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Media Bias and News Customization

by

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Media Bias and News Customization

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Abstract

In this paper, we analyze the effects of news customization (tailoring news to consumers' political preferences) on media bias. In particular, we extend Hotelling's duopoly location model to include news customization. Customization occurs when a media firm supplies the market with a continuous line segment of political opinions (i.e.: multi-ideology firm), instead of just a single point on the line (i.e.: single-ideology firm) as in the standard Hotelling model. The customization strategy has some costs related to the adaptation of news to consumers' political preferences, however, the advantage arises from the possibility to price discriminate between different consumers. In this set up, we show that the possibility to customize news by media firms does not reduce media bias. Accordingly, in order to avoid fierce price competition in the standard segment (which also reduces the revenues from price discrimination in the customized segment), firms decide not to cover a larger variety of political opinions.

Keywords: Media Bias, Customization, Media organizations.
JEL Classification: L13, L82.

"The sinister fact about literary censorship in England is that it is largely voluntary." — George Orwell

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1 Introduction

Media bias refers to the bias of the press in the selection of which events are reported and how they are covered. In this sense, media bias can go against the ethical and professional standards of journalism. Moreover, if the media bias is provoked by a third party (like owners or vested interests), media bias can jeopardize the constitutional and statutory rights of freedom of the press, which are at the heart of western democracies.

The concern about media bias is related to the fact that the press is regarded as the "fourth power" of democracies. Accordingly, democracies have three *de jure* elected powers (an executive, a legislative and a judiciary). Notwithstanding, the press is not an elected power (and therefore not a *de jure* power), it is considered to be a *de facto* power given that it has considerable influence over public opinion (and therefore on the outcome of elections, legislation and policy changes). For this reason, many have argued that freedom of thought is threatened in the absence of freedom of the press or in the presence of media bias (amongst others see Mill, 1859 and Hayek, 1945).

In recent years, media bias has gained increased attention in economics. Events that have contributed for this are the war in Iraq (see Gentzkow and Shapiro, 2006b), the 2002 US election (DellaVigna and Kaplan, 2007; Gentzkow, 2006; Larcinese et al., 2007), the growing influence of the satellite network Al Jazeera in Islamic countries (Gentzkow and Shapiro, 2004), the dispute in the US over the liberal *versus* conservative lean of the media industry (Herman and Chomsky, 1998; Groseclose and Milyo, 2005; Knight and Chiang, 2008), the intermingling between politicians and media groups in countries like Italy (see Durante and Knight, 2009) and the debate in Europe (and in particular in France) on the contribution of the media to the so-called *pensée unique* (see Gabszewicz et al., 2001)[1].

The main message from the studies mentioned previously is that media bias is a pervasive characteristic of media markets. Together with the empirical literature on media bias, the theoretical literature has been showing that media bias can be the result of different factors such as pressures from adver-

[1] Gabszewicz et al. (2001) define *pensée unique* (French for "single thought") as a "social context in which discrepancies among citizens' political opinions are almost wiped out". The expression is usually associated with the supremacy of neo-liberalism as an ideology. This idea is expressed by Margaret Thatcher's TINA argument ("There Is No Alternative") or Francis Fukuyama's thesis on the end of history.

tisers (Gabszewicz et al., 2001)[2]; private information of journalists (Baron, 2006); media capture by interest groups or political parties (Noam, 1987; Schulz and Weimann, 1989; Bovitz et al., 2002; Stromberg, 2001, 2004a; Baron, 2005; Besley and Prat, 2006)[3]; and consumers' prior beliefs (Mullainathan and Shleifer, 2005; Gentzkow and Shapiro, 2006a). Accordingly, the first three factors originate from the supply side, while the last one originates from the demand side.

Given the tendency of media markets to bias news (because of either supply or demand side forces), the question in the literature has been "what can reduce the media bias?" (Gentzkow and Shapiro, 2008). Accordingly, the important issue to investigate is if different political views can find voice in the media market. The focus so far has been on competition, i.e.: whether competition relatively to monopoly can reduce the extent of media bias (see Gentzkow and Shapiro, 2008). As discussed by Gentzkow and Shapiro (2008), competition is more likely to reduced media bias when the bias originates from the supply side. However, when the bias results from the demand side, the effects of competition on media bias are ambiguous.

In this paper, we look at the issue from a different angle. In particular, we investigate the claim put forward by some media experts that the Internet revolution has increased the capacity of media firms to customize news to consumers' preferences (see Sunstein, 2006, and Gentzkow, 2007). For instance, the media and Internet expert Chris Anderson (2009), editor-in-chief of the Wired Magazine, argues that one of the most important trends in the media markets is the customization of news services via the Internet[4].

In fact, to the best of our knowledge, so far the literature on media bias has just considered that media firms can only provide one political opinion. In this paper, we analyze the case when media firms can choose to provide more than one political opinion. Accordingly, if newspapers decide to "sell" more than one political orientation, the argument goes that media bias is reduced. We thus analyze the effects on media bias of the possibility by media firms to customize news to consumers' diverse political opinions.

The importance of customization for market competition has long been

[2]See Reuter and Zitzewitz (2006) for empirical evidence.

[3]For evidence see Besley and Burgess (2002), Stromberg (2004b) and Eissensee and Stromberg (2007).

[4]One example of news customization given by Anderson (2009) is the premium subscription of newspapers via Internet. When readers subscribe to a premium service, newspapers are increasingly targeting news (and also advertisement) to the readers' tastes.

recognized in economic analysis (see Mussa and Rosen, 1978). More recently, as a result of the new communication and information technologies (such as the Internet), customization has become a central issue in marketing and business analysis (see Balasubramanian, 1998; Bernhardt et al., 2006; Chen, 2006; Dewan et al., 2000, 2003; Gal-Or and Gal-Or, 2005; Jiang et al., 2006 and Syam et al., 2005). The focus in this literature is that the new technologies, by reducing the costs of screening consumers' preferences, allow firms to "hyper-target" and tailor products to consumers more efficiently.

As we have discussed above, according to some authorities on media issues, a similar trend seems to be occurring on the media markets. In order to investigate if news customization can reduce media bias, we adopt the modeling strategy used in the media bias theoretical literature: the Hotelling model (see Gabszewicz et al., 2001 or Mullainathan and Shleifer, 2005). In particular, focusing on the demand side driven media bias, we follow Mullainathan and Shleifer (2005) assuming that consumers have political preferences and that they suffer a disutility from reading news that do not conform with their political beliefs.

We extend the Hotelling duopoly location model to include news customization. Customization of news occurs when a media firm supplies the market with a continuous line segment of political opinions (i.e.: multi-ideology firm), instead of just a single point on the line (i.e.: single-ideology firm) as in the standard Hotelling model. The customization strategy has some costs related to adapting news to consumers' political preferences, however, the advantage arises from the possibility to price discriminate between different consumers. In order to customize news, media firms then face a trade-off between the customization costs and the ability to price discriminate the consumers that are offered their preferred ideal-variety[5].

In this sense, we follow the customization set-up introduced by Dewan et al. (2003), where firms can offer more than one product at an additional cost. Dewan et al. (2000, 2003) show that in the Salop circle (where firm location is fixed), firms have strong incentives to customize products in order to price discriminate between different consumers. We differ from Dewan et al. (2000, 2003) in that location in our model is not fixed and firms compete on the Hotelling line instead of in the Salop circle. Our objective is to analyze

[5]We therefore differ from the spatial price discrimination literature (see for example Thisse and Vives, 1988; Eber, 1997; Lal and Matutes, 1989 and Braid, 2008), where firms only offer one product, but firms price discriminate between consumers at different locations.

the effects of competition and news customization on media bias and media provision.

Contrary to Dewan et al. (2000, 2003), we show that when media firms choose location they decide not to customize news. Therefore, even when media firms have the possibility to customize news (which could reduce media bias) with the benefits of price discrimination, they even so opt not to do so. The rationale for this result is that with news customization, media firms increase price competition in the standard segment. Accordingly, fierce price competition in the standard segment also reduces the revenues from price discrimination in the customized segment, rendering the customization strategy not profitable as a result.

The rest of the paper is organized as follows. In the next section, we introduce the basic model of editorial political orientation and define news customization. In the third section, we study the customization and location equilibrium of the model. We conclude by discussing our results.

2 The Model

Similarly to Gabszewicz et al. (2001) and Mullainathan and Shleifer (2005), we adopt the Hotelling's (1929) spatial competition model to study media bias[6]. Since we analyze the effects of news customization on media bias, we depart from the standard approach with single-product firms by considering multi-product media firms. In particular, we follow Dewan et al. (2003) by allowing media firms to choose to offer customized products in order to satisfy consumers' preferences. The difference relatively to Dewan et al. (2003) is that, while they work in the Salop (1979) framework where firms do not choose location, we work in the Hotelling (1929) framework where firms can choose location. Accordingly, in Dewan (2003) firms are symmetrically located in the Salop circle, while in here firms choose location on the Hotelling's line.

The advantage of the Hotelling framework is that we can give a political dimension to our model (in terms of left and right wing politics). In fact, while Dewan et al. (2003) analyze the incentives to offer customized

[6]Our model is closer to Gabszewicz et al. (2001) than to Mullainathan and Shleifer (2005). Accordingly, Gabszewicz et al. (2001), like us, are based on the standard Hotelling (1929) model. In turn, Mullainathan and Shleifer (2005) add a behavioral framework to the Hotelling model.

commercial products, we analyze the incentives of media firms to offer alternative political orientations. In this sense, a single-product firm in our model is interpreted as a single-ideology firm (i.e.: a media firm that reports to only one political orientation), while a multi-product firm is regard as a multi-ideology firm (i.e.: a media firm that reports to alternative political orientations).

Consumers' Preferences. As in Hotelling (1929), we assume that consumers are uniformly distributed over a line of length one: $[0, 1]$. The line represents readers' preferences in terms of political orientation. Political orientation is ordered from left to right: 0 far left and 1 far right. We define t as the intensity of the readers' political preferences (i.e.: transport costs in Hotelling). Readers patronize only one media outlet (i.e.: consumers have unit demands). In this way, we have an ideal-variety-opinion model, where readers have a disutility from buying a newspaper with a different political orientation from their own ideal opinion.

Similarly, the location of a media firm on the line is interpreted as the newspaper's editorial political orientation. As in Hotelling (1929), we consider a duopoly market structure, where the two editorial firms are labeled as $i = L, R$. Newspaper L is left-oriented and newspaper R is right-oriented. In this sense, firm L is located at point $d_L = x_L \geq 0$ and firm R is located at point $d_R = 1 - x_R$, where $x_R \geq 0$. We interpret the firms' location, x_L and x_R, as the political core of firm L and firm R, respectively (see figure 1).

To our knowledge, most models that use the Hotelling framework assume that firms can only supply one product (x_L and x_R, for firm L and firm R, respectively). Accordingly, firms are located in only one location (i.e.: firms are single-product). We differ from this standard approach by opening up for media firms to customize media products to consumers' political preferences. Then, in our model firms can become multi-product by covering different political locations.

We then denote the firm's customization scope by k_i, which equals the length of the Hotelling's line chosen to be customized, i.e.: $0 \leq k_i \leq 1$, with $i = L, R$. Media firms can then decide to adopt a single-ideology strategy or a multi-ideology strategy. A single-ideology strategy corresponds to a single point on the line (x_L and x_R), while a multi-ideology orientation corresponds to a segment of the line ($[x_L, x_L + k_L]$ and $[1 - (x_R + k_R), 1 - x_R]$).

In this sense, with a single-ideology strategy, a media firm only reports

one political orientation. With this business strategy, a media firm offers a standard product to consumers with different political orientations. In turn, with a multi-ideology strategy, a media firm subscribes to different political ideologies. With this business strategy, a media firm offers customized news products to consumers in the customized segment and standardized media products to consumers in the standard segment (see figure 1). In other words, consumers in the customized segment pay for news that mirror exactly the political orientation to which they subscribe, while in the standard segment, readers pay for news that are closest to their ideal-opinion. Below we present the specific customization technology available to media firms.

Denoting the location of a reader's political opinion on the line as x, the utility from a reader can then be measured as[7]:

$$U = v - p_i - t\left(x - (x_i + k_i)\right)^2, \; i = L, R \tag{1}$$

Where v is a positive constant and p_i is the price of newspaper i. We assume that the parameter v is sufficiently large to ensure complete market coverage.

Technology: News Customization. Media firms are profit maximizing organizations[8] which produce with constant marginal costs (zero without loss of generality). In this paper, we are interested in studying the incentives of media firms to customize news to consumers' political preferences. The customization decision depends on the costs and the benefits of news customization. The costs arise through the adaptation of news to different consumers' political preferences and the benefits accrue through the possibility to price discriminate amongst the customized consumers.

Like in Dewan (2003), we assume that in order to customize, firms have to incur a customization cost (C) that equals:

$$C_i = \frac{\gamma k_i^2}{2}, \; i = L, R \tag{2}$$

Where γ represents the informational and the flexibility costs to adapt to the readers' political preferences. In this sense, the customization costs can

[7] Following D'Aspremont et al. (1979), in order to have a location equilibrium we assume quadratic transport costs.

[8] Gentzkow and Shapiro (2006b) provide evidence that this is the case for the US media market.

be seen as diseconomies of scope, given that costs increase with the number of customized products offered[9].

Four notes should be made in relation to the location in space of the firms' customization scope[10]. First, media firm L has only incentives to customize to the right of point x_L (the political core of firm L). Likewise, media firm R only considers customizing to the left of point $1 - x_R$. Accordingly, media firm L has no reason to customize to the left of point x_L, because consumers to the left of x_L belong to its political "hinterland" (see figure 1). In other words, like in Hotelling (1929), consumers located to the left of point x_L are captured by firm L, since they have no other option than consuming product x_L. The same argument can be made in relation to media firm R and the consumers located to the right of point $1 - x_R$.

Second, as shown in figure 1, a media firm can have at most two political orientations that are consumed in the standard segment: the duopolists location, x_L and x_R; and, in case of news customization, the end point of the customization scope, $x_L + k_L$ and $1 - (x_R + k_R)$. Accordingly, the location of the firm always represents a standard product since a media firm, independently of news customization, will always deliver the political view mirrored by its location on the line[11].

Third, we assume that the political location of a media firm also determines where on the line it can customize. Accordingly, a newspaper's customization segment is contiguous to the firm's political location (see figure 1). In this sense, the left-leaning newspaper (L) cannot customize separately from point x_L (and the same holds for firm R). The reasons why this occurs might be related with either (1) the political preferences of owners, journalists or interest groups; or (2) technological restrictions, in particular diseconomies of scope. In the first case, owners, journalists or interest groups might not be willing to publish away from their political area. In the second

[9] Besides the quadratic costs of customization, Dewan et al. (2003) also have a linear cost of customization. The inclusion of a linear cost of customization in our model does not change our results, and therefore, for simplification we eliminate it from the analysis.

[10] Mussa and Rosen (1978) also model customization in a continuous spectrum. They analyze vertical product differentiation, however, and not horizontal product differentiation as we do.

[11] Note that if a firm chooses to customize and decides to locate at the extremes of the line (0 or 1), the media firm has only one standardized segment. However, since we do not know *a priori* if a firm is going to customize or not, the political location of the firm is always considered to be a standard news product of the firm, even if *a posteriori* it ends up being only consumed as a customized product.

case, it might be too expensive to offer news products distant from the firm's ideological location[12].

Finally, given that consumers in the Hotelling (1929) model buy at most one political orientation (ideal-variety approach), we need to restrict the customization segments of the two firms to not overlap.

The advantage of customization, following Dewan et al. (2003), is the ability to price discriminate. In particular, if firms do not customize news (as happens in the standard segment), media firms cannot price discriminate between different readers, because consumers' ideal variety is not offered. As a result, media firms can only charge the standard product's price p_i, with $i = L, R$.

Under customization, on the contrary, the media firms can price discriminate, since they offer political news tailored to the consumers' political preferences. Accordingly, in the customized segment the firm can charge the customized consumer the standard product's price (p_i, with $i = L, R$) plus the fit cost of adapting the customized product from the closest standard product. The fit cost equals the distance to the closest standard product times transport costs (t), since firms under customization are able to extract the full surplus from the customized consumer.

Take the example of firm L (see figure 2). As we have seen above, firm L can have at most two standardized political opinions (points x_L and $x_L + k_L$) and a series of customized political opinions on the line segment $[x_L, x_L + k_L]$. Suppose that consumer x is located in the customized segment $[x_L, x_L + k_L]$ and that the closest standard political opinion is x_L (the location of firm L). We then have that $p_L + t\left(x - x_L\right)^2$ is the price charged by the news firm L to consumer x. More generally we then have[13]:

[12]For example, to customize away from the newspaper's political core, the media firm might need to hire a complete new journalist staff with knowledge of the opposite political area (conversely, to customize contiguous to the newspaper's political core, the media firm might be able to continue to use the same staff).

[13]In the case that a firm customizes and it locates at the extremes of the line ($x_L = x_R = 0$), it could be argued that the price discrimination scheme should be made in relation to the end point of the customized segment (k_L or $1 - k_R$). Accordingly, a firm could extract higher surplus from the consumers located at the extremes of the line. If we do this however, the duopoly game is not well behaved since the SOC for customization is not satisfied.

$$\begin{gathered}
\text{If } x_L < x < x_L + \tfrac{k_L}{2} \Rightarrow p_L + t\left(x - x_L\right)^2 \\
\text{If } x_L + \tfrac{k_L}{2} < x < x_L + k_L \Rightarrow p_L + t\left(x_L + k_L - x\right)^2 \\
\text{If } 1 - \left(x_R + k_R\right) < x < 1 - \left(x_R + \tfrac{k_R}{2}\right) \Rightarrow p_R + t\left(x - \left(1 - \left(x_R + k_R\right)\right)\right)^2 \\
\text{If } 1 - \left(x_R + \tfrac{k_R}{2}\right) < x < 1 - x_R \Rightarrow p_R + t\left(1 - x_R - x\right)^2 \qquad (3)
\end{gathered}$$

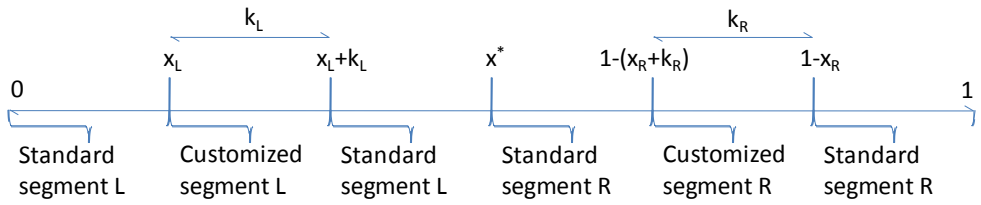
Note that the computation of the revenues from the customized segment can be extremely simplified with the aid of symmetry. Accordingly, as we have seen, if firm L customizes news it has two standard products. Therefore, the customized segment can be divided into two equally sized line segments ($\left[x_L, x_L + \frac{k_L}{2}\right]$ and $\left[x_L + \frac{k_L}{2}, x_L + k_L\right]$). In this sense, in the customized segment, we have two symmetric consumers in terms of distance to the closest standardized news product offered. To see this more clearly, take again the example above. However, suppose now that the closest standard product is $x_L + k_L$ (instead of x_L). The price of the customized political opinion for this consumer is then $p_L + t\left(x_L + k_L - x\right)^2$. However, given the symmetry, for two different readers in the customized segment of firm L, but located at an equal distance from the two standardized political orientations of firm L (x_L and $x_L + k_L$), the price is the same; i.e.: if $x - x_L = x_L + k_L - x$, then $p_L + t\left(x - x_L\right)^2 = p_L + t\left(x_L + k_L - x\right)^2$.

We can then show that profits in the customized segment for firm L equal (and symmetrically for firm R):

$$\begin{aligned}
&\int_{x_L}^{x_L + \frac{k_L}{2}} \left(p_L + t\left(x - x_L\right)^2\right) dx + \int_{x_L + \frac{k_L}{2}}^{x_L + k_L} \left(p_L + t\left(x_L + k_L - x\right)^2\right) dx \\
&\qquad = 2\int_{x_L}^{x_L + \frac{k_L}{2}} \left(p_L + t\left(x - x_L\right)^2\right) dx \\
&\qquad = 2\int_0^{\frac{k_L}{2}} \left(p_L + tx^2\right) dx \qquad (4)
\end{aligned}$$

Profits for firm L and firm R are then equal to:

$$\Pi_i = p_i\left(D_i - k_i\right) + 2\int_0^{\frac{k_i}{2}} \left(p_i + tx^2\right) dx - C_i,\ i = L, R \qquad (5)$$



Note: L is located at x_L. Points x_L and x_L+k_L are the two end points of the customization scope and also the standard news of L. Buyers in the left and in the right hand side of the customized segment k_L (i.e.: standard segments of L) choose x_L and x_L+k_L, respectively. Similar interpretation holds for R. Consumer x^* is indifferent between buying from L and R.

Figure 1: Customization: L located at x_L and R located at x_R

Where D_i is the demand for newspaper i. Accordingly, $D_L = x^*$ and $D_R = 1 - x^*$, where x^* is the reader who is indifferent between buying news from firm L or firm R. The first term in the profit expressions above refers to the revenues from the standard segment, while the second term represents the revenues from the customized segment (see figures 1 and 2).

Timing of the Game. The timing of the game is the following. In the first stage, editors select customization levels (k_i, with $i = L, R$) and the political location of the newspaper (x_L for the left-leaning newspaper L; and $1-x_R$ for the right-leaning newspaper R). In the second stage, editors choose the prices for the standardized political orientation, p_i, with $i = L, R$. As discussed above the price of the customized product equals the price of the standardized product plus the fit cost.

Truth. The central question in the media bias literature is to analyze whether firms have incentives to not report news accurately. In this sense "truth" can be any point on the line $T \in [0, 1]$. Therefore, media bias in our model arises if the reported news (for firm L point x_L, and for firm R point x_R) differs from the "true" news, i.e.: if $T \neq x_L$ and $T \neq x_R$.

The main idea in the paper is that news customization may increase the chances of reporting the "truth", because firms report a segment of the line and not only one point on the line. In the next section we analyze the validity of this claim.

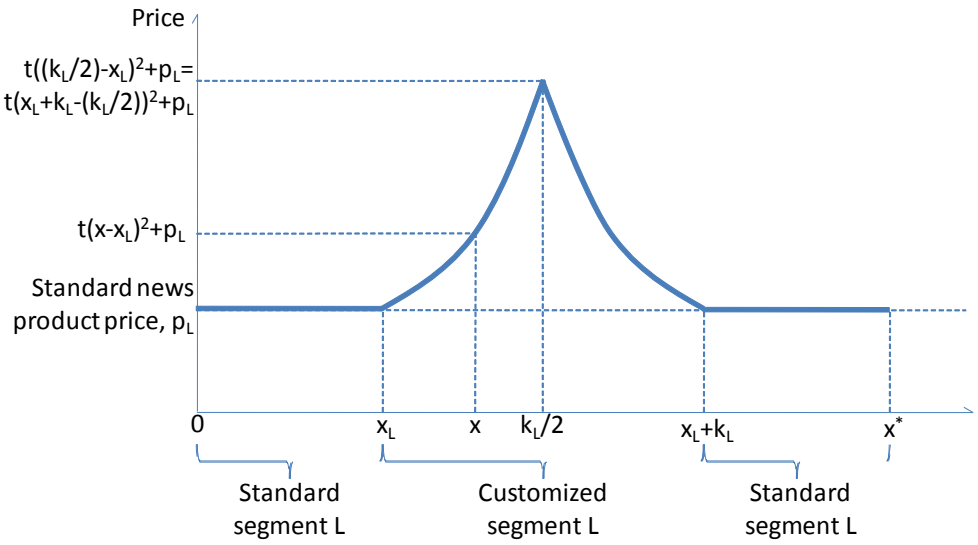


Figure 2: Price discrimination: L located at x_L

3 News Customization and Location

In this section, we analyze the production, customization and location equilibrium of the game. As usual, the model is solved by backward induction. Accordingly, we start by solving for prices (p_L and p_R), and then for location (x_L and x_R) and customization (k_L and k_R).

First, however, we need to find the consumer that is indifferent between buying from firm L and firm R. The indifferent consumer x^* is the one that makes:

$$p_L + t\left(x^* - (x_L + k_L)\right)^2 = p_R + t\left(1 - x^* - (x_R + k_R)\right)^2 \tag{6}$$

Solving for x^* we get:

$$D_i = \frac{p_j - p_i - t(x_i+k_i)^2 + t(1-(x_j+k_j))^2}{2t(1-(x_i+x_j+k_i+k_j))},\ i,j = L,R \text{ and } i \neq j \tag{7}$$

Remember from above that $D_L = x^*$ and $D_R = 1 - x^*$.

Stage 2: Prices. In the second stage, firms choose prices for the standard product. Prices can be found by substituting for x^* (equation 7) in the profit

expressions (equation 5) and maximizing in order to p_L and p_R. The first order condition (FOC) for prices can be shown to be equal to:

$$\frac{\partial \Pi_i}{\partial p_i} = \frac{p_j - 2p_i + t(1-(x_i+x_j+k_i+k_j))((x_i+k_i)-(x_j+k_j)+1)}{2(1-(x_i+x_j+k_i+k_j))t},\ i,j = L,R \text{ and } i \neq j \quad (8)$$

Note that the second order condition (SOC) for prices demands that $(1-(x_i+x_j+k_i+k_j)) > 0$, $i,j = L,R$ and $i \neq j$ (all SOCs are in the appendix). This is a very intuitive SOC, since it simply implies that $(x_i+x_j+k_i+k_j) < 1$, $i,j = L,R$ and $i \neq j$ (i.e.: the sum of firms' location and customization levels cannot be larger than the size of the line segment of length one where they compete).

Solving $\frac{\partial \Pi_i}{\partial p_i} = 0$ and $\frac{\partial \Pi_j}{\partial p_j} = 0$ for p_i and p_j $(i,j = L,R \text{ and } i \neq j)$, we obtain the equilibrium prices:

$$p_i = \frac{t(1-(x_i+x_j+k_i+k_j))(3+(x_i+k_i)-(x_j+k_j))}{3},\ i,j = L,R \text{ and } i \neq j \quad (9)$$

Stage 1: Location. In the second stage, firms choose location (x_L and x_R) and customization levels (k_L and k_R). We start with location and then customization. To find the equilibrium locations of firm L and firm R, we solve the first order conditions (FOCs) for location ($\frac{d\Pi_L}{dx_L}$ and $\frac{d\Pi_R}{dx_R}$). We have that the FOC for location equal for firm i (with $i = L,R$) equals:

$$\frac{\partial \Pi_i}{\partial x_i} = p_i \left(\frac{\partial D_i}{\partial x_i} + \frac{\partial D_i}{\partial p_j}\frac{dp_j}{dx_i} \right),\ i,j = L,R \text{ and } i \neq j \quad (10)$$

The first and second terms inside the brackets on the right-hand side of the previous equation are usually labeled in the Hotelling literature as the direct and the strategic effect, respectively. It is straightforward to show that these two terms equal:

$$\begin{aligned} \frac{\partial D_i}{\partial x_i} &= \frac{p_j - p_i + t(1-(x_i+x_j+k_i+k_j))^2}{2t(1-(x_i+x_j+k_i+k_j))^2} \\ \frac{\partial D_i}{\partial p_j} &= \frac{1}{2t(1-(x_i+x_j+k_i+k_j))} > 0 \\ \frac{dp_j}{dx_i} &= -\frac{2t(2-(x_i+k_i))}{3} < 0,\ i,j = L,R \text{ and } i \neq j \end{aligned} \quad (11)$$

Substituting for p_i and p_j $(i,j = L,R \text{ and } i \neq j)$ from equation 9 in $\frac{\partial D_i}{\partial x_i}$, we have:

$$\frac{\partial D_i}{\partial x_i} = \frac{3-5(x_i+k_i)-(x_j+k_j)}{6(1-(x_i+x_j+k_i+k_j))},\ i,j = L,R \text{ and } i \neq j \tag{12}$$

It can be shown that at the symmetric equilibrium (i.e.: $x_i = x_j$ and $k_i = k_j$, $i,j = L,R$ and $i \neq j$), $\left(\frac{\partial D_i}{\partial x_i}\right)_{Sym} = \frac{1}{2} > 0$. Then, as in the standard Hotelling model (see Tirole, 1988), the direct effect is positive, while the strategic effect is negative (i.e.: $\frac{\partial D_i}{\partial p_j}\frac{dp_j}{dx_i} < 0$, $i,j = L,R$ and $i \neq j$). Accordingly, the direct effect is positive given that a media firm increases its demand by moving closer to the center of the line. However, as the two media firms locate closer, price competition becomes fiercer, depressing profits. The net effect equals:

$$\left(\frac{\partial D_i}{\partial x_i} + \frac{\partial D_i}{\partial p_j}\frac{dp_j}{dx_i}\right) = -\frac{(1+3(x_i+k_i)+(x_j+k_j))}{6(1-(x_i+x_j+k_i+k_j))} < 0,\ i,j = L,R \text{ and } i \neq j \tag{13}$$

Then, in our model, like in other standard Hotelling models, the strategic effect dominates the direct effect.

Substituting for $\frac{\partial D_i}{\partial x_i}$, $\frac{\partial D_i}{\partial p_j}$, $\frac{dp_j}{dx_i}$ and p_i ($i,j = L,R$ and $i \neq j$) in equation 10 we have:

$$\frac{\partial \Pi_i}{\partial x_i} = -\frac{t(3+(x_i+k_i)-(x_j+k_j))(1+3(x_i+k_i)+(x_j+k_j))}{18} < 0,\ i,j = L,R \text{ and } i \neq j \tag{14}$$

Stage 1: News Customization. We now turn to the customization levels, k_L and k_R. To find the equilibrium customization levels of firm L and firm R, we solve the FOCs for customization ($\frac{d\Pi_L}{dk_L}$ and $\frac{d\Pi_R}{dk_R}$). We have that the FOC for customization for firm i (with $i,j = L,R$) equals:

$$\frac{\partial \Pi_i}{\partial k_i} = p_i\left(\frac{\partial D_i}{\partial k_i} + \frac{\partial D_i}{\partial p_j}\frac{dp_j}{dk_i}\right) + \frac{tk_i^2}{4} - \gamma k_i,\ i,j = L,R \text{ and } i \neq j \tag{15}$$

As for location, customization choices are affected by a direct ($\frac{\partial D_i}{\partial k_i}$) and a strategic effect ($\frac{\partial D_i}{\partial p_j}\frac{dp_j}{dk_i}$, $i,j = L,R$ and $i \neq j$). These terms equal:

$$\begin{aligned}
\frac{\partial D_i}{\partial k_i} &= \frac{p_j - p_i + t(1-(x_i+x_j+k_i+k_j))^2}{2t(1-(x_i+x_j+k_i+k_j))^2} \\
\frac{\partial D_i}{\partial p_j} &= \frac{1}{2t(1-(x_i+x_j+k_i+k_j))} > 0 \\
\frac{dp_j}{dk_i} &= -\frac{2t(2-(x_i+k_i))}{3} < 0,\ i,j = L,R \text{ and } i \neq j
\end{aligned} \tag{16}$$

Substitute for p_i and p_j $(i, j = L, R \text{ and } i \neq j)$ from equation 9 in $\frac{\partial D_i}{\partial k_i}$ to obtain:

$$\frac{\partial D_i}{\partial k_i} = \frac{(3-(5(k_i+x_i)+(k_j+x_j)))}{6(1-(x_i+x_j+k_i+k_j))},\ i, j = L, R \text{ and } i \neq j \tag{17}$$

Again, at the symmetric equilibrium (i.e.: $x_i = x_j$ and $k_i = k_j$, $i, j = L, R$ and $i \neq j$) we have that $\left(\frac{\partial D_i}{\partial k_i}\right)_{Sym} = \frac{1}{2} > 0$. Then, as for the location choices, while the direct effect of news customization on profits is positive, the strategic effect is negative. The direct effect is positive, since news customization increases profits via price discrimination. In turn, the indirect effect is negative, because news customization increases price competition in the standard segment and consequently reduces the profits from price discrimination in the customized segment. Remember that the price in the customized segment equals the price of the standard segment plus the customization cost: if the price of the standard segment is low the total price charged in the customized segment is also lower.

We can show that the strategic effect dominates the direct effect given that the first term inside the brackets in equation 15 simplifies to:

$$\left(\frac{\partial D_i}{\partial k_i} + \frac{\partial D_i}{\partial p_j}\frac{dp_j}{dk_i}\right) = -\frac{(1+3(x_i+k_i)+x_j+k_j)}{6(1-(x_i+x_j+k_i+k_j))} < 0,\ i, j = L, R \text{ and } i \neq j \tag{18}$$

Substituting the previous equation and p_i from equation 9 in equation 15, we obtain the following FOCs for customization:

$$\frac{\partial \Pi_i}{\partial k_i} = -\frac{(1+3(k_i+x_i)+(k_j+x_j))(3-(k_j+x_j)+(k_i+x_i))t}{18} + \frac{tk_i^2}{4} - \gamma k_i,\ i, j = L, R \text{ and } i \neq j \tag{19}$$

News customization then depresses profits through the decrease in the revenues from the standard segment and through the costs of customization (first and third terms in equation 19, respectively), but increases profits through price discrimination in the customized segment (second term in equation 19).

Solution of the Model. The solution of the model is found by solving $\frac{\partial \Pi_i}{\partial k_i}$, $\frac{\partial \Pi_i}{\partial x_i}$, $\frac{\partial \Pi_j}{\partial k_j}$ and $\frac{\partial \Pi_j}{\partial x_j}$ for k_i, x_i, k_j and x_j, $i, j = L, R$ and $i \neq j$ (equations 14 and 19). We obtain four solutions:

$$\begin{gathered}(1)\ \ k_i=\tfrac{4\gamma}{t}, k_j=0,\ x_i=-\tfrac{(t+16\gamma)}{4t}<0 \text{ and } x_j=-\tfrac{1}{4}<0\rightarrow x_i=x_j=0\\ (2)\ k_i=0,\ k_j=\tfrac{4\gamma}{t},\ x_i=-\tfrac{1}{4}<0 \text{ and } x_j=-\tfrac{(t+16\gamma)}{4t}<0\rightarrow x_i=x_j=0\\ (3)\ k_i=k_j=\tfrac{4\gamma}{t} \text{ and } x_i=x_j=-\tfrac{(t+16\gamma)}{4t}<0\rightarrow x_i=x_j=0\\ (4)\ k_i=k_j=0 \text{ and } x_i=x_j=-\tfrac{1}{4}<0\rightarrow x_i=x_j=0,\ i,j=L,R \text{ and } i\neq j\end{gathered} \tag{20}$$

As mentioned above since $\frac{\partial\Pi_i}{\partial x_i}<0$, then also $x_i=x_j=0$ under all the previous solutions. In what concerns, customization, the asymmetric solutions (1) and (2) fail to simultaneously satisfy all SOCs. The symmetric solution (3) satisfies the SOC for prices, location and customization if $t>8\gamma$. However for $t>8\gamma$ the cross SOC is not satisfied (i.e.: $\frac{d^2\Pi_i}{dx_i^2}\frac{d^2\Pi_i}{dk_i^2}-\left(\frac{\partial^2\Pi_i}{\partial x_i\partial k_i}\right)^2<0,\ i=L,R$). Only solution (4) satisfies all SOCs (i.e.: $\frac{\partial^2\Pi_i}{\partial p_i^2}<0$, $\frac{\partial^2\Pi_i}{\partial x_i^2}<0$, $\frac{\partial^2\Pi_i}{\partial k_i^2}<0$ and $\frac{d^2\Pi_i}{dx_i^2}\frac{d^2\Pi_i}{dk_i^2}-\left(\frac{\partial^2\Pi_i}{\partial x_i\partial k_i}\right)^2>0$). We then have:

$$\begin{aligned}k_i &= 0\\ x_i &= 0,\ i=L,R\end{aligned} \tag{21}$$

In this sense, a duopolist firm does not customize news and it locates at the extremes of the line (maximum differentiation). In other words, the possibility to price discriminate via news customization cannot reduce media bias when media firms compete on the Hotelling line.

To find prices, we just need to substitute in equation 9 for k_i, x_i, k_j and x_j ($i,j=L,R$ and $i\neq j$) from equation 21 to obtain:

$$p_i=t,\ i=L,R \tag{22}$$

Summing up the possibility of news customization does not change the basic results from the Hotelling model of spatial competition. The following proposition summarizes the results from our model.

Proposition 1 *In a duopolist media market with endogenous choice of location, the duopolists locate at the opposite extremes of the line and they never customize.*

4 Discussion

In this paper, we have analyzed the effects of news customization on media bias. We show that when media firms have the possibility to tailor news to consumers' political preferences with the benefit of price discrimination, they still decide not to do so. In this sense, the extent of the media bias is not reduced in the presence of news customization, since media firms choose to not cover a larger variety of political opinions. The rationale behind this result is that media firms do not wish to increase price competition in the standard segment.

The results obtained here raise some important questions, and therefore their robustness should be checked. In particular, it would be interesting to investigate how news customization interacts with advertisement, biased readers and biased editors-owners-journalists. Advertisement, as shown by Gabszewicz et al. (2001), increases the pressure for a minimum differentiation of political orientations amongst media competitors. By customizing media products, however, this pressure might be reduced, at least as long as media firms can price discriminate between advertisers. Second, as argued by Mullainathan and Shleifer (2005), biased readers increase the incentives of media firms to bias information. Though providing different products to different consumers does not eliminate the nature of consumers' beliefs, at least it safeguards the coexistence of different political orientations in the media market. The drawback of news customization in this context is that it may make it more difficult for consumers to form accurate beliefs, as long as they only listen to their own customized political views (see Sunstein, 2006). Third, we know from Baron (2006) that the bias that originates from the political preferences of editors, owners, and journalists increases the extent of media bias. It would be interesting to check whether the incentives for customization increase or decrease when media firms are committed to a political location.

A Appendix

Second Order Conditions The second order condition (SOC) for prices simplifies to:

$$\frac{\partial^2 \Pi_i}{\partial p_i^2} = -\frac{1}{t(1-(x_i+x_j+k_i+k_j))} < 0,\ i,j = L,R \text{ and } i \neq j \tag{23}$$

The SOC for location is:

$$\frac{\partial^2 \Pi_i}{\partial x_i^2} = -\frac{t(1-(k_j+x_j)+2(k_i+x_i))(3-(k_j+x_j)+(k_i+x_i))}{9(1-(x_i+x_j+k_i+k_j))} < 0,\ i,j = L,R \text{ and } i \neq j \quad (24)$$

In turn, the SOCs for customization equal:

$$\frac{\partial^2 \Pi_i}{\partial k_i^2} = -\frac{(1-(k_j+x_j)+2(k_i+x_i))t(3-(k_j+x_j)+(k_i+x_i))}{9(1-(x_i+x_j+k_i+k_j))} + \frac{tk_i-2\gamma}{2} < 0,\ i,j = L,R \text{ and } i \neq j \quad (25)$$

Finally, the cross derivative simplifies to:

$$\frac{d^2\Pi_i}{dx_i^2}\frac{d^2\Pi_i}{dk_i^2} - \left(\frac{\partial^2 \Pi_i}{\partial x_i \partial k_i}\right)^2 = \frac{(2\gamma - tk_i)(1-(k_j+x_j)+2(k_i+x_i))(3-(k_j+x_j)+(k_i+x_i))t}{18(1-(x_i+x_j+k_i+k_j))} > 0,\ i,j = L,R \text{ and } i \neq j \quad (26)$$

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