current study, two recent studies have considered a media market with both advertising and subscription fees as sources of revenue. In Gabszewicz, Laussel, and Sonnac (2002) and Ellman and Germano (2009), advertisers care only about the size and not the profile of the readership of each newspaper. This assumption is different from our setting, in which advertisers want to target audiences that are receptive to their advertising messages. Bergemann and Bonatti (2010) pursue this targeting objective of advertisers in an environment in which the sole source media outlets' revenues comes from advertising. In this recent study, the authors investigate how improvements in the targeting technology facilitated by online advertising affects the allocation of advertisements across different media and the equilibrium prices of advertising messages. Iyer, Soberman, and Villas-Boas (2005) also investigate the topic of targeted advertising in an environment in which the firms themselves, not media outlets, possess the targeting technology.

Another strand of literature related to our study involves consumers who may choose one or two competing products. In Sarvary and Parker (1997), consumers decide whether to rely on a single information source or to diversify their purchases to include competing sources. The authors show that the segmentation of consumers between those who purchase one or two sources of information depends on the relative importance consumers assign to obtaining precise information. In Guo (2006), a similar diversification of the consumption bundle may arise when there is uncertainty about future preferences. Buying competing products simultaneously serves as "insurance" against such uncertainty. The main difference between our study and Sarvary and Parker (1997) and Guo (2006) is our focus on competition between media outlets in two-sided markets instead of the one-sided framework considered in these studies.

THE MODEL

Consider a market with two newspapers, $i = 1, 2$; a mass of A advertisers; and a mass of M consumers, where M_1 of these consumers are subscribers to one of these two newspapers and M_2 are nonsubscribers. Newspapers provide news and print advertisements. By simultaneously operating in these two markets, newspapers have two potential sources of revenue: subscription fees (P_i) and advertising fees (K_i).

Each of the M_1 consumers reads either Newspaper 1 or 2 (but not both) and may buy products from the advertisers. We adapt the model that MS (2005) developed to capture the interaction between subscribers and newspapers. Specifically, when reading the newspaper, a subscriber receives information about a certain news item t, which is distributed according to $N(0, \sigma_t^2)$. Each consumer has some belief about the news item that is affected by his or her political opinion. We designate this political preference as b and assume that the consumer believes the news item to be

distributed according to $N(b, \sigma_t^2)$. In comparison to the true distribution of the news item, the consumer's belief is biased. The political opinion parameter b measures the extent and direction of this bias. It is uniformly distributed in the population of readers between $-b_0$ and b_0. For example, readers with beliefs closer to $-b_0$ can be considered liberals, and those in the proximity of b_0 can be considered conservatives.

Newspapers report news about t. They receive some data $d = t + \varepsilon$, where the random variable ε is independently distributed of t according to $\varepsilon \sim N(0, \sigma_\varepsilon^2)$. Note that the data the newspapers receive may be different because t and ε are random variables. Thus, $d \sim N(0, \sigma_d^2)$, where $\sigma_d^2 = \sigma_t^2 + \sigma_e^2$.[2] Newspapers may choose to report the data with slant s_i, so the reported news is $n_i = d + s_i$. Readers incur disutility when they read news inconsistent with their political opinions, as measured by the distance between the reported news and the readers' opinions: $(n_i - b)^2$. Holding constant the extent of inconsistency with their opinions, they also prefer less slanting in the news. As in MS (2005), the overall utility of a reader is as follows:

$$(1) \qquad U_b^i = \bar{u} - \chi s_i^2 - \phi(n_i - b)^2 - P_i \qquad \chi, \phi \geq 0,$$

where $\bar{u}$ is the reservation price of the reader, χ calibrates his or her preference for reduced slant, and ϕ calibrates the reader's preference for hearing news consistent with his or her political opinion. Note that the utility of the reader increases the smaller the slant s_i and the smaller the discrepancy between the reader's opinion b and the reported news n_i.

Similar to MS (2005), we also focus on the characterization of the equilibrium with full coverage of the market and linear slanting strategies of the newspapers in the form $s_i(d) = [\phi/(\phi + \chi)](B_i - d)$, with B_i interpreted as a choice of location of newspaper i.[3] This location choice of the newspaper can be a point inside or outside the interval $[-b_0, b_0]$ and reflect the newspaper's political preference. Using $s_i(d)$, the newspaper slants data toward its preference B_i when reporting news. Note that the extent of slanting is an increasing function of ϕ and a decreasing function of χ. Thus, as readers derive higher utility from news that is consistent with their political opinions and reduce the importance placed on obtaining accurate information, newspapers choose greater slanting in their reporting. Without loss of generality, we assume that Newspaper 2 is located to the right of Newspaper 1 ($B_1 < B_2$). That is, whereas Newspaper 1 slants more to the left, Newspaper 2 slants more to the right.

Substituting the linear slanting strategies for s_i and n_i into Equation 1 and using the distributional properties of the random variable d (specifically, $Ed = 0$ and $Ed^2 = \sigma_d^2$) yields the expected payoff of a consumer having opinion b at the time he or she chooses between the two newspapers. Note that at this time, the realizations of d and $s_i(d)$ are yet to be determined because of the fluctuations of the data supporting news stories. At the time of the choice, the reader is aware only of the locations and fees the newspapers have chosen (B_i and P_i) as well as his or her own political opinion b. Because the actual news may fluctuate depending on the realization of d, in evaluating the utility the reader derives from subscribing to the newspapers, he or she calculates expectation over all possible d realizations in Equation 1. For Newspaper i and reader of type b, this yields the following expected utility:

$$EU_b^i = \bar{u} - \frac{\phi^2}{\phi + \chi}(B_1 - b)^2 - \frac{\chi\phi}{\phi + \chi}\left(b^2 + \sigma_d^2\right) - P_i.$$

The consumer who is indifferent between the two newspapers satisfies the equation $EU_b^1 = EU_b^2$. Solving this equation for b yields the following:

$$(2) \qquad b_{indif} = \frac{(\phi + \chi)}{2\phi^2}\frac{(P_2 - P_1)}{(B_2 - B_1)} + \frac{B_1 + B_2}{2}.$$

Given the expression derived for b_{indif}, the newspapers' subscription revenues are

$$(3) \qquad R_{1,sub} = M_1 P_1 \frac{b_0 + b_{indif}}{2b_0}, \text{ and } R_{2,sub} = M_1 P_2 \frac{b_0 - b_{indif}}{2b_0}.$$

The population of advertisers is distributed according to the appeal of their products to consumers having conservative opinions, namely, those situated in the positive segment of the distribution of opinions. We designate this appeal parameter by α and assume it is uniformly distributed on the interval $[-\alpha_0, \alpha_0]$, $\alpha_0 \geq 0$. Negative values of α indicate products that are unappealing to conservative consumers with opinions in the range $[0, b_0]$, with more negative values indicating increased appeal to liberal consumers with opinions in the range $[-b_0, 0]$. Positive values of α indicate products that have the opposite characteristics, with larger positive values indicating increased appeal to conservatives. Products whose attractiveness to the consumer is unlikely to be determined by political opinions assume an α value in the neighborhood of zero. Given this specification, the parameter α_0 can be interpreted as reflecting the extent of heterogeneity of the appeal of different products to consumers with different political opinions.

We assume that in the absence of advertising, each consumer has a certain probability of purchasing a product. This probability can be modified with advertising. The change in purchase probability for a given reader depends on the extent of compatibility between the political opinion of the reader (his or her location b) and the type of the product advertised (its appeal α). When an advertisement is successfully targeted to enhance compatibility, the reader's purchase probability of the advertised product increases. However, with lack of compatibility, his or her purchase probability might actually decrease. We designate $E(\alpha, b)$ as the incremental probability (positive or negative) when a reader of political preference b is exposed to an advertisement related to product α and specify it as

[2]Note that there is no vertical differentiation between the newspapers in this setting (i.e., the accuracy of the data received by both newspapers is identical: $\sigma_{d_1}^2 = \sigma_{d_2}^2 = \sigma_d^2$). In the Web Appendix (www.marketingpower.com/jmr_webappendix), we demonstrate that our utility specification may also give rise to a trade-off between vertical and horizontal differentiation. Specifically, when $\sigma_{d_1}^2 < \sigma_{d_2}^2$, $|B_1| < |B_2|$.

[3]In the Web Appendix (www.marketingpower.com/jmr_webappendix), we show the optimality of linear slanting strategies when the newspapers' sole source of revenue is from subscription fees. However, in our analysis, in which both advertising and subscription fees are sources of revenue, we implicitly assume that the linearity of slanting strategies is still valid.

$$E(\alpha, b) = \left(h_0 + \frac{\alpha b}{b_0} \right), \text{where } h_0 > 0. \quad (4)$$

Thus, the effectiveness of advertising is greater when political opinions are more consistent with the appeal parameter of the advertised product, measured by the term αb in Equation 4. Note that the product αb is positive for both liberal consumers of products having a negative measure of appeal α and conservative consumers of products having a positive measure of appeal. The parameter h_0 is a measure of the basic effectiveness of advertising to increase consumers' purchase probabilities. The change in the probability of purchase $E(\alpha, b)$ also depends on the extent of compatibility between the variables b and α. For example, when a liberal consumer is exposed to an advertisement of a green product, this will cause an increase in his or her probability of purchasing this product that is above h_0, which is the basic increase in purchase probability when the consumer becomes aware of the product due to the advertisement. However, an extremely conservative consumer can respond very negatively to this product, in which case the change in his or her purchase probability due to the advertisement $E(\alpha, b)$ might even become negative.[4,5]

The specification in Equation 4 implies that an advertiser is likely to pursue two objectives in designing its advertising strategy: to obtain a large audience for its advertisements and to target an audience receptive to its advertising message. The first component of the advertising response function motivates the large audience objective, and the second motivates the targeting objective. Finally, for simplicity, we assume that advertising has the same effect on a subscriber and nonsubscribers with whom he or she shares information about advertised products. This assumption is reasonable because subscribers tend to communicate with friends and relatives, who often hold similar political opinions.

We measure the payoff of an advertiser by the average increase in the number of consumers likely to buy its product (average incremental probability × the mass of consumers M) net of the advertising fees paid to the newspapers. Thus, when an advertiser of appeal parameter α chooses to advertise only in Newspaper 1, its expected payoff as derived from the subscribers of Newspaper 1 is as follows:

$$E_1(\alpha) = M \int_{-b_0}^{b_{indif}} \frac{1}{2b_0} \left(h_0 + \frac{\alpha b}{b_0} \right) db - K_1. \quad (5)$$

If it chooses to advertise only in Newspaper 2, its expected payoff is as follows:

$$E_2(\alpha) = M \int_{b_{indif}}^{b_0} \frac{1}{2b_0} \left(h_0 + \frac{\alpha b}{b_0} \right) db - K_2. \quad (6)$$

Finally, if it chooses to advertise in both papers its expected payoff is as follows:

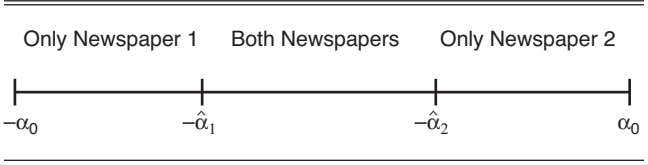
$$E_{12}(\alpha) = E_1(\alpha) + E_2(\alpha). \quad (7)$$

By choosing to advertise only in Newspaper 1, an advertiser recognizes that subscribers to this newspaper tend to have left-leaning political opinions, lying in the interval $[-b_0, b_{indif}]$, where $b_{indif} = 0$ at the symmetric equilibrium (when $-B_1 = B_2 \geq 0$). For example, if it advertises a green product ($\alpha < 0$) in Newspaper 1, it can expect a positive payoff if the advertising fee paid to the newspaper (K_1) is not too large, given that the average change in these readers' purchase probability due the advertisement is positive (i.e., $\int_{-b_0}^{0} [1/(2b_0)] [h_0 + (\alpha b/b_0)] db > 0$). In contrast, by choosing to advertise only in Newspaper 2, the advertiser draws readers who have more right-leaning opinions, in the interval $[b_{indif}, b_0]$. In this case, although these readers become aware of its product ($h_0 > 0$), their political preferences are inconsistent with the product ($\alpha b \leq 0$) when ($\alpha < 0$) and ($b \in [0, b_0]$), thus possibly leading to a negative expected payoff.

When advertising in both newspapers, an advertiser draws the entire population of readers. An advertiser chooses to advertise in a single newspaper, i, if $E_i(\alpha) > E_{12}(\alpha)$ and $E_i(\alpha) > 0$. From Equations 5–7, it follows that for this advertiser, $E_j(\alpha) < 0$ for $j \neq i$; in other words, the added benefit from advertising in the second newspaper falls short of the fee newspaper j charges. This may happen if the advertiser's product appeals mostly to readers having extreme political opinions. Advertising in a newspaper whose readership consists mostly of readers with opposing opinions in the political spectrum may not be worthwhile to the advertiser in this case. In contrast, an advertiser whose product's appeal is not highly correlated with political preferences (having an appeal parameter in the neighborhood of zero) may advertise in both newspapers because the added benefit from advertising in each newspaper is likely to be positive for this advertiser, implying that $E_{12}(\alpha) > E_i(\alpha)$, i = 1, 2. The preceding discussion indicates that the population of advertisers can be segmented into, at most, three intervals, as we show in Figure 1.

Advertised products with an appeal parameter less than $\hat{\alpha}_2$ are advertised only in Newspaper 1 because the advertisers of these products try to target mostly liberals. (From Equation 6, $E_2[\alpha]$ is an increasing function of α; thus, if $E_2(\hat{\alpha}_1) = 0$, $E_2[\alpha] < 0$ for all $\alpha < \hat{\alpha}_1$.) In contrast, those with appeal parameter larger than $\hat{\alpha}_2$ are advertised only in Newspaper 2 because advertisers want to reach only conservative readers for such high values of appeal parameter (from Equation 5, $E_1[\alpha]$ is a decreasing function of α; thus, if $E_1(\hat{\alpha}_2) = 0$, $E_1[\alpha] < 0$ for all $\alpha > \hat{\alpha}_2$). For intermediate values of $\alpha \in [\hat{\alpha}_1, \hat{\alpha}_2]$ advertisers choose to advertise in both newspapers (because both $E_1[\alpha]$ and $E_2[\alpha]$ are positive in

Figure 1
SEGMENTATION OF THE ADVERTISING MARKET



[4]According to Equation 4, the change in the purchase probability for extreme products and consumers is larger than that for moderate products and consumers. As we mention in fn. 10, when this feature of our model is not valid, some of our results may change, even though the strategic effects we identify will continue to operate.

[5]Let $F_{\alpha b}$ denote the initial probability of purchase in the absence of advertising of product α by a consumer with opinion b and $P_{\alpha b}$ denote the probability of purchase after advertising such that $P_{\alpha b} = F_{\alpha b} + E(\alpha, b)$. To guarantee that $0 \leq P_{\alpha b} \leq 1$, we assume that $1 - F_{\alpha b} - \alpha_0 \geq h_0 \geq \alpha_0 - F_{\alpha b}$ and $F_{\alpha b} + \alpha_0 < 1$. Note that these parameter restrictions do not conflict with those given in Lemma 1.

this range). The number of segments in Figure 1 can be smaller than three. If $\hat{\alpha}_1 \geq \hat{\alpha}_2$, no advertiser chooses to advertise in both newspapers (referred to in the literature on two-sided markets as single-homing), and if $\hat{\alpha}_1 = -\hat{\alpha}_0$ and $\hat{\alpha}_2 = \alpha_0$, all advertisers choose to advertise in both newspapers (double-homing). Note in particular that when $\alpha_0 = 0$, the mass of A advertisers is located at $\alpha = 0$, and in this case, advertisers do not care about targeting. At the symmetric equilibrium, from Equations 5 and 6, each advertiser derives the net benefit of $(Mh_0)/2 - K$ when placing an advertisement with either one of the newspapers. Double-homing is implied, given that both newspapers offer the same net benefit to each advertiser.

From Equations 5–7, we can derive the expressions for $\hat{\alpha}_1$ and $\hat{\alpha}_2$ as functions of the locations and advertising fees chosen by the newspapers as follows:

$$(8)\qquad \hat{\alpha}_1 = \frac{2b_0}{b_0 + b_{indif}}\left[\frac{2b_0K_2}{M(b_0 - b_{indif})} - h_0\right],$$

$$\hat{\alpha}_2 = \frac{2b_0}{b_0 + b_{indif}}\left[h_0 - \frac{2b_0K_1}{M(b_0 - b_{indif})}\right].$$

The appeal parameter $\hat{\alpha}_1(\hat{\alpha}_2)$ characterizes an advertiser that is indifferent between advertising in Newspaper 1 (Newspaper 2) and advertising in both newspapers (i.e., $E_2(\hat{\alpha}_1) = 0$ and $E_1(\hat{\alpha}_2) = 0$).

In the single-homing equilibrium, the interior segment of Figure 1 disappears, and the advertiser that is indifferent between Newspapers 1 and 2 can be derived from Equations 5 and 6 by solving for α in the equation $E_1(\alpha) = E_2(\alpha)$:

$$(9)\qquad \alpha_{indif} = \frac{2b_0b_{indif}}{\left(b_0^2 - b_{indif}^2\right)}h_0 - \frac{2b_0^2}{\left(b_0^2 - b_{indif}^2\right)}\frac{(K_1 - K_2)}{M}.$$

From Equation 9, we obtain the advertising revenues that accrue to the newspapers in the equilibrium with single-homing as follows:

$$(10)\quad R_{1,adv} = AK_1\frac{\alpha_0 + \alpha_{indif}}{2\alpha_0}, \text{and } R_{2,adv} = AK_2\frac{\alpha_0 - \alpha_{indif}}{2\alpha_0}.$$

When some advertisers double-home, the segment of the market covered by Newspaper 1 is $(\alpha_0 + \hat{\alpha}_2)/(2\alpha_0)$ and that covered by Newspaper 2 is $(\alpha_0 - \hat{\alpha}_1)/(2\alpha_0)$. As a result, the advertising revenues of the newspapers are

$$(11)\qquad R_{1,adv} = AK_1\frac{\alpha_0 + \hat{\alpha}_2}{2\alpha_0}, \text{and } R_{2,adv} = AK_2\frac{\alpha_0 - \hat{\alpha}_1}{2\alpha_0}.$$

In what follows, we derive symmetric equilibriums with the market of advertisers fully covered. At such equilibriums, $-\hat{\alpha}_1 = \hat{\alpha}_2 \geq 0$, and $-B_1 = B_2 \geq 0$. We focus on two possible cases: equilibrium with single-homing, in which each advertiser chooses to advertise in a single newspaper ($\hat{\alpha}_1 = \hat{\alpha}_2 = 0$ in Figure 1), and double-homing, in which all advertisers choose to advertise in both newspapers ($\hat{\alpha}_1 = -\alpha_0, \hat{\alpha}_2 = \alpha_0$).

We formulate the decision process of the newspapers as a two-stage game. In the first stage, each newspaper simultaneously announces a strategy $s_i(d)$ of how to report the news (its location B_i). In the second stage, the newspapers choose their prices P_i and K_i simultaneously. Subsequent to those two stages, advertisers choose where to advertise, and readers decide to which newspaper to subscribe to. Next, newspapers receive data d and report news $d + s_i(d)$. Finally, consumers read the news, are exposed to the advertisements, and form new impressions of the advertised products.

Using this framework but with no advertising, MS (2005) show that the equilibrium locations of the newspapers are $B_1^{MS} = -3b_0/2$ and $B_2^{MS} = 3b_0/2$. Thus, with subscription fees being newspapers' only source of revenues, newspapers choose extreme bias in reporting, to the right by Newspaper 2 and to the left by Newspaper 1, at equilibrium. Such extreme differentiation in reporting alleviates the extent of competition on subscription fees. In what follows, we investigate how these equilibrium locations change if newspapers earn revenues from advertising as well.

Note how bias in reporting as a vehicle to introduce differentiation between newspapers is different from other product features aimed at achieving horizontal differentiation. First, the utility of readers depends on two attributes of news reports—accuracy and consistency with political opinions—thus introducing potential opportunities for both vertical and horizontal differentiation. Whereas the location choice of each newspaper (B_i) is the vehicle to introduce horizontal differentiation, the weight assigned to this location in designing the slanting strategy (i.e., $\phi/[\phi + \chi]$) captures the relative importance of the vertical versus the horizontal attributes (i.e., accuracy vs. consistency with political opinions) in the utility function of the consumers. In particular, if the consumers' appreciation for accuracy (the vertical attribute) is infinite, the newspapers stop slanting the news and do not use reporting bias for horizontal differentiation. Another aspect that distinguishes bias from traditional models of horizontal differentiation is that newspapers attempt to appeal to two different audiences: readers and advertisers. Thus, each newspaper's positioning has implications for price competition in both markets. This contrasts with most models of product differentiation, in which features are chosen by taking into account competition in a single consumer market.

ANALYSIS

When both subscription and advertising revenues are available, the objectives of the newspapers are as follows:

Single-Homing ($\hat{\alpha}_1 = \hat{\alpha}_2 = 0$):

$$(12)\qquad \pi_1 = A\frac{\alpha_0 + \alpha_{indif}}{2\alpha_0}K_1 + M_1\frac{b_0 + b_{indif}}{2b_0}P_1, \text{and}$$

$$\pi_2 = A\frac{\alpha_0 - \alpha_{indif}}{2\alpha_0}K_2 + M_1\frac{b_0 - b_{indif}}{2b_0}P_2,$$

where b_{indif} and α_{indif} are given in Equations 2 and 9, respectively.

Double-Homing ($\hat{\alpha}_1 = -\alpha_0, \hat{\alpha}_2 = \alpha_0$):

$$(13)\qquad \pi_1 = AK_1 + M_1\frac{b_0 + b_{indif}}{2b_0}P_1, \text{and}$$

$$\pi_2 = AK_2 + M_1\frac{b_0 - b_{indif}}{2b_0}P_2,$$

where b_{indif} is given by Equation 2.

The newspapers choose subscription and advertising fees in the second stage to maximize profits given in Equations

12–13. When the newspapers locate symmetrically so that $B_1 = B_2 = B$, the solution to the maximization is as follows:

Single-Homing ($\hat{\alpha}_1 = \hat{\alpha}_2 = 0$):

$$(14)\qquad P_S^{**} = \frac{4B\phi^2 b_0}{\phi+\chi} - \frac{Ah_0}{\frac{M_1}{M}}, \text{ and } K_S^{**} = \frac{M\alpha_0}{2}.$$

Double-Homing ($\hat{\alpha}_1 = -\alpha_0, \hat{\alpha}_2 = \alpha_0$):

$$(15)\qquad P_D^{**} = \frac{4B\phi^2 b_0}{\phi+\chi} - \frac{Ah_0}{\frac{M_1}{M}}, \text{ and } K_D^{**} = \frac{M}{2}\left(h_0 - \frac{\alpha_0}{2}\right).$$

Thus, for a fixed symmetric choice of locations, subscription fees are higher if subscribers have greater preference for reports consistent with their political opinions (larger ϕ), have smaller preference for accurate reporting (smaller χ), and are more heterogeneous (larger b_0). Subscription fees are also higher when the advertising market is smaller (smaller A), the relative size of the subscriber population is larger (larger M_1/M), and the effectiveness of advertising declines (smaller h_0). In general, the more important advertising revenues in comparison to subscription revenues, the lower are the fees that newspapers charge to subscribers at the symmetric equilibrium.

Substituting the equilibrium advertising fees derived in Equations 14 and 15 back into Equation 8 implies different types of homing depending on the extent of heterogeneity among the advertisers (value of α_0). While for large values ($\alpha_0 > 2h_0$), single-homing is the unique equilibrium, for small values ($\alpha_0 \le 2h_0/3$, double-homing is the unique equilibrium.[6] As we explained previously, advertisers in our environment care about both the number and profile of readers who are exposed to their advertisements. When heterogeneity among advertisers is significant, targeting readers who are compatible with advertised products is important to the advertisers. Single-homing is more successful than double-homing in achieving such targeting. In the absence of targeting, advertisements might reach consumers with extreme political opinions incompatible with the products advertised. When heterogeneity is large, such lack of targeting is especially costly for advertisers because the product αb might assume very large negative values in Equation 4.

To obtain the equilibrium locations chosen by the newspapers in the first stage, we must solve first for the second-stage fees, $P_i(B_i, B_j)$ and $K_i(B_i, B_j)$, as functions of arbitrary location choices selected in the first stage (not necessarily symmetric locations only). The second-stage equilibrium strategies must be substituted back into Equations 12–13 to obtain the first-stage payoff functions of the newspapers.

Assuming the existence of an interior equilibrium, next, we compare the locations selected at the symmetric equilibrium (designated by B^{**}) to those derived when newspapers obtain revenues from subscribers only (denoted as $-B_1^* = B_2^* = B^{MS}$). When there is no heterogeneity among advertisers (i.e., when $\alpha_0 = 0$), advertisers double-home and $B^{**} = B^{MS} = 3b_0/2$, meaning that bias remains unaffected when advertising is added as a source of revenue. However, when $\alpha_0 > 0$, adding advertising to supplement subscription fees may moderate or intensify bias. In Lemma 1, we first derive restrictions on the parameters of the model to guarantee that those regimes can be supported with positive streams of revenues from subscribers (i.e., $B^{**} > 0$, and $P^{**} > 0$). For ease of presentation, we introduce a measure for the importance of advertising relative to subscription as a source of revenue for the newspapers, $T \stackrel{def}{=} (AM/M_1)[(\phi+\chi)/(8\phi^2)]$, where (AM/M_1) represents the size of the advertising market relative to the subscription market and $(\phi+\chi)/(8\phi^2)$ is a measure of the importance consumers attach to accuracy relative to consistency with their political opinions. If consumers attach great importance to accurate reporting (i.e., $[\phi+\chi]/\phi^2$ is large), the newspapers cannot charge high subscription fees. Therefore, if either one of the two components of T increases, the subscription market loses its importance as a source of revenues relative to the advertising market.

Lemma 1: To ensure positive subscription prices and strict differentiation between newspapers (i.e., $P^{**} > 0$, and $B^{**} > 0$):

(a) At the single-homing equilibrium:

$$T < T_{max}^S = \frac{3b_0^2(9\alpha_0 - 4h_0)}{2h_0(9\alpha_0 - 2h_0)}, \text{ and } \alpha_0 > 2h_0.$$

(b) At the double-homing equilibrium:

$$T < T_{max}^D = \frac{b_0^2(3h_0 - 2\alpha_0)}{2h_0(2h_0 - \alpha_0)}, \text{ and } \alpha_0 > \frac{2h_0}{3}.$$

Restricting attention to the regions specified in Lemma 1, we derive the optimal locations chosen by the newspapers at the symmetric equilibrium in Equations 16 and 17:

Single-Homing:

$$(16)\qquad -B_1^{**} = B_2^{**} = B_S^{**} = \frac{3b_0}{4} + \frac{Th_0\left(\frac{1}{2} + \frac{h_0}{3\alpha_0}\right)}{b_0} + \sqrt{\left[\frac{3b_0}{4} + \frac{Th_0}{b_0}\left(\frac{1}{2} + \frac{h_0}{3\alpha_0}\right)\right]^2 - \frac{4Th_0^2\left(1 + \frac{2Th_0}{3b_0^2}\right)}{3\alpha_0}}.$$

Double-Homing:

$$(17)\qquad -B_1^{**} = B_2^{**} = B_D^{**} = \frac{3b_0}{4} + T\frac{\alpha_0}{2b_0} + \sqrt{\left(\frac{3b_0}{4} + T\frac{\alpha_0}{2b_0}\right)^2 - 2T\alpha_0}.$$

Proposition 1 follows from the expressions derived in Equations 16 and 17.

P_1: With both advertising and subscription fees contributing to the newspapers' revenues,

(a) When heterogeneity among advertisers is sufficiently large ($\alpha_0 > 2h_0$), each advertiser chooses a single newspaper for placing its advertisements (single-homing), and newspapers introduce more bias in their reporting ($B_S^{**} > B^{MS}$). This bias increases as the importance of advertising as a source of revenue increases ($\partial B_S^{**}/\partial T > 0$).

[6]Note that between $2h_0/3$ and $2h_0$, there is an equilibrium at which some advertisers single-home and others double-home. In addition, multiple equilibriums may arise in this range (for derivations, see the Web Appendix at www.marketingpower.com/jmr_webappendix).

(b) When heterogeneity among advertisers is sufficiently small ($\alpha_0 < 2h_0/3$), each advertiser chooses both newspapers for placing its advertisements (double-homing), and newspapers introduce less bias in their reporting ($B_D^{**} > B^{MS}$). This bias decreases as the importance of advertising as a source of revenue increases ($\partial B_D^{**}/\partial T > 0$).

To understand the results reported in P_1, it is important to highlight the new effects influencing the location choice of the newspapers that arise when advertising is added as a source of revenue to supplement subscription fees. The first readership effect is related to the intensified incentives of each newspaper to increase its readership. (For Newspaper 1, this means increasing b_{indif}, and for Newspaper 2, it means decreasing it.) Note that at the symmetric equilibrium (i.e., when $b_{indif} = 0$), $\partial K_1^S/\partial b_{indif} = Mh_0/(3b_0) > 0$ and $\partial K_1^D/\partial b_{indif} = Mh_0/(2b_0) > 0$.[7] Thus, regardless of the type of homing, a newspaper that delivers a larger readership can command a higher advertising fee from advertisers. This implies that each newspaper has extra incentives to move closer to its competitor's location to increase its market share among readers (e.g., $\partial b_{indif}/\partial B_1 = \frac{1}{2} > 0$ at symmetry, when $P_1 = P_2$).

However, adding advertising as a source of revenue introduces a counterforce when advertisers single-home. We refer to this force as the "incremental pricing effect" to capture the idea that a change in a newspaper's location not only has a direct effect on the intensity of price competition in the subscription market but may also have an indirect, incremental effect on the intensity of price competition in the advertising market.[8] When a newspaper modifies its location and advertisers single-home, the competing newspaper may need to adjust its advertising fee to defend its market share among advertisers. For example, when Newspaper 1 increases B_1, it moves closer to the location of Newspaper 2, and as a result of reduced differentiation, Newspaper 2 is forced to cut subscription fees. In addition, because the new, moderated location of Newspaper 1 offers a larger readership to advertisers, Newspaper 2 must cut its advertising fee as well to defend its market share in the advertising market.[9] The existence of this incremental pricing effect introduces incentives for Newspaper 1 to polarize to discourage Newspaper 2 from aggressive pricing. These incentives are stronger than in an environment in which newspapers compete in a single subscriber market because Newspaper 2 is forced to cut both its advertising and subscription fees.

According to P_{1a}, the incremental pricing effect present at the single-homing equilibrium more than outweighs the objective of increasing readership, thus leading to intensified bias at the equilibrium when advertising is added as a source of revenue to augment subscription fees. Moreover, this bias increases as the importance of advertising as a source of revenue (T) increases. In contrast, according to P_{1b}, at the equilibrium with double-homing, bias in reporting the news is reduced when advertising supplements subscription fees. At this type of equilibrium, the only additional effect that advertising introduces is the added objective of newspapers to offer larger readerships to advertisers. Because the market share of each newspaper in the advertising market is fixed at 100% and the newspapers do not need to defend their market shares among advertisers, the incremental pricing effect is nonexistent in the double-homing environment. Note that the readership effect intensifies, in this case, when advertising is a more important source of revenue (large T). Figure 2 depicts the relationship between the equilibrium locations of the newspapers and the importance of advertising as a source of revenue to the newspapers, as P_1 suggests.[10]

We can use the results reported in P_1 to conjecture how the equilibrium is likely to change in case of less than full coverage of readers. At the single-homing equilibrium (when α_0 is large), bias in reporting is significant. Therefore, it is sensible that when the market is less than fully covered, consumers with moderate opinions in the neighborhood of b = 0 would choose to drop out of the market

[7]The solutions for the advertising fees as functions of the locations are:

$$K_1^S = M\left[\frac{\alpha_0\left(b_0^2 - b_{indif}^2\right)}{2b_0^2} + \frac{b_{indif}h_0}{3b_0}\right],$$

$$K_2^S = M\left[\frac{\alpha_0\left(b_0^2 - b_{indif}^2\right)}{2b_0^2} - \frac{b_{indif}h_0}{3b_0}\right],$$

$$K_1^D = \frac{M(b_0 + b_{indif})}{2b_0}\left[h_0 - \frac{\alpha_0(b_0 - b_{indif})}{2b_0}\right], \text{ and}$$

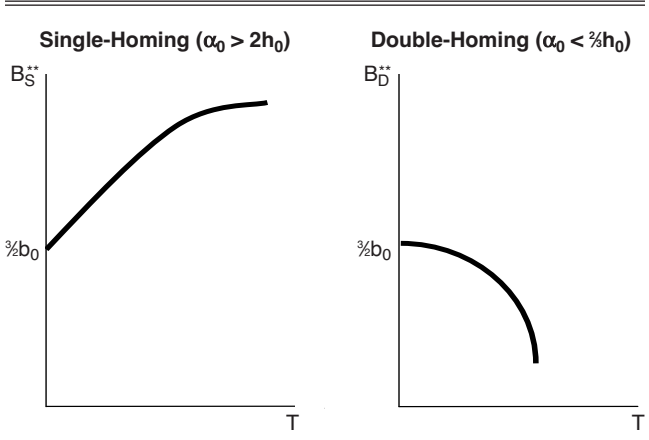
$$K_2^D = \frac{M(b_0 - b_{indif})}{2b_0}\left[h_0 - \frac{\alpha_0(b_0 + b_{indif})}{2b_0}\right].$$

[8]Note that this effect does not exist in standard models of horizontal differentiation in which a change in location has implications on price competition in only one market.

[9]As Newspaper 1 increases its readership by increasing B_1, Newspaper 2 loses market share among advertisers because at the symmetric equilibrium from Equation 2 and from Equation 9, $\partial\alpha_{indif}/\partial b_{indif} = 2h_0/b_0 > 0$. Thus, Newspaper 2 has an incentive to cut its advertising fee because $\partial K_2^S/\partial B_1 = -Mh_0/(6b_0) < 0$ at symmetry.

[10]Note that with a different advertising response function, which implies that the change in purchase probability for moderate products and consumers is larger than that for extreme products and consumers, the readership effect will be stronger, because in this case, the moderate readers will be more valuable for the advertisers and therefore the newspapers. We predict that while the results for double-homing reported in P_1 will continue to hold in such an environment, the results for single-homing may change because the readership effect may outweigh the incremental pricing effect.

Figure 2
EQUILIBRIUM LOCATIONS AS A FUNCTION OF T



($EU_b^i < 0$ for such consumers). As a result, the subscribers of each newspaper are fewer in number and have more extreme beliefs in comparison to a fully covered market. This new composition of subscribers reduces the benefit from double-homing even further. In the Web Appendix (www.marketingpower.com/jmr_webappendix), we demonstrate that newspapers may have reduced incentives to polarize as a result of incomplete coverage of the subscriber market. Indeed, when the reservation price of readers is relatively low and their valuation of accurate reporting is high, bias is more moderate than that derived in MS (2005) (i.e., smaller than $3b_0/2$) even though advertisers single-home. At the double-homing equilibrium (when α_0 is small), bias is moderate. In this case, consumers with extreme opinions are likely to drop out of the market. The population of subscribers becomes less heterogeneous as a result, thus enhancing the benefit from double-homing. In the Web Appendix (www.marketingpower.com/jmr_webappendix), we demonstrate that in this case as well, incomplete coverage may moderate the extent of bias the newspapers select if the reservation price of readers (and their valuation of accuracy) is low (high).

CONCLUSION

In this study, we extend the work of MS (2005) by investigating media bias when advertising is added as a source of revenue to supplement subscription fees. We show that the additional advertising market introduces two counteracting effects on the behavior of newspapers. First, as newspapers attempt to increase their readership to attract advertisers, they moderate slanting to appeal to readers having moderate opinions. Second, when advertisers choose to single-home, a second effect arises that may lead to greater polarization in news reporting. If newspapers moderate bias in this case, they are forced to compete more aggressively, not only for subscribers but for advertisers as well. Downward pressure on subscription and advertising fees follows. To avoid such intensified price competition, newspapers may choose to increase polarization. We demonstrate that when the heterogeneity among advertisers in appealing to consumers with different political preferences is significant, the attempt to alleviate price competition dominates, thus leading to greater polarization. When this heterogeneity is negligible, we predict reduced polarization.

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