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User-Generated Content and Bias in News Media

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In this study, we investigate newspapers' decision to expand their product lines by adding online editions that incorporate user-generated content. We demonstrate that such product line extensions mitigate the extent of slanting in print media. The results also show that as the extent of discretion of users to generate online content increases, print versions of newspapers become more polarized. Furthermore, adding online editions results in reduced profits for newspapers as the additional product variants increase the intensity of competition in the market and the discretion awarded to users limits the ability of newspapers to extract rents from consumers.

Data, as supplemental material, are available at http://dx.doi.org/10.1287/mnsc.2013.1746.

Key words: media competition; bias in news; user-generated content; product line
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1. Introduction

User-generated content (UGC) is increasingly common in the online economy, often appearing in forms of blogs, wikis, podcasts, pictures, videos, and social networks (Lee 2008). In 2008, 42.8% of Internet users (82.5 million people) contributed to some form of UGC, and it is expected that this number will reach 51.8% by 2012 (114.5 million people) (Verna 2009). In the case of news media, use of websites to integrate user content has intensified. For example, the *Wall Street Journal* (*WSJ*), in its online version, offers readers the opportunity to add content under the section titled "Journal Community." In this digital platform, readers create groups having particular interests (e.g., "The Mideast," "The New Regulation Economy," "American Views on European Politics," etc.) and share opinions on the subject. In addition, using this platform, news readers can make comments or ask questions about stories published by *WSJ* journalists. Similarly, CNN on its website has been broadcasting news videos called I-Reports that are submitted by its audience. For these news companies, the impact of UGC on profitability is unknown, as it can be a substitute to the professionally prepared content. A report by Accenture (2007) confirms this concern by arguing that media owners see UGC as the biggest threat to the survival of their businesses.

In this paper, we investigate a newspaper's decision to extend its product line to include an online edition that incorporates UGC. Specifically, we are interested in the impact of this decision on bias of reported news as well as the role of UGC in determining the extent of this reporting bias and newspapers' profits.

In our model the main characteristic that distinguishes the online edition of a newspaper from its print edition is the ability of readers to add UGC to the former variant. We assume that this feature of the online edition is especially appreciated by readers who have extreme political opinions. We conjecture that such readers have a stronger desire to be heard and/or convince other readers of their views. This assumption is consistent with recent research in psychology that investigates how people's opinions deviate from that of the average group member. Morrison and Miller (2008), for instance, show that people whose opinions are extreme in the direction of the norm that reflects the common attitudes of their group (e.g., liberal positions for college students) are more likely to express their opinions than moderates. As a result of the added appreciation of some consumers for UGC, the diversification of the product mix leads to possible segmentation of readers according to their political opinions. Readers who are moderates prefer the print edition of the newspaper. In contrast, readers who are extreme in their opinions opt for the online edition and can be active in generating content on the newspaper's site.[1]

[1] A separate analysis we conducted provides further support for this segmentation by comparing reader comments in *WSJ* online with those in the print edition of the *WSJ* (i.e., letters to the editor). Our data set comprised of all the online and offline subscriber comments to 46 articles on healthcare reform that appeared between January 1, 2010, and January 1, 2011, in the print edition. In the print edition, there were 132 letters to the editor written by 130 readers, and in the online edition, there were 5,818 comments

Our paper contributes to several strands of literature. First is the literature on media bias that is implied by the media's attempt to appeal to consumers who have different opinions. Mullainathan and Shleifer (2005) investigate the relationship between newspaper competition on subscription fees and such bias. In Gentzkow and Shapiro (2006), bias occurs since media firms slant their reports toward consumer priors to maintain reputation for high-quality reporting. Xiang and Sarvary (2007) examine media bias in the presence of conscientious consumers who seek the truth. Finally, Gal-Or et al. (2012) analyze slanting in news media when advertisers wish to target readers who are receptive to their messages. None of these studies addresses, however, the question of how introducing an online edition to supplement a print edition is likely to affect the extent of slant in reporting of news.

The second strand of literature to which this study contributes deals with how competing sellers choose the breadth of their product lines to facilitate improved segmentation. Some of this literature assumes exogenous product attributes (e.g., Brander and Eaton 1984, Gilbert and Matutes 1993). Our work is more similar to the literature that examines product line rivalry when product characteristics are endogenously chosen (e.g., Katz 1984, Moorthy 1987, Champsaur and Rochet 1989, Villas-Boas and Schmidt-Mohr 1999, Desai 2001, Schmidt-Mohr and Villas-Boas 2008). In contrast to this literature on competitive product line design, in our study the enrichment of the product line occurs by active participation of customers in determining the (nonprice) characteristics of the products included in the line.

Finally, our paper contributes also to literature related to UGC. There has been significant amount of research that involves empirical measurement of the effects of UGC on sales (Chevalier and Mayzlin 2006, Liu 2006, Dhar and Chang 2009, Zhu and Zhang 2010) and on other similar variables such as TV ratings (Godes and Mayzlin 2004) or new customer acquisition (Trusov et al. 2009). However, analytical work in this area has been limited. Furthermore, much of this work has addressed UGC in the context of the exchange of information about products among online readers (e.g., Mayzlin 2006, Chen and Xie 2008, Kuksov et al. 2013).[2] In contrast, our research focuses on UGC in generating news reports online.

2. Model

Consider a market with two newspapers, $i = 1, 2$, where each can decide on whether to add an online version to supplement the print version of its publication. We assume that due to technological advancement, the online version facilitates far greater capabilities for the readers to add content to the publication than the print version. For simplicity, we assume that only the online version can incorporate readers' input. We will refer to the activity of readers such as sharing opinions and making comments on the online version as UGC. We assume that the only source of revenues of the newspapers is from subscription fees,[3] and that the unit cost of offering the print version is higher than that of the online version. We designate by c and δc, with $0 < \delta < 1$, the unit cost incurred by the newspaper to produce the print and online versions, respectively. The added cost of the print version may relate, for instance, to added distribution costs.

We assume that customers who have extreme political beliefs are likely to be attracted to the greater capabilities offered by the online version to express these beliefs. Hence, in our model customers are segmented according to the intensity of their political opinions. Those who have more moderate opinions choose the print version, since they do not plan to engage in UGC, and those who have extreme opinions choose the online version, since they value the UGC feature of this medium.

To capture the heterogeneity of customers according to political opinions, we adopt the model developed by Mullainathan and Shleifer (2005). Specifically, there is a unit mass of consumers who are uniformly distributed according to their political opinions, designated by b, on the interval $[-b_0, b_0]$. Readers with left-leaning opinions belong to the negative region of this interval, and those with right-leaning opinions belong to the positive region. Information about

made by 2,030 subscribers. Two raters independently rated all the comments using a seven-point rating scale with 1 (7) representing strong support for liberal (conservative) policies. Correlation between the scores of the two raters was positive and statistically significant: $\rho = 0.54$ ($p < 0.01$) for letters to the editor, and $\rho = 0.64$ ($p < 0.01$) for online comments. To determine a political opinion rating for a reader, for each article we first calculated the average score of the two raters. Then, as some readers provided comments to more than one article, we calculated the overall political rating of a reader by taking the average of her (rater-averaged) ratings across all of the articles. Using this procedure, the obtained mean ratings were 5.27 and 4.82 for the online and print commentators, respectively. Furthermore, the difference between these ratings was statistically significant ($t_{2,158} = 4.39$, $p < 0.01$).

[2] One exception is that of Zhang and Sarvary (2011), who show emergence of differentiated market positions for Web 2.0 communities as a result of UGC.

[3] In a related paper, Gal-Or et al. (2012) investigate slanting of news by print papers when they earn revenues from advertising in addition to subscription fees. In a working paper version of the present study (Yildirim et al. 2011), we examine the case in which revenues for the online editions accrue from advertisers and revenues for the print editions from subscribers. In this case newspapers moderate their slanting to deliver larger readerships to the advertisers. As a result of this reduced differentiation between the newspapers, downward pressure on subscription fees intensifies, and profits are likely to decline even further from adding the online variants.

news items t is normally distributed according to $N(0, \sigma_t^2)$. Newspapers provide the readers with news about t. A reader of type b has prior beliefs about these news items that is normally distributed according to $N(b, \sigma_t^2)$. Hence, in comparison to the true distribution, readers have biased beliefs about the news, determined by their political opinions. The variable b measures the extent to which the beliefs of the reader are biased relative to the true mean of the distribution of t. For example, suppose that there is a new education reform program implemented by the private sector, such as a for-profit company taking over a failed school district. The news item relates to the likely improvement in test scores in the district as a result of the initiative, and based upon past history of similar programs, the improvement in scores is normally distributed with mean 0 and variance σ_t^2. Because it is a private sector initiative, conservatives, who normally tend to support market-based solutions, are likely to overestimate the success of the new program, whereas liberals, who usually oppose private sector involvement in education, are likely to underestimate the likely success of the program in improving test scores. In other words, a reader with opinion b will have prior beliefs about the improvement in test scores that are normally distributed according to $N(b, \sigma_t^2)$, where $b > 0$ for a conservative reader, and $b < 0$ for a liberal reader.

Newspapers receive some data $d_i = t + \varepsilon_i$, where the random variable ε_i is independently distributed of t according to $\varepsilon_i \sim N(0, \sigma_\varepsilon^2)$. Each newspaper i may choose to slant its reporting so that $n_i = d_i + s_i$, where n_i is the reported news, and s_i is the slant in reporting. Whereas the newspaper has full control over the extent of slanting of its print version, the slant of the online version may depend also on the UGC added by subscribers to this product. To allow for the possibility of different levels of slanting, we designate by s_i and s_i^o the slant of the print and online products, respectively, and similarly, by n_i and n_i^o the reported news in the two variants.

As in Mullainathan and Shleifer (2005), we assume that readers incur disutility when reading news inconsistent with their opinions, as measured by the distance between the reported news and the readers' opinions: $(n_i - b)^2$ and $(n_i^o - b)^2$. As well, holding constant the extent of inconsistency with their opinions, readers dislike slanting. When newspaper i chooses the subscription fees P_i and K_i for its print and online versions, the net utility of a consumer having opinion b is

$$U_b = \begin{cases} \bar{u} - \chi s_i^2 - \phi(n_i - b)^2 - P_i \\ \quad \text{if she subscribes to print version of } i, \\ \bar{u} - \chi(s_i^o)^2 - \phi(n_i^o - b)^2 - K_i \\ \quad \text{if she subscribes to online version of } i, \end{cases} \quad (1)$$

where $\bar{u}$ stands for the reservation price of the reader, $\phi > 0$ calibrates her preference for hearing news consistent with her political opinions, and $\chi > 0$ calibrates her preference for reduced slant. Using the utility framework in (1), readers first choose a newspaper[4] and then decide whether to subscribe to the online or print versions of the newspaper, while incorporating the fact that the online version includes UGC.

We assume that newspaper i generates slant in its reporting by using a weighted average of a preselected focal point B_i and the data d_i, namely, $n_i = \gamma_i B_i + (1 - \gamma_i) d_i$.[5] In the Web appendix (available at http://tinyurl.com/p7jvgzc), we argue that this method of reporting implies the weights $\gamma_i = \phi/(\phi + \chi)$ and $(1 - \gamma_i) = \chi/(\phi + \chi)$.[6] The implied slanting strategy, therefore, takes the form $s_i(d_i) = (\phi/(\phi + \chi))(B_i - d_i)$, where B_i is the location choice of the print version of newspaper i, and it represents the predetermined focal point around which slanting of the news arises.[7] This location choice can be a point inside or outside of the interval $[-b_0, b_0]$. Notice that the extent of slanting decreases with χ and increases with ϕ. Thus, as readers place greater importance on receiving accurate information and lesser importance on hearing confirmatory news, newspapers choose

[4] We assume that each reader subscribes to only one newspaper (referred to as single-homing in the literature). It is however, also possible that some readers may subscribe to both newspapers (i.e., double-homing). There could be different patterns of double-homing. For example, readers with moderate beliefs may subscribe to both newspapers and readers having extreme beliefs may subscribe to a single newspaper. Those readers who double-home may cross subscribe to print editions of different papers or to their online editions. In such cases, it is easy to show that each newspaper acts as a local monopoly. Given our objective to relate political positioning of the newspapers to the intensity of price competition, we do not consider double-homing in this paper. If we allowed such double-homing, the absence of price competition would likely lead to reduced slanting in reporting of newspapers.

[5] Note that there may be other ways to tilt the data.

[6] These weights capture the readers' relative preference for the accuracy versus confirmation of their beliefs and can be implemented, for example, by hiring sophisticated journalists who can write news stories that convey this balance between tilting news in favor of the committed focal point and the true data.

[7] In the Web appendix we show that in the $\{NE, NE\}$ regime, the slanting strategy that we use (i.e., the weights $\gamma_i = \phi/(\phi + \chi)$) maximizes both consumer utility and newspaper profits. Note that we could not prove the optimality of this slanting strategy in the $\{E, E\}$ and $\{NE, E\}$ subgames. However, in these other subgames we continue to use $\gamma_i = \phi/(\phi + \chi)$. Assuming that this is the slanting strategy that the newspapers use in all the regimes, we aim to investigate whether newspapers extend their product lines to add an online edition, and how this decision affects their political bias and profits. For a further discussion of the optimal weights in the other subgames, see the Web appendix.

lower slanting in their reporting.[8] As well, note that in our formulation slanting depends upon the ex post realization of the data, but the focal point B_i is chosen ex ante. Hence, when the data is very different from the ex ante focal point chosen by newspaper i, the extent of slanting is big. In contrast, if the data is close to the focal point, the extent of slanting is small. Without loss of generality, we assume that newspaper 2 is located to right of newspaper 1 ($B_1 < B_2$); that is, whereas newspaper 1 has a left-wing slant, newspaper 2 has a right-wing slant.

Because subscribers to the online version are active in generating additional content, the political position of the online product reflects both the position of the newspaper and the UGC supplied by subscribers to this variant of the product. We designate the combined positioning of the online variant of newspaper i by B_i^o and specify it as follows:

$$B_i^o = B_i + \alpha(E[b_i^o]) \quad 0 < \alpha < 1, \tag{2}$$

where $E[b_i^o]$ measures the mean opinion of subscribers to the online version of newspaper i.[9] Accordingly, the generated news and slanting in the online version take the form $n_i^o = \gamma_i B_i^o + (1-\gamma_i)d_i$ and $s_i^o(d_i) = (\phi/(\phi+\chi))(B_i^o - d_i)$, respectively. Hence, the modified location of the online version is the sum of the position chosen by the newspaper and the mean opinion of subscribers to this product multiplied by a positive fraction α that measures the extent of discretion of online readers to generate content online. The fact that $\alpha < 1$ reflects the sensible assumption that the effect of the newspaper itself in determining the positioning of the online variant is higher than that of its readers.[10]

It is noteworthy that when readers make their choice among the different media, the realization of the data supporting the news stories (the random variable d_i) is yet to be determined. At the time the reader makes her choice, she is familiar with the subscription fees of the newspapers (P_i and K_i), their locations (B_1 and B_2), and her own political opinion b. Hence, in comparing the different media, the reader evaluates her prior expected utility calculated from (1) by integrating over all possible realizations of the random variable d_i and using the distributional properties of d_i (namely, $E[d_i] = 0$ and $\mathrm{Var}[d_i] = \sigma_d^2$). Hence, we obtain the following:

$$E[U_b] = \begin{cases} \bar{u} - \dfrac{\phi^2}{(\phi+\chi)}(B_i - b)^2 - \dfrac{\chi\phi}{(\phi+\chi)}(b^2+\sigma_d^2) - P_i \\ \quad \text{for print version of } i, \\ \bar{u} - \dfrac{\phi^2}{(\phi+\chi)}(B_i^O - b)^2 - \dfrac{\chi\phi}{(\phi+\chi)}(b^2+\sigma_d^2) - K_i \\ \quad \text{for online version of } i. \end{cases} \tag{3}$$

Our specification implies that when a newspaper decides to add an online variant to supplement its print version, it expands its product mix to consist of two products with differing levels of slanting in reporting. According to (2), the slanting in reporting is higher online due to the added input supplied by subscribers to this product. The expanded product mix is likely to support, therefore, improved segmentation of readers as described in Figure 1, when both newspapers offer an expanded product mix. Later, in §3.1, we show that such segmentation can indeed exist.

In the figure, readers having extreme political opinions ($b > \hat{b}_2$ and $b < \hat{b}_1$) choose to subscribe to one of the online products, and those having moderate opinions ($\hat{b}_1 < b < \hat{b}_2$) choose to subscribe to one of the print products. Because slanting is more extreme online than in the print version, it is readers with extreme political opinions who self-select to subscribe to the product that is more consistent with their extreme preferences. Moreover, because those subscribers add UGC to the website of the newspaper,[11] the modified location of the online version reflects the extreme opinions of these subscribers.[12] Specifically,

$$B_2^o = B_2 + \alpha\frac{(b_0 + \hat{b}_2)}{2} \quad \text{and} \quad B_1^o = B_1 + \alpha\frac{(-b_0 + \hat{b}_1)}{2}.^{13} \tag{4}$$

[8] For instance, if readers place higher importance to accuracy such that $\chi > 2\phi$, then expected slant is $Es_i < B_i/3$ since $Ed_i = 0$. As well, when $\chi \to \infty$, newspapers do not slant their news at all (i.e., $Es_i = 0$).

[9] Since $\alpha \neq 0$, by introducing an online edition, a newspaper commits to a product line expansion with a different positioning, which gives rise to the "delegation effect" we discuss later in §3.3.

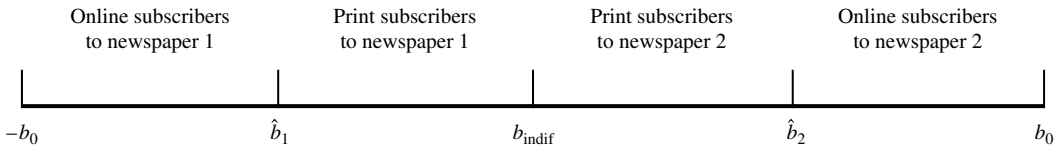
[10] In our model the online edition of each newspaper includes all the reports of the print edition plus content provided by online readers that reflect political inclinations of readers who generate them. We conjecture that online readers read at least some of the additional material, thus providing incentives for individuals with extreme political beliefs to add content in the hopes of influencing the opinions of other online readers. We assume that typical UGC reflects the mean of the opinions of the subscribers to the online edition.

[11] Note that according to our formulation, every reader of the online editions necessarily contributes to UGC, which is a potential shortcoming of our paper. It would be interesting to explore users' content contribution decisions.

[12] Note our implicit assumption that online readers' UGC contribution truthfully reflects their opinions.

[13] Notice that B_i^o is constrained by the incentive compatibility condition that determines the choice of the readers between the print and online version (i.e., $\hat{b}_i$, $i = 1, 2$.) As we discuss in §3.3, this limits the newspapers' ability to freely choose B_i that will extract the maximum possible rents from consumers.

Figure 1 Segmentation When Both Newspapers Offer Both Print and Online Variants



We model the game as consisting of three stages. In the first stage, the newspaper decides whether to supplement its print version with an online product. We designate this choice by E_i and NE_i when expanding and not expanding the product mix, respectively. In the second stage, each newspaper decides the political positioning of its print version, B_i, and commits to the linear slanting strategy described earlier. In the third stage, each newspaper chooses its subscription fees P_i and K_i, where the latter choice is relevant only if an online version is added in the first stage. Following the three stages, consumers decide on their subscription patterns (prior to the realization of d), newspapers gain access to news and report it according to the locations selected in the second stage, and readers of the online versions add UGC to the newspapers' websites.

3. Derivation of the Equilibria

Contingent upon the expansion decision of the two newspapers in the first stage, four different possibilities may arise, as follows: $\{E_1, E_2\}$, $\{E_1, NE_2\}$, $\{NE_1, E_2\}$, and $\{NE_1, NE_2\}$. The last possibility refers to the case that both newspapers offer only the print version. This case has already been investigated by Mullainathan and Shleifer (2005). The authors find that the positioning of the newspapers when only a print version is offered by each is $B_1 = -\frac{3}{2}b_0$ and $B_2 = \frac{3}{2}b_0$. Such extreme positioning leads to greater differentiation between the newspapers and alleviated competition on subscription fees. In what follows, we characterize the remaining two cases: the symmetric case when both newspapers choose to add an online product and the asymmetric case when only one newspaper adds the online version.

3.1. Both Newspapers Add an Online Version

When both papers choose to add the online product, the segmentation of consumers is characterized in Figure 1. For simplicity, we will use the superscript $\{E, E\}$ to characterize the equilibrium variables in this symmetric case. Considering the stage when consumers choose their subscription patterns, we start by identifying the threshold reader $b_{\text{indif}}^{E,E}$, the reader who is indifferent between the print editions of newspapers 1 and 2, and $\hat{b}_1^{E,E}$ ($\hat{b}_2^{E,E}$), the readers who are indifferent between the print and online editions of newspaper 1 (2), respectively.

The marginal reader $b_{\text{indif}}^{E,E}$ has the same expected utility from subscribing to the print editions of newspapers 1 and 2; that is, from (3),

$$b_{\text{indif}}^{E,E} = \frac{B_2^{E,E}+B_1^{E,E}}{2} + \frac{(P_2^{E,E}-P_1^{E,E})}{(B_2^{E,E}-B_1^{E,E})}\frac{\phi+\chi}{2\phi^2}. \quad (5)$$

From (5), the location of the subscriber indifferent between newspapers 1 and 2 is shifted away from the average locations of the two newspapers, $(B_2^{E,E}+B_1^{E,E})/2$, in a manner dependent on the discrepancies between the fees charged for the print subscriptions.

Similarly, the location of the indifferent reader $\hat{b}_i^{E,E}$ is a function of the locations of the online and print editions of newspaper i and the difference between the prices of these editions:

$$\hat{b}_i^{E,E} = \frac{(B_i^o)^{E,E}+B_i^{E,E}}{2} + \frac{(P_i^{E,E}-K_i^{E,E})}{(B_i^{E,E}-(B_i^o)^{E,E})}\frac{(\phi+\chi)}{2\phi^2}, \quad i=1,2. \quad (6)$$

Note that the right-hand side of (6) is also a function of $\hat{b}_i^{E,E}$ since the location of the online edition $(B_i^o)^{E,E}$ is a function of $\hat{b}_i^{E,E}$ from (4). Solving the system of Equations (6) for $\hat{b}_i^{E,E}$ in terms of the locations and fees of the newspapers yields the following:

$$\hat{b}_1^{E,E} = \frac{(2B_1^{E,E}+(2-\alpha)b_0)}{(4-\alpha)} - \frac{2\sqrt{(B_1^{E,E}-b_0)^2-((4-\alpha)/\alpha)(P_1^{E,E}-K_1^{E,E})((\phi+\chi)/\phi^2)}}{(4-\alpha)}, \quad (7)$$

$$\hat{b}_2^{E,E} = \frac{(2B_2^{E,E}-(2-\alpha)b_0)}{(4-\alpha)} + \frac{2\sqrt{(B_2^{E,E}+b_0)^2-((4-\alpha)/\alpha)(P_2^{E,E}-K_2^{E,E})((\phi+\chi)/\phi^2)}}{(4-\alpha)}. \quad (8)$$

To support the segmentation depicted in Figure 1, the solution for $\hat{b}_i^{E,E}$ should satisfy the inequalities $-b_0 < \hat{b}_1^{E,E} < b_{\text{indif}}^{E,E} < \hat{b}_2^{E,E} < b_0$. From the expressions derived in (7) and (8), this may not necessarily be the case. In particular, when the print edition of the newspaper is significantly more expensive than the online

edition ($P_i^{E,E} \gg K_i^{E,E}$), $\hat{b}_1^{E,E}$ may be bigger and/or $\hat{b}_2^{E,E}$ may be smaller than $b_{\text{indif}}^{E,E}$. Hence, the print edition may not attract any subscribers.

It may be interesting to point out that the threshold consumers $\hat{b}_i^{E,E}$ play a dual role in our model. The first is the traditional role that exists in any environment with market segmentation. Specifically, these threshold levels designate consumers who are indifferent between two adjacent variants of a given product. The second role is new to our model and relates to the active role that online subscribers play in determining the characteristics of the online variant of the product. According to (2), the political position of the online edition depends upon the composition of subscribers to this product. As the threshold levels $|\hat{b}_i^{E,E}|$ increase, the segment of consumers who choose the online subscription has more extreme political opinions, thus generating more extreme content online via the UGC. As a result, the slant in reporting of the online variant intensifies.

Furthermore, note that in traditional models of horizontal product differentiation, when consumers cannot affect the characteristics of the different variants, the threshold consumers that demarcate the different segments are given by equations similar to the system (6). However, in contrast to our setting, product characteristics (represented by $(B_i^o)^{E,E}$ for the online editions in our model) are considered exogenous by consumers in the traditional models. When UGC plays a role in affecting the slant of the online versions, $(B_i^o)^{E,E}$ is no longer considered exogenous by the readers. Instead, they are fully cognizant of the fact that when readers with more extreme political opinions subscribe to the online edition, the content of this edition becomes more politically biased. Readers use this information in deciding whether to choose between the print and online editions. Such considerations transform the system of Equations (6) to the expressions for $\hat{b}_i^{E,E}$ in (7) and (8).

Given the locations of the indifferent consumers expressed in (5), (7), and (8), in the third stage, newspapers choose their subscription fees $P_i^{E,E}$, $K_i^{E,E}$ to maximize their profits as follows:

$$\pi_1^{E,E} = \frac{1}{2b_0}\big((b_0 + \hat{b}_1^{E,E})(K_1^{E,E} - c\delta) + (b_{\text{indif}}^{E,E} - \hat{b}_1^{E,E})(P_1^{E,E} - c)\big), \tag{9}$$

$$\pi_2^{E,E} = \frac{1}{2b_0}\big((b_0 - \hat{b}_2^{E,E})(K_2^{E,E} - c\delta) + (\hat{b}_2^{E,E} - b_{\text{indif}}^{E,E})(P_2^{E,E} - c)\big). \tag{10}$$

Optimizing (9) and (10) with respect to $P_i^{E,E}$ yields the subscription fees of the print editions of both newspapers as functions of the choices made in the first two stages of the game:

$$P_1^{E,E} - c = \frac{\phi^2}{(\phi+\chi)}(B_2^{E,E} - B_1^{E,E}) \cdot \left(\frac{(B_1^{E,E} + B_2^{E,E})}{3} + 2b_0\right), \tag{11}$$

$$P_2^{E,E} - c = \frac{\phi^2}{(\phi+\chi)}(B_2^{E,E} - B_1^{E,E}) \cdot \left(-\frac{(B_1^{E,E} + B_2^{E,E})}{3} + 2b_0\right).$$

Next, optimizing (9) and (10) with respect to $K_i^{E,E}$ and using $\partial\hat{b}_i^{E,E}/\partial K_i^{E,E}$ derived from (7) and (8) yields the following:

$$K_1^{E,E} - P_1^{E,E} = -c(1-\delta) + \frac{\phi^2}{(\phi+\chi)} \cdot \frac{\alpha(b_0 + \hat{b}_1^{E,E})((2-\alpha)b_0 - (4-\alpha)\hat{b}_1^{E,E} + 2B_1^{E,E})}{2},$$

$$K_2^{E,E} - P_2^{E,E} = -c(1-\delta) + \frac{\phi^2}{(\phi+\chi)} \cdot \frac{\alpha(b_0 - \hat{b}_2^{E,E})((2-\alpha)b_0 + (4-\alpha)\hat{b}_2^{E,E} - 2B_2^{E,E})}{2}. \tag{12}$$

Substituting (11) and (12) back into (9) and (10) provides the second-stage payoff functions of the newspapers given that both chose to add the online option. Each newspaper chooses its location $B_i^{E,E}$ to maximize this second-stage payoff function. We illustrate this second-stage optimization by considering only newspaper 2. A similar approach is also valid for newspaper 1. Using the envelope theorem in (10) when optimizing with respect to $B_2^{E,E}$, we obtain the following:

$$\frac{\partial\pi_2^{E,E}}{\partial B_2^{E,E}} = \frac{\partial\pi_2^{E,E}}{\partial\hat{b}_2^{E,E}}\frac{\partial\hat{b}_2^{E,E}}{\partial B_2^{E,E}} + \frac{\partial\pi_2^{E,E}}{\partial b_{\text{indif}}^{E,E}}\frac{\partial b_{\text{indif}}^{E,E}}{\partial B_2^{E,E}} + \frac{\partial\pi_2^{E,E}}{\partial b_{\text{indif}}^{E,E}}\frac{\partial b_{\text{indif}}^{E,E}}{\partial P_1^{E,E}}\frac{\partial P_1^{E,E}}{\partial B_2^{E,E}}. \tag{13}$$

A change in $B_2^{E,E}$ has a direct effect on $\pi_2^{E,E}$ via the expressions for $b_{\text{indif}}^{E,E}$ and $\hat{b}_2^{E,E}$ in (5) and (8), and an indirect effect via the effect of newspaper 2's location on the print subscription fee of newspaper 1, $P_1^{E,E}$. (By the envelope theorem the effect on $P_2^{E,E}$ and $K_2^{E,E}$ vanishes and $K_1^{E,E}$ does not affect $\pi_2^{E,E}$ at all.) We substitute from (5), (8), (10), (11), and (12) in the derivatives on the right-hand side of (13) and evaluate the resulting expression at the symmetric equilibrium to obtain a relationship between $B_2^{E,E}$ and $\hat{b}_2^{E,E}$ as follows:

$$-B_1^{E,E} = B_2^{E,E} = B^{E,E} = \frac{3}{4b_0}(\alpha(\hat{b}^{E,E})^2 + (2-\alpha)b_0^2). \tag{14}$$

It is easy to see from (14) that if segmentation arises, namely, if $\hat{b}^{E,E} < b_0$, then $B^{E,E} < (3b_0)/2$. Hence, the positioning of the print version is less extreme in comparison to the case that newspapers do not add an online option (the case considered by Mullainathan and Shleifer 2005). This result is not surprising given that each newspaper expanded its product mix to include a variant that is more politically extreme. It reduces, therefore, the slanting of the product that is chosen by the segment of the consumers who have moderate preferences.

To investigate whether a symmetric equilibrium with segmentation by both newspapers is feasible, we now use (14) to derive conditions under which there exists $\hat{b}^{E,E} \in (0, b_0)$. We designate by $\Delta U_P(b, \hat{b}^{E,E})$ the added utility that a reader having beliefs b derives from the print over the online edition, given that the online segment comprises readers in the interval $[\hat{b}^{E,E}, b_0]$. At the equilibrium with segmentation, $\Delta U_P^*(\hat{b}^{E,E}, \hat{b}^{E,E}) = 0$, namely, the reader of type $\hat{b}^{E,E}$ is indifferent between the print and online editions. Moreover, for $0 < b < \hat{b}^{E,E}$, readers prefer the print version and $\Delta U_P(b, \hat{b}^{E,E}) > 0$, and for $\hat{b}^{E,E} < b \le b_0$, readers prefer the online version and $\Delta U_P(b, \hat{b}^{E,E}) < 0$. We define by $T \stackrel{\text{def}}{=} c(1-\delta)((\phi+\chi)/(2\phi^2))$ an adjusted cost advantage measure of the online over the print versions of the product. In Lemma 1 we present conditions on α and T, which satisfy these requirements on $\Delta U_P(b, \hat{b}^{E,E})$, and therefore support segmentation.

Lemma 1. (i) *To support market segmentation at the symmetric equilibrium,* $0 < \alpha < \alpha^* \approx 0.376$ *and* $LB_T < T < UB_T$, *where* $LB_T \stackrel{\text{def}}{=} (\alpha/2)(\alpha+1)b_0^2$ *and* $UB_T \stackrel{\text{def}}{=} (((4-\alpha)(2(\alpha+2) - \sqrt{(4-\alpha)^2 - 3\alpha(2-\alpha)})^2)/(72\alpha))b_0^2$.

(ii) *When segmentation can be supported, at the symmetric equilibrium,* $b_0/2 < \hat{b}^{E,E} < b_0$.

As the lemma reports, the relative control of online readers over the location of the online edition can be no more than 0.376 of the control of the newspaper itself. Even with such limited discretion awarded to readers, segmentation may still fail unless the adjusted cost advantage of the online version, T, lies in the interval specified in part (i) of the lemma. In particular, in the absence of any cost advantage, so that at $T = 0$, each newspaper will choose not to extend its market offering at the symmetric equilibrium. The adjusted cost advantage should be bigger than LB_T, an expression that increases with α and b_0. However, the print version of each newspaper might be cannibalized altogether if the cost advantage is extremely big. This happens when $T \ge UB_T$, an expression that increases in α and b_0, once again. The lemma further demonstrates that because the enrichment of the newspaper's product line is not under the full control of the newspaper itself, when segmentation can be supported, the size of the print segment is bigger than the size of the online segment. The newspaper would have had full control over the political position of the online version only if it had the power to dictate the value of $\hat{b}^{E,E}$ on the consumers. Because consumers self-select between the versions themselves, the political position of the online version is constrained by an incentive compatibility condition that determines which version each reader finds optimal to choose. To illustrate part (ii) of Lemma 1, when the parameters of the model are $b_0 = 1$, $\alpha = 0.1$, $c = 1$, $\delta = 0.8$, and $\phi^2/(\phi+\chi) = 1.333$, thus satisfying the conditions given in part (i) of the lemma, $\hat{b}^{E,E} = 0.8$. Hence, the market shares of the online and print editions of each newspaper are 20% and 30%, respectively.[14]

It is noteworthy that the results reported in the lemma imply the existence of discontinuity in each newspaper's behavior as T approaches UB_T. Specifically, for values of T smaller than UB_T, the market share of the online version is smaller than that of the print version, and for values of T bigger than UB_T, the print version disappears completely, because of the significant cost advantage offered by the online version. The discontinuity is the result of the difficulty of supporting segmentation in an environment with UGC. In such an environment, a given reader's choice between the print and online editions does not only depend upon her own type b, but also on the cutoff point $\hat{b}$ in the population of readers at large (which the reader cannot control and takes as given) that determines the type of active UGC contributors. Equipped with the information that readers in the segment $[\hat{b}, b_0]$ add content to the online version, a reader whose own type is $\hat{b}$ should be indifferent between the print and online editions. Segmentation fails if there isn't such a value of $\hat{b}$ inside the support of the distribution of political beliefs. It fails, in particular, for T values outside of the interval indicated in the lemma.[15]

For the rest of our analysis we assume that segmentation can be supported, and the conditions in Lemma 1 hold. Given these conditions, we can obtain the properties of the equilibrium without finding closed form solutions for $B_i^{E,E}$. For example, using

[14] For other numerical examples that illustrate the results of our main model (Lemma 1 and Propositions 1–5), see Tables WA.1–WA.3 in the Web appendix.

[15] Recall that the added benefit of the print over the online version for a reader of type b, given that $\hat{b}$ determines the segment of UGC contributors, is designated as $\Delta U_P(b, \hat{b})$. For segmentation to exist there should be a value of $\hat{b}$ in the interval $(0, b_0)$ so that $\Delta U_P^*(\hat{b}, \hat{b}) = 0$. Such a value fails to exist for T values outside of the interval indicated in the lemma.

the results in Lemma 1 and (14), we can compare the extent of slanting in reporting when newspapers extend their product mix to the extent of slanting when only the print version is offered by each newspaper.

Proposition 1. *When both newspapers offer both print and online editions*,

(i) $(B^o)^{E,E} = B^{E,E} + \alpha(b_0 + \hat{b}^{E,E})/2 > (3b_0)/2$,

(ii) $B^{E,E} < (3b_0)/2$, *and*

(iii) $B^{E,E}_{\text{weighted}} \equiv (B^{E,E}\hat{b}^{E,E} + (B^o)^{E,E}(b_0 - \hat{b}^{E,E}))/b_0 < (3b)_0/2$.

Recall that when only the print version is offered, $B^{NE,NE} = (3b)_0/2$. Hence, extending the product mix to include an online version reduces reporting slant of the print version but increases the slant of the online version.[16] In essence, product diversification facilitates obtaining a better match between the preferences of the readers and the variants of the products they choose to consume. According to part (iii) of the proposition, however, the weighted average location of each newspaper, with weights determined by the relative market shares of the two editions, declines as a result of segmentation. For example, using the same parameter values as above ($b_0 = 1$, $\alpha = 0.1$, $c = 1$, $\delta = 0.8$, and $\phi^2/(\phi + \chi) = 1.333$), at the equilibrium, $B^{E,E} = 1.473$, $(B^o)^{E,E} = 1.563$ and $B^{E,E}_{\text{weighted}} = 1.491$. (Note that without UGC, $B^{NE,NE} = 1.5$ in this case.)

Next we investigate how UGC affects the equilibrium locations of the newspapers. Recall that the parameter α measures the extent of discretion of online readers to generate content online. Using the results in (14) and Lemma 1, we can investigate how $B^{E,E}$ changes with α.

Proposition 2. *If both newspapers offer print and online subscription options*, $\partial B^{E,E}/\partial\alpha > 0$.

To understand the role of α in explaining the comparative static reported in Proposition 2, recall from (2) that as α increases, the slanting in the online edition intensifies. Hence, readers with more extreme political opinions self-select to subscribe to the online version, and the location of the reader who is indifferent between the print and online editions (i.e., $\hat{b}^{E,E}$) increases. As a result, the segment of readers subscribing to the print edition includes additional, more politically extreme subscribers. To appeal to this new profile of more extreme readers, the newspaper intensifies slanting in its print edition. For example, for the same set of parameter values mentioned above, as α increases from 0.1 to 0.11, 0.12 and 0.13, $B^{E,E}$ increases from 1.473 to 1.482, 1.490, and 1.498, respectively.[17]

[16] Restricting the expected slant of the print edition to the extreme location of the readers (i.e., $(\phi/(\phi + \chi))B^{E,E} < b_0$) will not change the equilibrium we derive as long as $\phi < 2\chi$.

3.2. Only One Newspaper Adds an Online Version

In this section we consider the asymmetric case when only one newspaper extends its product mix. Without any loss of generality, we assume that newspaper 2 offers both versions and newspaper 1 offers the print version only. We use the superscripts $\{NE, E\}$ to designate this case. Figure 2 depicts the segmentation of the market for such an asymmetric environment.

By using a similar approach as in the previous section, the relationships between the locations of the print versions and the threshold reader $\hat{b}_2^{NE,E}$ can be derived as follows:

$$B_1^{NE,E} = -\tfrac{3}{4}\left(b_0 + \sqrt{-\alpha(\hat{b}_2^{NE,E})^2 + (1+\alpha)b_0^2}\right), \quad (15)$$

$$B_2^{NE,E} = \tfrac{3}{4}\left(5b_0 - 3\sqrt{-\alpha(\hat{b}_2^{NE,E})^2 + (1+\alpha)b_0^2}\right). \quad (16)$$

Proposition 3 follows from Equations (15) and (16).

Proposition 3. *When newspaper* 1 *offers only the print edition and newspaper* 2 *offers both the print and online editions*:

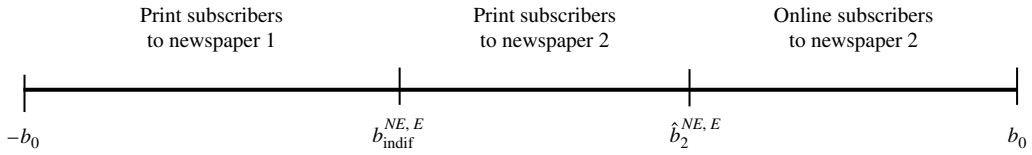
(i) $B_1^{NE,E} < -\tfrac{3}{2}b_0$, $B_2^{NE,E} < B^{E,E} < \tfrac{3}{2}b_0$; *and*

(ii) $b_{\text{indif}}^{NE,E} = \tfrac{1}{2}(b_0 - \sqrt{-\alpha(\hat{b}_2^{NE,E})^2 + (1+\alpha)b_0^2}) < 0$.

According to part (i) of Proposition 3, because newspaper 2 extends its product mix while its competitor does not, it chooses to reduce the slanting of its print version below the level established when both newspapers extend their lines. Such a choice facilitates newspaper 2 to steal market share from newspaper 1. As a result, newspaper 1 is forced to shift its location further to the left to differentiate itself from the print version of newspaper 2. Part (ii) of the proposition states, indeed, that when newspaper 1

[17] Note that when α is 0, each newspaper offers one variant, which is equivalent to the $\{NE, NE\}$ regime where the equilibrium location is $B = (3b_0)/2$. As α increases from 0 to a positive value, differentiation between two different variants of the product arises, no matter how small α is. The differentiation in the locations of the two editions is generated around the original location of $(3b_0)/2$ that arises in the $\{NE, NE\}$ regime; specifically, the print edition has the location $B^{E,E}$ that is smaller than $(3b_0)/2$, and the online edition has the location $(B^o)^{E,E}$ that is bigger than $(3b_0)/2$. In the two-variant regime, $B^{E,E}$ increases with α, while always assuming a value that is less than $(3b_0)/2$. However, as α continues to increase further, the online segment of each newspaper may shrink to such an extent that it disappears altogether, and each newspaper starts to offer only the print edition of the newspaper, once again. This happens when $\alpha = \alpha^*$ that is reported in Lemma 1. Therefore, the cases $\alpha = 0$ and $\alpha > \alpha^*$ are both parameter values that lead to a single variant offered by each newspaper, in which case $B = (3b_0)/2$ corresponds to the equilibrium location.

Figure 2 Market Segmentation When Only Newspaper 2 Extends Its Product Mix



limits its product mix in comparison to newspaper 2, it loses market share, and newspaper 2 attracts more than 50% of the readers to one of its two editions. For example, using the same set of parameters as before ($b_0 = 1$, $\alpha = 0.1$, $c = 1$, $\delta = 0.8$ and $\phi^2/(\phi + \chi) = 1.333$), $B_1^{NE,E} = -1.514$, $B_2^{NE,E} = 1.457$, and $b_{\text{indif}}^{NE,E} = -0.01$.

3.3. Equilibrium Product Line Extension Decision and the Role of UGC

Before characterizing the Nash equilibrium of the game, we start by considering an environment where each newspaper offers both editions but has full control over the positioning of the online edition. Essentially, newspaper i has the exclusive rights to choose both B_i and B_i^o. In Proposition 4 we report that in such an environment, each newspaper eliminates any product differentiation according to politics between its print and online editions, thus preventing segmentation of its readers according to the intensity of their political opinions.

Proposition 4. *When newspapers have the exclusive rights to choose the positioning of both the print and online editions, at the equilibrium each newspaper does not introduce any differentiation between the locations of the two editions* (*i.e.*, $B_i = B_i^o$).

The result reported in Proposition 4 is consistent with findings existing already in the literature. Specifically, when the distribution of consumers on the Hotelling line is uniform and transportation costs are quadratic, as they are in our model, Zhang (2011) found that in a static model competing firms will never find it optimal to proliferate their product lines. This result holds regardless of whether or not the location choice of each firm is constrained to be in the interior of the Hotelling line. (We demonstrate a similar result in the Web appendix.)[18] When the distribution of consumers on the Hotelling line is nonuniform, Wernerfelt (1986) demonstrates that product proliferation may arise in an environment with quadratic transportation costs. However, in Wernerfelt (1986), firms choose quantities as strategies rather than prices, as in our study and Zhang (2011).[19]

As is well known in the literature, product differentiation may lead to two opposing effects in a competitive environment. Although offering two editions allows newspapers to better match the preferences of different readers, enriching the product line can also cause too much competition in the market, and thus lead to lower prices. According to Proposition 4, the latter effect dominates, and the newspapers do not introduce any differentiation according to political beliefs between the two editions if they have full control over the content of both editions.[20] However, in our environment each newspaper allows readers to add content to its online edition, thus delegating to them some control over the political position of this version of the paper. Such delegation introduces an additional strategic effect that is absent in an environment when each newspaper has full control over both versions. Specifically, the decision to enrich the product line in the first stage of the game automatically generates two variants of the newspaper because of UGC. Such an implicit commitment to offer two variants can affect, in turn, the choice of the positioning made by the competing newspaper subsequently in the second stage when designing its slanting strategy. This link between the breath of the product line of a given newspaper and the slanting strategy of the competing newspaper does not exist in the environment described in Proposition 4. With full control over the content of both editions, offering an online edition does not actually commit the newspaper to introducing product differentiation between the two editions. Instead, in the environment of Proposition 4, the slanting strategy used in any edition offered is chosen by both newspapers simultaneously in the second

[18] With quadratic transportation costs, the principle of maximum differentiation arises (d'Aspremont et al. 1979), implying that the location choice of each firm is at the edge of the Hotelling line when constrained, and outside of the line when unconstrained, even when offering only one product. Proliferation of the product line under such circumstances would imply that the additional variants of the product would have to be even more extremely located, thus making it unprofitable for the firms.

[19] Brander and Eaton (1984) also demonstrate the existence of product proliferation with quantities as strategies. However, they do not use the Hotelling framework to model horizontal product differentiation. Instead, they assume a general inverse demand specification with product differentiation.

[20] Note that the absence of differentiation reported in the proposition may not hold if there are other sources of heterogeneity among consumers. According to our formulation, consumers differ only with respect to their political beliefs. If consumers differ along additional dimensions, newspapers may have incentives to offer different variants to better match the tastes of consumers. For instance, the online edition may include additional features such as sharing news through social media that appeal to young readers.

stage, irrespective of the enrichment decisions they chose earlier. In Proposition 5 we demonstrate that the existence of the additional "delegation effect" in an environment with UGC leads to an equilibrium with each newspaper offering an enriched product line that contains two politically differentiated editions.

Proposition 5. (i) *In an environment with UGC, offering both print and online versions is a dominant strategy for each newspaper. Specifically, for newspaper* 1 $\pi_1^{E,E} > \pi_1^{NE,E}$ *and* $\pi_1^{E,NE} > \pi_1^{NE,NE}$, *and similarly for newspaper* 2. *As a result, each newspaper offers two editions that are differentiated by politics.*

(ii) *In spite of being a dominant strategy, the profits of each newspaper are lower with an enriched product line than if both offer only print editions, namely,* $\pi_i^{NE,NE} > \pi_i^{E,E}$.

According to Proposition 5, strategic considerations lead each newspaper to offer two different versions of the product. The resulting improved segmentation of consumers does not lead, however, to higher profits.[21] For example, for the same parameter space as above, $\pi_2^{NE,E} = 4.04 > \pi_2^{NE,NE} = 4 > \pi_2^{E,E} = 3.931 > \pi_1^{NE,E} = 3.887$. There are two reasons why the profits of the newspapers decline with segmentation. The first is the already mentioned added competitive pressure on prices that the enrichment of the product line may generate. Because $B^{E,E} < B^{NE,NE}$, segmentation diminishes the extent of product differentiation between the print editions, and newspapers are forced to compete more aggressively for their print subscribers, thus leading to lower fees. The second reason is unique to the UGC environment. In this environment, the political position of the online version cannot be fully dictated by the newspaper, given that it is constrained by the incentive compatibility condition that determines the choice of readers between the print and online version (the value of $\hat{b}$). With this additional constraint to be satisfied, the newspaper cannot extract as much rents from consumers as it would with full control over the political positions of both versions of the newspaper. In spite of reduced profitability, though, each newspaper has an incentive to offer the online edition to avoid losing market share to the rival. The "delegation effect" previously mentioned implies that adding the online edition automatically commits the newspaper to offering two differentiated variants. As a result, the newspaper has an incentive to enrich its product line to force the competitor to a more extreme political position, and by doing so steal market share from it. To illustrate, for the parameter space above, when newspaper 2 adds the online edition, newspaper 1 adopts a more liberal position irrespective of the product extension strategy newspaper 1 selects. Specifically, $|B_1^{NE,NE}| = 1.5 < 1.514 = |B_1^{NE,E}|$, and similarly, $|B_1^{E,NE}| = 1.457 < 1.473 = |B_1^{E,E}|$. As reported in Proposition 5, the existence of the "delegation effect" does not necessarily lead to higher profits for the newspapers.

A similar result has already been derived in the industrial organization literature. Fershtman and Judd (1987) and Sklivas (1987), for instance, demonstrate that in a Cournot duopoly, firms may find it optimal to give their managers a compensation scheme tied to a weighted average of revenues and profits. Such a compensation rule causes the firm to choose a higher level of output than implied by simple profit maximization. Similar to the "delegation effect" in our model, this compensation scheme acts as a commitment device for the firms to acquire a more aggressive posture vis-à-vis the competitors to get them to reduce their output. When both firms use this compensation scheme, however, they end up earning lower profits as the market price declines. Nevertheless, at the equilibrium, firms do not have an incentive to deviate from the compensation rule that rewards their managers based upon not only profits but revenues as well. Similarly in our setting, even though in the final equilibrium the newspapers earn lower profits due to their decision to expand their product lines, the newspapers do not have an incentive to deviate from this decision because of strategic reasons.[22]

The analysis so far has assumed that α is exogenous. To further explore the role of UGC, we now extend our analysis to allow the choice of α_i to become a decision variable chosen simultaneously

[21] Note that the results in Proposition 5 can be obtained without UGC. For example, using a dynamic model, Zhang (2011) shows that behavior-based segmentation can cause too much competition in equilibrium, thus leading to a similar prisoners' dilemma result.

[22] In the Web appendix we also argue that once this decision has been made in the first stage, the newspapers do not have an incentive to reverse it in the subsequent stages. In the third stage, for example, when prices are selected, each newspaper could block off interest in the online version by significantly raising its price K_i. However, at the equilibrium with segmentation, $P_i - c < K_i - \delta c$, implying that the newspaper would lose profits from the high margin segment if it were to deviate from the equilibrium prices. In the second stage, the newspaper could potentially block off interest in the online version by unilaterally deviating from the equilibrium location $B^{E,E}$. In the numerical calculations conducted in the Web appendix, we demonstrate, however, that even if the newspaper could eliminate interest in the online version (i.e., if $\hat{b} = b_0$) while using the weight $\gamma_i = \phi/(\phi + \chi)$, its profits would decline if it unilaterally deviated from offering both versions. Profits are likely to decline even further if, to block off interest in the online version, the newspaper had to use a different value of γ_i. Note that this line of reasoning does not constitute a formal proof of the fact that newspapers do not have an incentive to block off interest in the online version in the second stage. The argument relies heavily on the optimality of $\gamma_i = \phi/(\phi + \chi)$, which, as discussed in Footnote 7, we cannot formally prove. This is, therefore, a weakness of our paper.

with the decision on whether to extend the product mix in the first stage.

COROLLARY 1. *If α_i, $i = 1, 2$ are chosen in the first stage together with the extension decision of the newspapers, each newspaper chooses a positive α_i. In particular, the outcome $\alpha_1 = \alpha_2 = 0$ can never arise at the symmetric equilibrium.*

Recall that according to Proposition 5, newspapers always choose to extend their product lines with online editions that involve UGC, irrespective of the choice of their competitors. This is consistent with the result reported in Corollary 1. When the competitor of newspaper i chooses $\alpha_j = 0$, newspaper j's two editions are undifferentiated. Newspaper i can then choose $\alpha_i > 0$ in response, and steal market share from j by introducing two different variants of its product, implying that $\alpha_i = 0$ cannot be a best response for i, and therefore, $\alpha_i = \alpha_j = 0$ is not an equilibrium.

4. Concluding Remarks

Over the past decade newspapers have been increasingly incorporating UGC in their online editions. We show that expanding the product line to include online editions that involve UGC reduces the extent of slanting in reporting of the print edition but increases the extent of slant in the online edition. The increased slant of the online edition is primarily generated by the readers themselves who choose to add content to this variant of the product. In fact, we demonstrate that if newspapers had full control over the content of the online editions, they would choose the slant of their print and online editions to be identical. In contrast, when UGC is added by readers to the online editions, each newspaper is indirectly forced by subscribers to offer two differentiated versions of its product. We also find that adding online editions results in reduced profits for newspapers as the additional product variants increase the intensity of competition in the market and the discretion awarded to users causes the newspapers to lose control over the attributes of their product lines, thus limiting their ability to extract rents from consumers. Note that our model assumes full coverage of the market of readers. If the market is less than fully covered when only print editions are offered, introducing online editions that are more politically biased due to UGC might lead to greater coverage. We demonstrate in the Web appendix that this can enhance each newspaper's profits. In addition, given our goal of investigating the role of UGC in affecting political bias in news reporting, our model focuses on the political opinions of readers as the sole determinant of their choice between the print and online editions. There are obviously many other attributes that distinguish consumers who prefer one edition over the other. Online users are likely to be younger or have higher valuation for the technological features provided by online newspapers (such as content sharing-digging, mobile applications, and so on). In the Web appendix, we incorporate a second dimension of heterogeneity, unrelated to politics that differentiates among readers. In this case we show that there is reduced tendency on the part of newspapers to rely on political beliefs when segmenting the market. As a result, the polarization of the newspapers moves closer to the outcome in an environment when only print editions are offered.

Supplemental Material

Supplemental material to this paper is available at http://dx.doi.org/10.1287/mnsc.2013.1746.

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