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Advertising, News Customization and Media Pluralism

by

Armando J. Garcia Pires

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Advertising, News Customization and Media Pluralism

Armando J. Garcia Pires *
Institute for Research in Economics and Business Administration (SNF)

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Abstract

We analyze how consumers' political preferences, advertising and news customization affect media pluralism (i.e.: diversity of political opinions expressed in the news market). If firms choose to customize, media pluralism may increase, since a larger spectrum of political opinions is covered in the news market. However, when a news firm decides on customization, it has to weight the costs and the benefits (search and adaptation costs *versus* price discrimination in the customized segment, respectively). We show that in a one-sided market (without advertising), maximum political differentiation arises and firms do not customize, i.e.: media pluralism is not increased. In a two-sided market (with advertising), on the other hand, news firms always customize, i.e.: media pluralism increases. Furthermore, when the advertising market is large, maximum differentiation emerges together with a zero price to non-customized consumers. When the advertising market is small, maximum differentiation might be weakened and firms change to positive prices in the non-customized segment.

Keywords: News customization, media plurality, advertising, two-sided markets.

JEL Classification: L13, L82.

*Address for correspondence: Armando J. Garcia Pires, Institute for Research in Economics and Business Administration (SNF), Norwegian School of Economics and Business Administration (NHH), Breiviksveien 40, 5045 Bergen, Norway. Tel: +(47)55959622, Fax: +(47)55959439; E-mail: armando.pires@snf.no.

"I'm your free homeopape machine, a service supplied exclusively by all the fine Rootes hotels throughout Earth and the colonies. Simply dial the classification of news that you wish, and in a matter of seconds I'll speedily provide you with a fresh, up-to-the-minute homeopape tailored to your individual requirements". From Ubik, by Philip K. Dick (Doubleday, 1969).

1 Introduction

Philip K. Dick, in the sci-fi novel Ubik, imagines an automated device that produces customized newspapers according to each reader's preferences: the homeopape (homeo-, similar plus pape, paper). Today, scientific fiction is slowly becoming reality. In fact, some automated news aggregator websites, such as Google News, already allow subscribers to have a high level of news customization[1]. For instance, Google News' clients have the option to tailor the issues or newspapers sources that are available to them by creating a personalized page. Every time the user visits Google News, the personalized page will display the selected topics or news sources. In addition, e-mails can be sent to subscribers whenever new articles matching their requests come online. In what concerns cost and revenues, Google News' business model is very simple. Since Google News does not develop news, it incurs very low costs. In turn, revenues accrue from target advertising of sponsored links[2].

Other case of customization is the so-called "content farms", such as Associated Content and Demand Media[3]. Content farms can be defined as websites that produce a large number of specialized news. The contents developed are targeted to specialized audiences with the intent to capture search traffic that drives ad revenue. To be more precise, content farms usually operate in the following way. First, an algorithm works out what stories or topics appeal most to readers and advertisers. The results are then sent to an army of free-lancers who write the chosen news. Free-lancers

[1] Google News is an automated news aggregator, and no person employed by Google is involved in the creation of the news presented on the website (employees only develop the aggregation algorithm). The articles that appear on Google News are produced by other news websites.

[2] There are several methods to calculate how much an advertiser must pay for ads on a website. However, in all of the different methods used there is a positive correlation between the website's traffic and the ad revenue it produces (see Mangàni, 2004).

[3] Associated Content and Demand Media are amongst the top 20 Web properties in the US as measured by comScore (The Economist, 2010a).

are paid per piece. Finally, the articles are sold to web news portals and newspapers. The content farms' strategy is as such twofold: first, to develop a wealth of targeted news to maximize readership (and therefore ad revenues), and second, to not hire journalists directly in order to reduce costs. The difference relatively to Google News is that content farms produce their own news.

According to the Pew Project for Excellence in Journalism (2010), Google News and the content farms are part of a major tendency of customization and a growing importance of advertising in the news market. These two trends are being pushed from a new business paradigm that has been emerging in the news sector: the Internet as a media platform. One the one hand, with the Internet it is easier to target news, since not only are firms more able to identify consumers' preferences but customization is also done in a more flexible and effective way (see Armstrong 2006a and Levin, 2010)[4]. On the other hand, the Internet has opened a new channel for firms to explore advertising. The algorithms developed by Google News to aggregate news and by content farms to spot the most appealing stories for readers and advertisers, are good examples of how much the Internet facilitates customization and advertising.

Also as a consequence of the Internet, the news market has been experiencing a migration of contents and readers from traditional media platforms (such as newspapers, network TV and cable TV) to the web. As a result, the news sector has been facing a reduction in readership and advertising revenues on the traditional media platforms[5]. In addition, has not yet emerged a profitable business model for the news sector on the Internet. This is so because online readers do not usually pay for the news they watch and web advertising proceeds are not being as high as initially expected (Pew Project for Excellence in Journalism, 2010). The move to online is then pointed out as the main culprit for the much discussed crisis in the news sector, since

[4]The move to customization is not only particular to the news market, but also to other consumer markets. In fact, in the last decade both the business and marketing literature have been highlighting the role of the new communication and information technologies (such as the Internet) for customization. The argument is similar to the one in the news market: the Internet allows firms to hyper-target products to consumers more efficiently by reducing the costs of screening consumers' preferences (see Balasubramanian, 1998; Bernhardt et al., 2006; Chen, 2006; Dewan et al., 2003; Gal-Or and Gal-Or, 2005 and Syam et al., 2005).

[5]Such has been the case for newspapers and network TV, but not for cable TV (Pew Project for Excellence in Journalism, 2010).

the Internet is cannibalizing the revenues from traditional media platforms without generating sufficient revenues to compensate for it (Pew Project for Excellence in Journalism, 2010). The big question for the news sector is then how to monetize the growing online audience, given the shrinkage in the traditional revenue streams.

In particular, in order to face the new Internet paradigm, news firms have been experimenting with two online business strategies: scale *versus* premium (The Economist, 2010b). In the scale strategy, news firms do not charge for online content and they typically follow a more mainstream audience. The idea behind this strategy is that it is difficult for mainstream news firms to be paid for content on the Internet, since they offer a product that can be accessed for free somewhere else. Therefore, with free news they try to maximize the number of viewers in order to attract more advertising. In turn, in the premium strategy, news firms charge for online content and they tend to aim for a more specialized audience. The rationale for this strategy is that online advertising might not be sufficient to keep a newspaper running. The alternative as such is to give consumers something that they really value in order to be able to have an extra revenue source from web subscriptions.

Interestingly enough, one of the Internet business models more popular in the news sector, "freemium", tries to combine the scale and the premium strategies. With freemium (free plus premium) a firm offers a basic downloadable digital product for free, while charging a premium for advanced or special features (see Marín and Gayo, 2009). With the free part, the aim is to generate large circulation on the news firm's website and therefore increase the ad revenues. With the premium part, the objective is to satisfy the demand of some readers for specialized information at a price[6].

Associated with the discussion on the crisis in the news sector and the Internet, is another phenomenon: media pluralism[7]. In particular, there is an

[6]Influential newspapers such as the Wall Street Journal (WSJ) and the Financial Times (FT) have adopted with success a freemium online strategy (Pew Project for Excellence in Journalism, 2010). Both the WSJ and the FT, however, are considering the introduction of a micro payment system for the free online service, where non-subscribers will pay for each article consulted. If this materializes, their freemium strategy will be transformed into something like pay-per-news plus premium.

[7]Media pluralism can be defined as the diversity of political opinions with a voice in the market. Media pluralism is sometimes associated with another phenomenon: media bias. Media bias refers to the bias of the press in the selection of which events are reported and how they are covered (see Mullainathan and Shleifer, 2005). The idea is that the larger the media pluralism, the lower the media bias, since there are more chances that the "truth"

ongoing debate on whether fiercer competition for readership and advertising contributes to a reduction in media pluralism. For example, Herman and Chomsky (1998) defend the view that the extreme reliance on ad revenues brought about by the Internet will tend to reduce media pluralism, given that news firms need to appeal to a more mainstream audience to draw more advertising. In turn, others like Anderson (2009) argue that the push for customization made possible by the Internet can increase media pluralism, because news firms are able to cover a larger spectrum of political opinions and topics.

The hypothesis by Herman and Chomsky (1998) has received formal treatment in the economics' literature by Gabszewicz et al. (2001). They show that media pluralism in fact can shrink in the presence of advertising. This is so, because advertisers want their ads to reach a maximum number of consumers and news firms need the revenues from advertising. As a result, news firms have incentives to follow a minimum political differentiation strategy in order to capture a larger audience. The news sector can therefore contribute to the so-called *pensée unique*, where only political views close to the center find voice in the market[8].

The second hypothesis, however, has to our knowledge not been the object of analysis. In this paper, we look to the influence of consumers' political preferences, news customization and advertising on media pluralism. Our objective is to see whether customization can counter-balance the negative effects of advertising on media pluralism identified by Gabszewicz et al. (2001).

The starting point of our study is the work-horse model of the media competition literature: the Hotelling (1929) ideal variety model (see Downs, 1957 and Schulz and Weimann, 1989). In the media competition interpretation of Hotelling, readers experience a decrease in utility when they consume news products that do not match their political preferences. As a consequence, this set-up introduces a force that supports the well known maximum differentiation result (D'Aspremont et al., 1979), i.e.: in a media duopoly, two

is reported in the news (even if "less-truth" news are also broadcasted).

[8]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 is for example expressed by Margaret Thatcher's TINA argument ("There Is No Alternative") or Francis Fukuyama's (1992) thesis on the end of history.

opposing opinions tend to be expressed in the news market[9].

We differ from the standard media competition approach based solely on Hotelling (1929) in two ways. First, like Gabszewicz et al. (2001), we depart from the one-sided market framework, where news firms derive income only from news sales, to a two-sided markets framework, where news firms' profits come from both selling news and advertising space. In addition, advertisers prefer to buy ads in news firms that have a larger audience. As shown by Gabszewicz et al. (2001), the two-sided market brings in a force that contributes for minimum differentiation, given that news firms maximize advertising revenues by moving to the political center where demand is larger.

Second, we consider that news firms are multiple ideologies, instead of single ideology. The main idea, as mentioned above, is that the customization strategy, when chosen by news firms, can increase media pluralism since more political opinions are expressed in the market. For the effect, we follow Dewan et al.'s (2003) modeling framework of customization in consumer markets. To be more precise, we have that when a news firm decides to customize it has to weight the costs of customization with the benefits. The costs of customization are the search costs of identifying consumers' preferences and the adaptation costs of customizing products[10]. The benefits are price discrimination. In particular, news firms can offer the customized news at a premium above the price of the standard news[11]. In this sense, customization adds a force that may contribute for larger political plurality, once it increases the diversity of political opinions in the news market.

In this sense, our model encompasses three forces that can affect media plurality in different directions, i.e.: consumers' political preferences,

[9]Applying the Hotelling model to media bias, Mullainathan and Shleifer (2005) demonstrate that since consumers have a disutility from watching news that does not conform to their prior beliefs, news firms will tend to bias news (i.e.: maximum differentiation) in order to attract consumers. In this sense, according to Mullainathan and Shleifer (2005), media bias is a pervasive characteristic of the news market.

[10]For example, Google News observes consumers' preferences by delegating the news choice to them. In turn, content farms invest in market research to identify the most interesting news to consumers at a given point in time.

[11]For example, FT has a four layer freemium model: unregistered and registered members (both free), standard subscription (3,19 per week, approximately $4,31) and premium subscription (6,29 per week, approximately $8,50). In turn, The WSJ has a free online service and a specialized paid service for subscribers with scoops, updated news and an online market data center ($1,99 per week, approximately 1,47).

advertising and customization that contribute to maximum differentiation, minimum differentiation and higher media pluralism, respectively. We find that in a one-sided market, customization is never sustainable, i.e.: with no advertising media pluralism is not increased. In turn, in a two-sided market, news firms always customize news, i.e.: with advertising media pluralism is increased. The differences between the one-sided and the two-sided market cases arise because without the advertising revenues news firms are not able to face the fierce price competition that follows under customization or to finance the costs of customization.

In what concerns prices and the political orientation of the news firms, we have that in a one-sided market firms opt for a maximum differentiation of their political message and charge positive prices. In turn, in a two-sided market, when the advertising market is very large, maximum differentiation also arises but news firms charge a zero price to standard consumers[12]. Prices for the standard news become positive as the size of the ad market decreases. However, only when the advertising market is significantly reduced, the maximum differentiation result is weakened. This is so, since when the ad market becomes too small, news firms need to compensate lower ad revenues not only by charging for news in the standard segment, but also by moving in the direction of minimum differentiation in order to attract a more mainstream audience and therefore increase advertising revenues. In turn, when the advertising market is large, news firms do not care so much about provoking a more intense price competition, since the extra ad revenues are sufficient to make up for a less mainstream appeal to advertisers.

The previous result differs from Gabszewicz et al. (2001). In Gabszewicz et al. (2001) maximum differentiation is weakened when advertising revenues are large. This is so, since in Gabszewicz et al. (2001) news firms compete for advertising revenues and therefore with a large ad market they are pressured to accommodate their political message so as to attract a larger audience. In turn, when advertising revenues are small, news firms go for maximum differentiation in order to reduce price competition and as such increase news sales to compensate for the small advertising revenues. In our model the opposite occurs, since when advertising revenues are large, with customization news

[12] Our model can then encompass the zero-price economy predicted by Anderson (2009). In his book "Free: The Future of a Radical Price", Anderson (2009) argues that the Internet is pressuring the price of information (such as news) towards zero. The reasons are the Internet culture (which is based on a "free" mentality) and the low costs of operating online (i.e.: the marginal cost of reproducing intangible digital goods is practically zero).

firms can reduce the need for minimum differentiation. If the advertising revenues are small, in turn, news firms need to capture a larger audience (i.e.: move to minimum differentiation) in order to increase advertising revenues and in this way be able to finance customization.

In this sense, our paper shows that, contrary to Gabszewicz et al. (2001), advertising is not a "necessary evil", since it can support strategies such as customization that increase consumers' choice and as a result can contribute to an increase in media pluralism. Furthermore, this is particularly important when the advertising market is large.

The rest of the paper is organized as follows. Next, we introduce the base model of editorial political orientation and define news customization. In the third and fourth sections, we analyze the non-advertising game (one-sided market) and the advertising game (two-sided market). We conclude by discussing our main results.

2 The Model

Our model builds on the media competition approach based on Hotelling (1929), such as in Downs (1957) and in Schulz and Weimann (1989). To this we add advertising like in Gabszewicz et al. (2001) and customization in the vein of Dewan (2003). Following Gabszewicz et al. (2001), we interpret media plurality as the diversity of political opinions with expression in the news market, i.e.: the fewer the political opinions the lower the media plurality[13].

Similarly to Downs (1957) and Schulz and Weimann (1989), media competition is modeled in the Hotelling (1929) framework, where the points on the line represent political opinions. Consumers have an ideal political variety (left or right) and suffer a disutility when exposed to news that differs from their preferred ideology. In this sense, as in the standard Hotelling model (D'Aspremont et al., 1979), news firms have incentives to opt for a maximum differentiation of their political message (i.e.: to either the left or the right) in order to satisfy consumers' preferences without increasing price competition.

In turn, akin to Gabszewicz et al. (2001), the introduction of advertising

[13]Other interpretations of media plurality are possible. For example, the Hotelling line could represent consumers' preference for different types of news, like sports and business news.

provides a two-sided market framework in our model[14]. This is so, since news firms do not only derive income from selling news but also from selling advertising space to advertisers and, in addition, a larger customer base attracts more advertisers. As a consequence, as in Gabszewicz et al. (2001), we have positive externalities between the consumer and the advertising market. In other words, firms have incentives to choose for a minimum differentiation of their political message (i.e.: report news close to the center) in order to draw a larger audience and maximize advertising revenues.

In terms of customization, we depart from the standard approach with single ideology firms by considering the possibility of multiple ideologies firms. To be more precise, as in Dewan et al. (2003), news firms can decide to customize news in order to satisfy consumers' preferences[15]. A news firm that chooses the single ideology strategy locates in a single point on the Hotelling line, while a news firm that chooses the multiple ideologies strategy extends itself over a line segment[16]. The advantage of customization is price discrimination[17]. With customization, we introduce incentives for firms to cover a larger spectrum of political opinions, and therefore increase media plurality.

The three blocks in our model, then, generate three forces that affect media plurality in different directions. Consumers' preference for variety contributes to maximum differentiation (Mullainathan and Shleifer, 2005). Competition for advertising revenues drives firms to minimum differentiation (Gabszewicz et al., 2001). Price discrimination, in turn, can make it attractive to serve the news market with diverse political opinions. In the following sections, we evaluate which of these forces that dominates.

[14]On the economics of advertising see Bagwell (2007). On two-sided markets see Rochet and Tirole (2006) and Armstrong (2006a). On media and advertising see Kaitatzi-Whitlock (1996), Gabszewicz et al. (2006), Anderson and Gabszewicz (2006), Ellman and Germano (2009), Reisinger, et al. (2009), Crampes et al. (2009) and Roger (2009). On the empirical evidence on the two-sided nature of the news sector see Argentesi and Filistrucchi (2007).

[15]In the case of Google News, for example, a left wing reader can decide to customize his personalized page with news from just New York Times, while a right wing reader can choose to subscribe news from only Fox News.

[16]We differ from Dewan et al. (2003) since they work in the Salop (1979) circle, while we work in the Hotelling (1929) line. For the purposes of our analysis, the Hotelling line has the advantage of having a more straightforward interpretation in terms of opposing editorial policies (left and right).

[17]On the economics of advertising see Armstrong (2008).

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

Similarly, the location of a news firm on the line is interpreted as the news firm's political orientation. As in Hotelling (1929), we consider a duopoly market structure, where the two news firms are labeled as $i = L, R$. L is the left-leaning news firm; and R is the right-leaning news firm. In this sense, L is located at $d_L = x_L$ and R at $d_R = 1 - x_R$ (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 L and R, respectively). Accordingly, firms are located in only one location (i.e.: firms are single variety). We differ from this standard approach by opening up for news firms to customize news to consumers' preferences. Hence, in our model news firms can become multiple ideologies by covering different locations.

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

In this sense, if a news firm chooses a single ideology strategy, it only subscribes to one political orientation. With this business strategy, a news firm offers standard news to consumers with different political orientations. In turn, if a news firm chooses a multiple ideologies strategy, it subscribes to different political orientations. With this business strategy, a news firm offers customized news to consumers in the customized segment and standardized news to consumers in the standard segment (see figure 1). In other words, readers in the customized segment consume news reflecting exactly the political orientation that they subscribe to, while in the standard segment, readers consume news that are closest to their ideal opinion. Below, we present the specific customization technology available to news firms.

In this sense, if a reader x is not located inside the customized segment

(i.e.: his/her ideal opinion is not offered), his/her utility can be measured as[18]:

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

where v is a positive constant (that captures the reservation price of consumers) and p_i is the price of the news firm i. We assume that the parameter v is sufficiently large to ensure complete market coverage. More important, if a consumer is located inside the customized segment his/her utility is therefore: $U = v - p_i$, since $t = 0$ (i.e.: his/her ideal opinion is offered).

Technology: News Customization. Media firms are profit-maximizing organizations, which produce with constant marginal costs (zero without loss of generality). The customization decision depends on the costs and the benefits of news customization. The costs include the search and adaptation costs connected to consumers' preferences. In turn, the benefits accrue through the possibility to price discriminate amongst consumers.

Like in Dewan (2003), we assume that in order to customize, news firms have to incur a customization cost (C). In particular, when a news firm customizes it must bear the additional fixed costs for processing information related to the consumer's tastes and for acquiring flexibility to adapt news to these political preferences. The fixed costs are positively related to the scope of the customization, i.e.: if a firm offers more customization it bears higher fixed costs. The idea is that, since consumers are uniformly distributed on the line, the amount of data and flexibility needed for adapting news to consumers' preferences increases with the size of the customization scope. We then have that C equals:

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

where γ represents the search and flexibility costs pertaining to adapting to consumers' political preferences. In this sense, the customization costs increase with the number of customized news offered[19].

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

[19] Dewan et al. (2003), besides the quadratic costs, also consider a linear cost of customization. The inclusion of a linear cost of customization in our model does not change our results. For simplification, therefore, we eliminate it from the analysis.

In what concerns the customization scope, the following should be noted. First, L has only incentives to customize to the right of point x_L (similarly, R only considers customizing to the left of point $1 - x_R$)[20]. Accordingly, L has no reason to customize to the left of point x_L, because consumers on the left of x_L belong to its "hinterland" (see figure 1). In other words, like in Hotelling (1929), consumers located to the left of point x_L are captured by L, since they have no other option than consuming x_L. The same occurs for news firm R, which similarly has no incentives to customize to the right of point $1 - x_R$ (when $1 - x_R \neq 0$).

Second, as shown in figure 1, a news firm can have at most two orientations that are consumed in the standard segment: the duopolist location, x_L and x_R; and, in the 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 news firm always represents a standard product, since independently of news customization, a news firm always delivers the editorial orientation mirrored by its location on the line[21].

Third, we assume that a news firm's location (x_L and x_R) also determines where on the line it can customize. Accordingly, a news firm's customization segment is contiguous to the news firm's location (see figure 1). In this sense, L cannot customize separately from point x_L (and the same is true for news firm R). The reasons for this might be due to either: (1) the editorial preferences of the owners, the journalists or the interest groups related with the news firm; or (2) reputation issues. In the first case, the owners, the journalists or the interest groups connected with a news firm might not be willing to publish away from their preferred political area. In the second case, it might be argued that consumers would not trust the news firm if it subscribed to two completely different editorial orientations (for example, extreme right and extreme left ideas).

Fourth, given that consumers in the Hotelling (1929) model buy at most one variety, we need to restrict the customization segments of the two news firms from not overlapping. In other words, we have a consumer x^* that is indifferent between buying news from L or R (see figure 1).

[20] Note that this issue does not arise when $x_L = 0$ and $1 - x_R = 0$.

[21] If L and R choose to customize and to locate at the extremes of the line, in practice, they only have one standardized segment. However, since we do not know *a priori* if a news firm is going to customize or not, the location of L and R is always considered to be a standard news product, even if *a posteriori* it ends up being consumed only as a customized product.

The advantage of customization, for the news firm, following Dewan et al. (2003), is price discrimination. In the standard Hotelling (1929) set-up, the duopolist does not know where consumers are located, and therefore price discrimination is not possible. However, in our model, news firms incur customization costs in order to know exactly where consumers are located and their respective political preferences. This is what allows news firms to price discriminate[22].

In particular, if a consumer is not offered a customized news product (as is the case for all consumers when a firm does not customize or for consumers in the standardized segment when a firm does customize), a news firm cannot price discriminate between him/her and the other consumers, because the consumer's ideal variety is not offered. As a result, news firms can only charge this consumer the standard news' price p_i. On the contrary, if a consumer is offered a customized news product (as it is the case for consumers in the customized segment when a firm does customize), a news firm can price discriminate between him/her and the remaining consumers, since the consumer's ideal variety is offered. Accordingly, in the customized segment the news firm can charge the customized consumer the price of the standard news (p_i) plus the fit cost of adapting the customized news. In particular, the fit cost is going to equal the distance to the closest standard news times transport costs (t), once news firms under customization are able to extract the full surplus from the customized consumer.

Take the example of news firm L (see figure 2). As we have discussed above, L can have at most two standardized products (x_L and $x_L + k_L$) and a series of customized products on the line segment $[x_L, x_L + k_L]$. Suppose that consumer x is located in the customized segment and that the closest standard news product is x_L (the location of L). We then have that $p_L + t\left(x - x_L\right)^2$ is the price charged by L to consumer x. More generally[23]:

[22]Our paper then differs from the spatial price discrimination literature of Beckman (1976) and Thisse and Vives (1988). In this literature, customization involves a basic product that satisfies consumers' diverse tastes, with the marginal cost of redesign increasing with the distance between the basic product and the buyer's ideal taste. According to Dewan et al. (2003), this modeling strategy is not very suitable for analyzing customization in the context of the Internet, where "the notion of a basic product becomes ill-defined and all the planned varieties can be produced equally efficiently".

[23]If the news firms customize and locate at the extremes of the line ($x_L = x_R = 0$), it could be argued that the price discrimination scheme could be made in relation to the end point of the customized segment (k_L or $1 - k_R$). In this sense, the news firms could extract higher surplus from the consumers located at the extremes of the line. If we do

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

Note that the computation of the revenues from the customized segment can be simplified with the aid of symmetry. As discussed above, if L customizes news, it has two standard news 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 offered. To see this more clearly, consider once again the example above. However, suppose that now the closest standard news is $x_L + k_L$ (instead of x_L). The price of the customized editorial orientation for this consumer is then $p_L + t\left(x_L + k_L - x\right)^2$. Given the symmetry, however, for two different consumers in the customized segment of news firm L, but located equally distant from the two standardized editorial orientations of 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 $p_L + t\left(x - x_L\right)^2 = p_L + t\left(x_L + k_L - x\right)^2$.

Furthermore, as argued by Dewan et al. (2003), the above pricing scheme is optimal. To show this, suppose again that consumer x is located in the customized segment $[x_L, x_L + k_L]$ and that the closest standard news is x_L (the location of L). Hence, if L charges a price higher than $p_L + t\left(x - x_L\right)^2$, the customization scheme simply collapses. In turn, if the price is lower than $p_L + t\left(x - x_L\right)^2$, L is not extracting the full rent from consumers. If, however, the price equals $p_L + t\left(x - x_L\right)^2$, readers in the standard segments $[0, x_L[$ and $]x_L + k_L, x^*]$ choose the standard products x_L and $x_L + k_L$, respectively. In turn, readers in the customized segment buy the customized product tailored for them. In this sense, the pricing scheme above is optimal and prevents arbitrage among buyers. We can then show that profits in the customized segment for L equal (and symmetrically for R):

this, however, the duopoly game is not well behaved since the SOC for customization is not satisfied. The rationale for this result is that consumers at the extremes of the line would have incentives to buy the closest customized product from the rival firm, breaking as a result the stability of the equilibrium.

$$\int_{x_L}^{x_L+\frac{k_L}{2}} \left(p_L + t\left(x - x_L\right)^2\right) dx + \int_{x_L+\frac{k_L}{2}}^{x_L+k_L} \left(p_L + t\left(x_L + k_L - x\right)^2\right) dx$$

$$= 2\int_{x_L}^{x_L+\frac{k_L}{2}} \left(p_L + t\left(x - x_L\right)^2\right) dx = 2\int_0^{\frac{k_L}{2}} \left(p_L + tx^2\right) dx. \quad (4)$$

Relating the above to our discussion in the introduction, we then have that when a firm customizes it follows a premium strategy, since it price discriminates between consumers. In turn, when a firm does not customize, it pursues a scale strategy, once price discrimination is absent.

Advertising. In addition to the news market, news firms can also explore revenues from the advertising market. We follow Anderson and Coate (2005) and Peitz and Valletti (2008) in assuming that demand for ads for the news firm i equals:

$$r_i = \alpha - \beta a_i,\ i = L, R, \quad (5)$$

where r_i is the price of advertising per reader, a_i is the advertising volume. The parameters α and β reflect the size of the advertising market. Accordingly, a high α and a low β represent a large advertising market[24].

Gross advertising income is then:

$$A_i = \left(\alpha - \beta a_i\right) a_i D_i,\ i = L, R, \quad (6)$$

where D_i is the demand for the news firm i. Accordingly, $D_L = x^*$ and $D_R = 1 - x^*$ (remember that x^* is the reader who is indifferent between buying news from L and R).

As will be seen more clearly below, in this set-up, ad demand depends on the news firm's audience size. More precisely, ad demand is positively correlated with the size of the news firm's audience[25]. This feature gives our model a two-sided market framework, since there are positive externalities between the consumer and the advertising markets.

[24] In this sense, we do not introduce customization of advertising. For customized advertising see for example Esteban et al. (2001).

[25] Apart from the indirect effect via the audience size, we do not consider that advertisers can influence directly the political orientation of a news firm. In particular, advertisers have no political preferences for what they would like to see news firms report. On this view on advertising and media firms see Reuter and Zitzewitz (2006).

Profits. From the above, we have that the profits for the news firm i equal:

$$\Pi_i = p_i \left(D_i - k_i\right) + 2 \int_0^{\frac{k_i}{2}} \left(p_i + tx^2\right) dx - C_i + A_i,\ i = L, R. \tag{7}$$

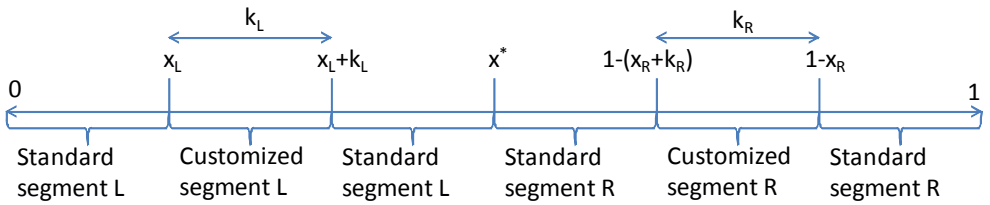
The first and the second terms represent the revenues from the news market for the standard and customized segments, respectively. The third term stands for the costs of customization. The fourth term captures the revenues from the advertising market.

Media Plurality. Following Gabszewicz et al. (2001), we interpret media plurality as the diversity of political opinions with a voice in the news market. In this sense, the greater the number of political opinions that find expression in the news sold to consumers, the higher the media plurality. The main idea in this paper is that news customization can increase media plurality, because when news firms customize, they report a segment on the line and not only one point on the line. In other words, with customization news firms increase the extent of political opinions covered in the news market.

Timing of the Game. In order to assess the effects of consumers' political preferences, advertising and customization on media plurality, we consider two games. The first is a benchmark case with no advertising (i.e.: one-sided market framework) and the second introduces advertising (i.e.: two-sided market framework). In the advertising game the timing is the following: in the first stage, editors select customization levels k_i and the location of the news firm x_i; in the second stage, news firms decide on advertising levels a_i; and in the third stage, editors choose the prices for the standardized news p_i, with $i = L, R$. In the benchmark case, the second stage is eliminated.

3 Benchmark: Non-Advertising Game

In this section, we analyze the production, customization and location equilibrium of the non-advertising game. As usual, the model is solved by backward induction. We start with prices p_i, and continue with location x_i and customization k_i, with $i = L, R$. Before that, however, we need to find the consumer that is indifferent between buying from L and R, x^*.



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 on the left and on 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

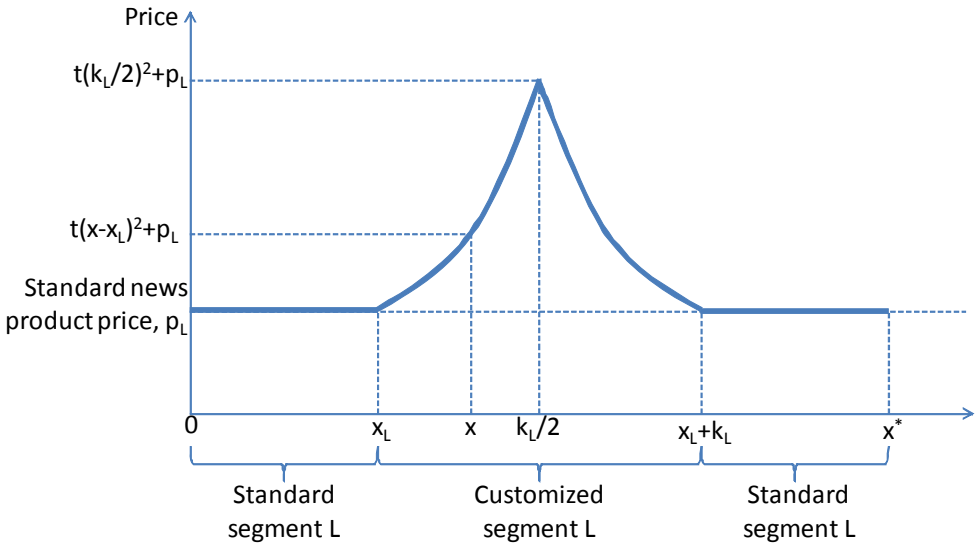


Figure 2: Price discrimination: L located at x_L

Indifferent consumer. The indifferent consumer x^* is the one that makes:

$$v - p_L - t\left(x^* - (x_L + k_L)\right)^2 = v - p_R - t\left(1 - (x_R + k_R) - x^*\right)^2. \quad (8)$$

Solving for x^*, and noting that $D_L = x^*$ and $D_R = 1 - x^*$, we get that D_i equals:

$$D_i = \frac{p_j - p_i - t(x_i + k_i)^2 + t(1-(x_j+k_j))^2}{2t(1-(x_i+x_j+k_i+k_j))},\ i, j = L, R \text{ and } i \neq j. \quad (9)$$

Stage 2: Prices. In the second stage, the news firms choose prices for the standard news p_i, with $i = L, R$. Prices can be found by first substituting for D_i (equation 9) in the profit expressions (equation 7) and then computing the first order condition (FOC) for p_i equals[26]:

$$\frac{\partial \Pi_i}{\partial p_i} = \frac{p_j - 2p_i + t(1-(x_i+x_j+k_i+k_j))((x_i+k_i)-(x_j+k_j)+1)}{2(1-(x_i+x_j+k_i+k_j))t},\ i, j = L, R \text{ and } i \neq j. \quad (10)$$

Solving $\frac{\partial \Pi_i}{\partial p_i}$ and $\frac{\partial \Pi_j}{\partial p_j}$ simultaneously for p_i and p_j, we obtain for firm i:

$$p_i = \frac{t(1-(x_i+x_j+k_i+k_j))(3+(x_i+k_i)-(x_j+k_j))}{3},\ i, j = L, R \text{ and } i \neq j. \quad (11)$$

Stage 1: Location. In the first stage, the news firms choose location and customization levels. We start with location x_i, with $i = L, R$. In the next subsection, we pass on to customization. The FOC for x_i is:

$$\frac{\partial \Pi_i}{\partial x_i} = p_i \left(\frac{\partial D_i}{\partial x_i} + \frac{\partial D_i}{\partial p_j} \frac{dp_j}{dx_i} \right),\ i, j = L, R \text{ and } i \neq j. \quad (12)$$

The first and second terms inside the bracket on the right-hand side of equation 12 are usually labeled in the Hotelling literature as the direct and the strategic effect of location on revenues, respectively. The term $\frac{\partial D_i}{\partial x_i}$ captures the direct effect of the location of firm i (x_i) on its own demand (D_i). The term $\frac{\partial D_i}{\partial p_j} \frac{dp_j}{dx_i}$ refers to the indirect effect of the location of (x_i) on its own demand (D_i), via the impact on the price of the rival firm j (p_j). In other words, when a firm chooses its location, it also has to consider the effects

[26] All second order conditions (SOCs) are in the appendix.

on price competition, and not only on the demand that it is facing. It is straightforward to show that the elements in equation 12 equal:

$$\begin{aligned}\frac{\partial D_i}{\partial x_i} &= \frac{p_j - p_i + t(1-(x_i+x_j+k_i+k_j))^2}{2t(1-(x_i+x_j+k_i+k_j))^2} \\ \frac{\partial D_i}{\partial p_j} &= \frac{1}{2t(1-(x_i+x_j+k_i+k_j))} > 0 \\ \frac{dp_j}{dx_i} &= -\frac{2t(2-(x_i+k_i))}{3} < 0,\ i,j = L,R \text{ and } i \neq j. \end{aligned} \quad (13)$$

Substituting for p_i and p_j from equation 11 in $\frac{\partial D_i}{\partial x_i}$, we have:

$$\frac{\partial D_i}{\partial x_i} = \frac{3-5(x_i+k_i)-(x_j+k_j)}{6(1-(x_i+x_j+k_i+k_j))},\ i,j = L,R \text{ and } i \neq j. \quad (14)$$

It can be shown that in the symmetric equilibrium (i.e.: $x_i = x_j$ and $k_i = k_j$), $\left(\frac{\partial D_i}{\partial x_i}\right)_{Sym} = \frac{1}{2} > 0$. Then, as in the standard Hotelling model (see D'Aspremont et al., 1979) the direct effect is positive, while the strategic effect is negative (i.e.: $\frac{\partial D_i}{\partial p_j}\frac{dp_j}{dx_i} < 0$). Accordingly, the direct effect is positive, given that a news firm increases its demand by moving to the center of the line. However, as the two firms locate closer together, price competition becomes fiercer, depressing profits. The net effect equals:

$$\left(\frac{\partial D_i}{\partial x_i} + \frac{\partial D_i}{\partial p_j}\frac{dp_j}{dx_i}\right) = -\frac{(1+3(x_i+k_i)+(x_j+k_j))}{6(1-(x_i+x_j+k_i+k_j))} < 0,\ i,j = L,R \text{ and } i \neq j. \quad (15)$$

In the non-advertising case, then, similar to standard Hotelling models, the strategic effect dominates the direct effect. Substituting in equation 12 for equation 15 and p_i from equation 11 , we have:

$$\frac{\partial \Pi_i}{\partial x_i} = -\frac{t(3+(x_i+k_i)-(x_j+k_j))(1+3(x_i+k_i)+(x_j+k_j))}{18} < 0,\ i,j = L,R \text{ and } i \neq j. \quad (16)$$

In the absence of advertising, therefore, maximum differentiation is promoted, since locating closer to rivals unambiguously depresses profits.

Stage 1: News Customization. We turn now to customization k_i, with $i = L, R$. The FOC for k_i equals:

$$\frac{\partial \Pi_i}{\partial k_i} = p_i\left(\frac{\partial D_i}{\partial k_i} + \frac{\partial D_i}{\partial p_j}\frac{dp_j}{dk_i}\right) + \frac{tk_i^2}{4} - \gamma k_i,\ i,j = L,R \text{ and } i \neq j. \quad (17)$$

In equation 17, the first term is the effect of customization on the news firm's demand, the second term is the effect of customization on price discrimination and the third term is the effect of customization on costs. Note also that, as for location, the effects of customization on the firm's demand (the first term in equation 17) can be divided into a direct effect ($\frac{\partial D_i}{\partial k_i}$) and an indirect effect ($\frac{\partial D_i}{\partial p_j}\frac{dp_j}{dk_i}$). The term $\frac{\partial D_i}{\partial k_i}$ captures the direct effect of firm i's customization (k_i) on its own demand (D_i). The term $\frac{\partial D_i}{\partial p_j}\frac{dp_j}{dk_i}$ refers to the indirect effect of firm i's customization (k_i) on its own demand (D_i), via the impact on the price of the rival firm (p_j). Therefore, when a firm chooses customization it also has to consider the effects of customization on price competition, and not only on demand. It can be demonstrated that the elements of the first term in equation 17 equal:

$$\begin{aligned}
\frac{\partial D_i}{\partial k_i} &= \frac{p_j - p_i + t(1-(x_i+x_j+k_i+k_j))^2}{2t(1-(x_i+x_j+k_i+k_j))^2} \\
\frac{\partial D_i}{\partial p_j} &= \frac{1}{2t(1-(x_i+x_j+k_i+k_j))} > 0 \\
\frac{dp_j}{dk_i} &= -\frac{2t(2-(x_i+k_i))}{3} < 0,\ i,j = L,R \text{ and } i \neq j. \qquad (18)
\end{aligned}$$

Substituting for p_i and p_j from equation 11 in $\frac{\partial D_i}{\partial k_i}$, we obtain:

$$\frac{\partial D_i}{\partial k_i} = \frac{3-(5(x_i+k_i)+(x_j+k_j))}{6(1-(x_i+x_j+k_i+k_j))},\ i,j = L,R \text{ and } i \neq j. \qquad (19)$$

At the symmetric equilibrium (i.e.: $x_i = x_j$ and $k_i = k_j$), we have that $\left(\frac{\partial D_i}{\partial k_i}\right)_{Sym} = \frac{1}{2} > 0$. Like 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 with news customization firms move in the direction of the center of the line, therefore increasing the demand for news. In turn, the indirect effect is negative because news customization increases price competition and consequently it also 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. Therefore if the price of the standard segment is low, the total price charged in the customized segment is also low.

We can show that the first term in equation 17 simplifies to:

$$\left(\frac{\partial D_i}{\partial k_i} + \frac{\partial D_i}{\partial p_j}\frac{dp_j}{dk_i}\right) = -\frac{1+3(x_i+k_i)+(x_j+k_j)}{6(1-(x_i+x_j+k_i+k_j))} < 0,\ i,j = L,R \text{ and } i \neq j. \qquad (20)$$

The direct effect, as such, is smaller than the indirect effect. Customization can therefore reduce profits via an increase in price competition.

Substituting in equation 17 for equation 20 and for p_i from equation 11, we obtain the following FOC for customization:

$$\frac{\partial \Pi_i}{\partial k_i} = -\frac{(1+3(k_i+x_i)+(k_j+x_j))(3-(k_j+x_j)+(k_i+x_i))t}{18} + \frac{tk_i^2}{4} - \gamma k_i,\ i,j = L,R \text{ and } i \neq j. \tag{21}$$

News customization hence depresses profits through fierce price competition and higher costs (the first and the third terms in equation 21, respectively), but increases profits through price discrimination in the customized segment (the second term). Next, we investigate which effect dominates.

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 $\frac{\partial \Pi_j}{\partial x_j}$ simultaneously for k_i, x_i, k_j and x_j, with $i,j = L,R$ and $i \neq j$ (equations 16 and 21). We obtain four solutions, but only the following one satisfies all SOCs (see appendix):

$$\begin{aligned} k_i &= 0 \\ x_i &= 0,\ i = L,R. \end{aligned} \tag{22}$$

To find prices, we just need to substitute in equation 11 for k_i and x_i from equation 22 to obtain:

$$p_i = t,\ i = L,R. \tag{23}$$

In this sense, when the ad market is non-existent, a duopolist news firm locates at the extremes of the line (maximum differentiation) and it does not customize. In other words, the negative effects of customization shown in equation 21 (the first and the third terms) dominate the positive effects (the second term), i.e.: the possibility to price discriminate via customization does not compensate for the increase in price competition and the costs of customization. Hence, without advertising, political plurality does not increase in the news market, since firms do not customize news to consumer political preferences. The following proposition summarizes the above results.

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

4 Advertising Game

In this section, we analyze the production, advertising, customization and location equilibrium of the advertising game. Like in the non-advertising game, in order to do this, we need first to define the indifferent consumer (D_i, with $i = L, R$ and $D_L = x^*$ and $D_R = 1 - x^*$). We find that in the advertising game the indifferent consumer is the same as in the non-advertising game. Therefore equations 8 and 9 continue to apply and we can go forward to solve as usual the model by backward induction. We start with prices p_i, after advertising a_i, and then location x_i and customization k_i, with $i = L, R$.

Stage 3: Prices. In the third stage, the news firms choose the price for the standard news p_i, with $i = L, R$. The FOC for p_i equals:

$$\frac{d\Pi_i}{dp_i} = \frac{t(1-(x_i+x_j+k_i+k_j))((k_i+x_i)-(k_j+x_j)+1)-2p_i+p_j+a_i(\beta a_i-\alpha)}{2(1-(x_j+k_j+x_i+k_i))t}, \; i, j = L, R \text{ and } i \neq j. \tag{24}$$

Solving $\frac{d\Pi_i}{dp_i}$ and $\frac{d\Pi_j}{dp_j}$ simultaneously for p_i and p_j, we obtain:

$$p_i = \frac{(2a_i(\beta a_i-\alpha)+a_j(\beta a_j-\alpha))+t(1-(x_i+x_j+k_i+k_j))(3-(k_j+x_j)+(k_i+x_i))}{3}, \; i, j = L, R \text{ and } i \neq j. \tag{25}$$

Stage 2: Advertising. In the second stage, the news firms choose advertising levels a_i, with $i = L, R$. The FOC for a_i is:

$$\frac{d\Pi_i}{da_i} = -\frac{(p_i-p_j-t(1+(k_i+x_i)-(k_j+x_j))(1-(x_i+x_j+k_i+k_j)))(\alpha-2\beta a_i)}{2(1-(x_i+x_j+k_i+k_j))t}, \; i, j = L, R \text{ and } i \neq j. \tag{26}$$

Substituting for p_i and p_j from equation 25, we can simplify $\frac{d\Pi_i}{da_i}$ to:

$$\frac{d\Pi_i}{da_i} = -\left(2\beta a_i - \alpha\right)$$
$$\frac{(a_j - a_i)(\beta(a_i + a_j) - \alpha) + t(3 - (k_j + x_j) + (k_i + x_i))(1 - (k_i + k_j + x_i + x_j))}{6(1 - (x_i + x_j + k_i + k_j))t}, \; i, j = L, R \text{ and } i \neq j. \tag{27}$$

Solving $\frac{d\Pi_i}{da_i}$ and $\frac{d\Pi_j}{da_j}$ simultaneously for a_i and a_j (with $i, j = L, R$ and $i \neq j$), we obtain:

$$a_i = \frac{\alpha}{2\beta}, \; i = L, R. \tag{28}$$

Gross advertising income (A_i) can be found by substituting for a_i from equation 28 in equation 6:

$$A_i = \frac{\alpha^2}{4\beta} D_i, \; i = L, R. \tag{29}$$

Advertising income then increases with the demand for news (D_i). This shows the two-sided nature of the news market in our model, since there are positive externalities between the market for news and the market for advertising. In other words, a news firm with higher sales is more attractive for advertisers and, as such, the former has incentives to increase the demand for news in order to augment the demand for ads.

Stage 1: Location. In the first stage, the news firms choose location and customization. We start with the choice of location x_i, with $i = L, R$. In the next subsection, we look at customization. The FOC for x_i equals:

$$\frac{\partial \Pi_i}{\partial x_i} = p_i \left(\frac{\partial D_i}{\partial x_i} + \frac{\partial D_i}{\partial p_j} \frac{dp_j}{dx_i} \right) + \frac{\partial A_i}{\partial D_i} \frac{dD_i}{dx_i}, \; i, j = L, R \text{ and } i \neq j. \tag{30}$$

Relatively to the non-advertising game (equation 12), equation 30 has a new term (the second one). In particular, now the choice of location affects not only the revenues in the news market (the first term in equation 30) but also the revenues in the advertising market (the second term).

After solving explicitly equation 30, we find that the first term in equation 30 (i.e.: the effects of location in the news market sales) is exactly the same as in the non-advertising case. Then equations 13 to 15 continue to apply. In this sense, in the advertising game we also have that the positive direct effect of locating closer to the center of the line in order to capture more

demand ($\frac{\partial D_i}{\partial x_i}$) is smaller than the negative indirect effect of tougher price competition ($\frac{\partial D_i}{\partial p_j}\frac{dp_j}{dx_i}$). As such, competition in the news market continues to promote maximum differentiation.

In the ad market (the second term in equation 30), however, we have:

$$\frac{\partial A_i}{\partial D_i} = a_i\left(\alpha - \beta a_i\right) = \frac{\alpha^2}{4\beta} > 0,\ i = L, R. \tag{31}$$

And also:

$$\frac{dD_i}{dx_i} = \frac{p_j - p_i + t(1-(x_i+x_j+k_i+k_j))^2}{2t(1-(x_i+x_j+k_i+k_j))^2},\ i, j = L, R \text{ and } i \neq j. \tag{32}$$

Substituting for p_i, p_j, a_i and a_j (equations 25 and 28) in equation 32, we obtain:

$$\frac{\partial D_i}{\partial x_i} = \frac{3-5(x_i+k_i)-(x_j+k_j)}{6(1-(x_i+x_j+k_i+k_j))},\ i, j = L, R \text{ and } i \neq j. \tag{33}$$

Since at the symmetric equilibrium $\left(\frac{\partial D_i}{\partial x_i}\right)_{Sym} = \frac{1}{2} > 0$, then advertising contributes to minimum differentiation. This result is similar to the one obtained by Gabszewicz et al. (2001). The intuition is that news firms by locating closer to the center of the news market can attract more demand for news (D_i), which in turn increases demand for ads and therefore augments advertising revenues (equation 29). In spite of this similarity relatively to Gabszewicz et al. (2001), we shall see that this result has different implications in our model.

Summing up, in the presence of advertising, location affects the profits of news firms in two opposing ways. The first term in equation 30 (the effect of the firm's location on the firm's demand) contributes to maximum differentiation, while the second term (the effect of the firm's location on the firm's ad revenues) support for minimum differentiation. Below, we will analyze which effect dominates.

Stage 1: News Customization. We now turn to customization k_i, with $i = L, R$. The FOC for k_i equals:

$$\frac{d\Pi_i}{dk_i} = p_i\left(\frac{\partial D_i}{\partial k_i} + \frac{\partial D_i}{\partial p_j}\frac{dp_j}{dk_i}\right) + \frac{\partial A_i}{\partial D_i}\frac{dD_i}{dk_i} + \frac{tk_i^2}{4} - \gamma k_i,\ i, j = L, R \text{ and } i \neq j. \tag{34}$$

Relatively to the non-advertising game (equation 17), equation 34 has a new term (the second one). In particular, now customization affects not only

the firm's demand (the first term in equation 34), price discrimination (the third term) and the costs of customization (the fourth term), but also the revenues from the advertising market (the second term). We have that the first term in equation 34 (i.e.: the effect of customization on demand) is exactly the same as in the non-advertising case. Equations 18 to 20 therefore continue to apply. In this sense, in the advertising game, the direct positive effect of customization on the demand for news ($\frac{\partial D_i}{\partial k_i}$) is smaller than the indirect negative effect of fierce price competition ($\frac{\partial D_i}{\partial p_j}\frac{dp_j}{dk_i}$). Consequently, customization can reduce profits in the news market, given that it contributes to lower prices in the standard and in the customized segments. Accordingly, a lower price in the standard segment implies a lower price also in the customized segment, given that the price in the customized segment equals the price in the standard segment plus the fit cost.

In turn, in the ad market, we have that:

$$\frac{\partial A_i}{\partial D_i} = (\alpha - \beta a_i)\, a_i = \frac{\alpha^2}{4\beta} > 0,\ i = L, R. \tag{35}$$

And also:

$$\frac{dD_i}{dk_i} = \frac{p_j - p_i + t(1-(x_i+x_j+k_i+k_j))^2}{2(1-(x_i+x_j+k_i+k_j))^2 t},\ i, j = L, R \text{ and } i \neq j. \tag{36}$$

Substituting for p_i, p_j, a_i and a_j (equations 25 and 28), equation 36 can be simplified to:

$$\frac{dD_i}{dk_i} = \frac{3-5(x_i+k_i)-(x_j+k_j)}{6(1-(x_i+x_j+k_i+k_j))},\ i, j = L, R \text{ and } i \neq j. \tag{37}$$

Given that at the symmetric equilibrium $\left(\frac{\partial D_i}{\partial k_i}\right)_{Sym} = \frac{1}{2} > 0$, customization affects positively ad revenue via the positive effect on news sales. The rationale is that higher demand for news increases demand for ads (two-sided market). In addition, advertising can also contribute positively to news customization, because higher advertising revenues can make it possible for news firms to finance customization.

Summing up, in the presence of advertising, customization affects the profits of news firms in four opposing ways. The first and the fourth terms in equation 34 (the effect of the firm's customization levels on the firm's demand and on the firm's costs, respectively) contribute negatively to customization. In turn, the second and the third terms in equation 34 (the effect of the firm's customization levels on ad revenues and on price discrimination, respectively)

have a positive impact on customization. Next, we analyze which effect dominates.

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 $\frac{\partial \Pi_j}{\partial x_j}$ simultaneously for k_i, x_i, k_j and x_j, with $i, j = L, R$ and $i \neq j$ (equations 16 and 21). The advertising game gives four solutions (two asymmetric and two symmetric, see appendix). However, only the following symmetric solution satisfies all SOCs:

$$\begin{aligned} k_i &= \frac{4\gamma}{t} \\ x_i &= \frac{\alpha^2 - 4\beta(32\gamma - t) + \sqrt{\alpha^4 + 24t\beta(6t\beta - 5\alpha^2)}}{32\beta t} \\ a_i &= \frac{\alpha}{2\beta},\ i = L, R. \end{aligned} \tag{38}$$

From equation 38 we have that $k_i > 0$ and $a_i > 0$. In this sense, given that news firms always customize, in the advertising game the positive effects of customization (the second and the third terms in equation 34) dominate the negative ones (the first and the fourth terms).

In what concerns location, x_i can either be positive or negative[27]. In other words, in the advertising game the forces for maximum differentiation (the first term in equation 30) can be weakened by those for minimum differentiation (the second term), i.e.: if $x_i \leq 0 \Rightarrow x_i = 0$, firms choose maximum differentiation; and if $x_i > 0$ firms move in the direction of minimum differentiation. As shown in appendix, the sign of x_i depends on the threshold level $\beta' = \frac{\alpha^2(2\gamma - t)}{(t+16\gamma)(8\gamma - t)}$ (i.e.: β' makes $x_i = 0$). Remember that a low β represents a large advertising market, while a high β means a small advertising market (see equation 5). Furthermore, also as discussed in the appendix, we need to impose that $t > 8\gamma$, in order to the customized segments of the two news firms do not overlap. The game is then only valid for $t > 8\gamma$, i.e.: when trade costs are significantly larger than the costs of customization[28]. As a result of the previous observations, we have that the solution of the advertising game has two cases.

[27] Since $x_i \in [0, 1]$, when $x_i < 0$ it follows that $x_i = 0$ (see appendix).

[28] The intuition for this condition is very straightforward. If the transport costs are not sufficiently larger than the costs of customization, nothing stops the news firms from overlapping their customized segments.

1) Equilibrium of the game for $0 < \beta \leq \frac{\alpha^2(2\gamma - t)}{(t+16\gamma)(8\gamma - t)}$ and $t > 8\gamma$:

$$\begin{aligned} k_i &= \tfrac{4\gamma}{t} \\ x_i &= 0 \\ a_i &= \tfrac{\alpha}{2\beta},\ i = L, R. \end{aligned} \tag{39}$$

We then have that when the advertising market is relatively large, news firms choose maximum differentiation.

Substituting for k_i, x_i and a_i (equation 39) into p_i (equation 25), we obtain:

$$p_i = \tfrac{4\beta(t-8\gamma)-\alpha^2}{4\beta},\ i = L, R. \tag{40}$$

Again the sign of p_i depends on the value of β, now with threshold level $\beta'' = \frac{\alpha^2}{4(t-8\gamma)}$ (i.e.: β that makes $p_i = 0$). In particular, $p_i > 0$ for $\beta > \frac{\alpha^2}{4(t-8\gamma)}$. Since, $\beta' - \beta'' = \frac{3\alpha^2}{4(t+16\gamma)} > 0$, we have:

$$\begin{aligned} \text{If } 0 &< \beta \leq \tfrac{\alpha^2}{4(t-8\gamma)} \Rightarrow p_i = 0 \\ \text{If } \tfrac{\alpha^2}{4(t-8\gamma)} &< \beta < \tfrac{\alpha^2(2\gamma-t)}{(t+16\gamma)(8\gamma-t)} \Rightarrow p_i = \tfrac{4\beta(t-8\gamma)-\alpha^2}{4\beta} > 0,\ i = L, R. \end{aligned} \tag{41}$$

When the advertising market is extremely large ($0 < \beta \leq \frac{\alpha^2}{4(t-8\gamma)}$), the price in the standard segment is zero. However, when the advertising market is large, but not extremely large ($\frac{\alpha^2}{4(t-8\gamma)} < \beta < \frac{\alpha^2(2\gamma-t)}{(t+16\gamma)(8\gamma-t)}$), prices in the standard segment become positive.

2) Equilibrium of the game for $\beta > \frac{\alpha^2(2\gamma - t)}{(t+16\gamma)(8\gamma - t)}$ and $t > 8\gamma$:

$$\begin{aligned} k_i &= \tfrac{4\gamma}{t} \\ x_i &= \tfrac{\alpha^2 - 4\beta(32\gamma - t) + \sqrt{\alpha^4 + 24t\beta(6t\beta - 5\alpha^2)}}{32\beta t} \\ a_i &= \tfrac{\alpha}{2\beta},\ i = L, R. \end{aligned} \tag{42}$$

We then have that when the advertising market is relatively small, news firms do not opt for maximum differentiation.

Substituting for k_i, x_i and a_i (equation 42) into p_i (equation 25), we have:

$$p_i = \tfrac{12t\beta - 5\alpha^2 - \sqrt{\alpha^4 + 24t\beta(6t\beta - 5\alpha^2)}}{16\beta} > 0,\ i = L, R. \tag{43}$$

It can be easily checked that $p_i > 0$. As a result, when the advertising market is small, news firms charge positive prices. The next proposition summarizes the results of the advertising game.

Proposition 2 *In a duopolist two-sided news market with endogenous choice of location, the duopolists' advertising and customization levels are always positive and equal to* $a_i = \frac{\alpha}{2\beta}$ *and* $k_i = \frac{4\gamma}{t}$. *On the other hand, in terms of location, two equilibriums arise. For* $0 < \beta \leq \frac{\alpha^2(2\gamma - t)}{(t+16\gamma)(8\gamma - t)}$ *and* $t > 8\gamma$, *the duopolists locate at the extremes of the line. Also, for* $0 < \beta \leq \frac{\alpha^2}{4(t-8\gamma)}$ *the duopolists charge zero price, while for* $\frac{\alpha^2}{4(t-8\gamma)} < \beta < \frac{\alpha^2(2\gamma - t)}{(t+16\gamma)(8\gamma - t)}$ *prices are positive. In turn, for* $\beta > \frac{\alpha^2(2\gamma - t)}{(t+16\gamma)(8\gamma - t)}$ *and* $t > 8\gamma$, *the duopolists do not locate at the extremes of the line. In this case the duopolist charges positive prices.*

When the advertising market is small, then, news firms do not choose maximum differentiation. Note that although, like in Gabszewicz et al. (2001), we weakened the maximum differentiation result through advertising , the mechanism is different. In fact, while in Gabszewicz et al. (2001) minimum differentiation is encouraged when advertising revenues are large, in our model this is only the case when the opposite occurs. To understand this, note that both in our set-up and in Gabszewicz et al. (2001) firms compete for advertising, which depends on the demand for news. In particular, as we have seen, demand for ads is larger when firms locate closer to the center (minimum differentiation), since news sales are maximized. The problem is that locating closer to the center increases price competition. In Gabszewicz et al. (2001), however, when the ad market is very large, the benefits of minimum differentiation (higher demand for news which induces higher demand for ads) can compensate for the disadvantages of fierce price competition. Here, in turn, firms can use customization to move to the center of the line without the need for minimum differentiation, i.e.: they can locate at the extremes of the line and customize in the direction of the center. Large advertising revenues can support maximum differentiation plus the customization strategy, because they help to finance the costs of customization. However, when the advertising revenues are smaller, competition for adverting demand becomes very fierce and news firms need to move to the center in order to attract more advertising. Only with this strategy, news firms can continue to be able to finance customization.

In this sense, in our model, like in Gabszewicz et al. (2001), advertising can contribute to minimum differentiation. However, differently from Gabszewicz et al. (2001), this effect is less important when the advertising market is large. Furthermore, independently of maximum or minimum differentiation, advertising always supports customization of news, which increases media plurality. This never occurs in the absence of advertising. In our set-up, then, advertising can have positive effects on the news market, given that not only can it reduce the chances of the emergence of a media consensus (i.e.: minimum differentiation) but it can also allow firms to follow business strategies that increase media plurality (i.e.: customization).

5 Discussion

In this paper, we have analyzed how consumers' political preferences, advertising and news customization affect media pluralism. We have departed from the standard set-up where news firms profess a single political orientation to a framework where news firms can give voice to different political views. In other words, our model can encompass multiple product news firms that offer diverse political orientations. This differs from the usual approach of single-product news firms that sell just one political orientation. To be more precise, news firms in our model can choose to sell customized news to a set of customized consumers and standardized news (with only one political orientation mirrored) to consumers outside the customized segment.

Our results reveal the importance of advertising, customization and price strategies for media plurality in the news market. Starting with the consequences of considering or not advertising in the news sector, we show that in a one-sided news market (i.e.: with no advertising), the standard maximum differentiation result obtained with the Hotelling model with quadratic transport costs still holds (D'Aspremont et al., 1979). More interesting, in the absence of advertising, news firms have no incentives to customize news to different political views and, therefore, media plurality is not increased. The intuition is that customization increases price competition in the standard segment, reducing indirectly also the revenues from the customized segment, since the price to customized consumers equals the price of the standard segment plus a premium. In this way, and following the discussion in the introduction, without an ad market, news firms tend to follow a scale strategy, i.e.: appeal to a general audience.

In turn, in a two-sided news market (i.e.: with advertising), news firms always have incentives to customize, independently of the size of the ad market. Accordingly, advertising revenues make it possible for news firms to finance the customization strategy, and to compensate for the fierce price competition that can ensue. Then, in a two-sided market media plurality can be increased, because news firms cover a larger spectrum of political opinions via customization. Thus, and in accordance with our discussion in the introduction, in the presence of advertising, news firms tend to pursue a premium strategy, i.e.: to sell customized news at a premium.

To consider the effects of customization, we have to compare our model, which has customization, with Gabszewicz et al. (2001), which has not. In our set-up with customization and advertising we have the following. If the advertising market is large, maximum differentiation prevails. Only if the advertising market is small, do the forces for minimum differentiation start to dominate. With advertising, like Gabszewicz et al. (2001), we then weakened the maximum differentiation result. However, while in Gabszewicz et al. (2001) a shift to minimum differentiation always represents a decrease in media pluralism, such is not the case in our framework. This is so, since in our set-up in the presence of advertising, news firms always customize, and therefore media pluralism can nonetheless increase even when firms move in the direction of minimum differentiation.

Furthermore, customization carries another central implication: in our paper the move to minimum differentiation emerges in a different scenario than in Gabszewicz et al. (2001). In fact, while in Gabszewicz et al. (2001) minimum differentiation is promoted when the ad market is large, the opposite is the case here. In the single political-orientated news firm set-up (i.e.: no customization) of Gabszewicz et al. (2001), when the advertising market is very large, advertising revenues are too high relatively to the news sales revenues. As a consequence, the weakening of maximum differentiation is a profitable strategy, because in spite of increasing price competition it increases advertising revenues. Therefore news firms prefer to appeal to a large audience by locating closer to the center in order to capture more advertising. When the advertising market is small, however, news firms' revenues depend more on selling news than on advertising proceeds. As such, news firms opt for maximum differentiation in order to reduce price competition. In this sense, Gabszewicz et al. (2001) argues that when advertising becomes more important media plurality decreases, because only one political opinion tends to find its way into the news market.

In our multiple political-orientated news firm set-up (i.e.: with customization), on the contrary, maximum differentiation emerges when the advertising market is large, because with higher advertising revenues it is easier to finance news customization and at the same time face the resulting fierce price competition. In other words, customization makes it possible to cover a larger audience and to sell more ad space without the need to move to the center. If the advertising market is small, however, news firms choose to move to the center of the line to attract a larger audience. By doing so, news firms aim to capture more advertising in order to finance the customization strategy. Furthermore, since news firms can charge customized consumers higher prices, contrary to Gabszewicz et al. (2001), when the advertising market is small they do not need to relax the price competition via maximum differentiation.

Another interesting result in our paper is related to the news firms' price strategies. We demonstrate that prices in the standard segment depend on the size of the advertising market. In particular, when the ad market is very large, news firms, at the same time as they customize and go for maximum differentiation of their political message, charge a zero price to consumers in the standard segment, i.e.: customized consumers just pay the fit cost. This resembles the freemium business model discussed in the introduction. As the ad market shrinks, news firms first change to positive prices in the standard segment and eventually they also move in the direction of the center of the market. When this occurs, consumers in the customized segment start to pay the (positive) standard segment price plus the fit cost. This is similar to the pay plus premium business strategy mentioned in the introduction.

Our paper gives some predictions that fit well with some of the trends in the news market brought about by the Internet. In particular, the customization of news (Pew Project for Excellence in Journalism, 2010), the dependence on advertising revenues to follow new business strategies (Anderson and Gabszewicz, 2006) and freemium pricing models with standard news products at zero price and specialized news services at a premium value (Anderson, 2009). With the revenues from the traditional media platforms decreasing (readership and print advertising for newspapers, and advertising for network TV) and the migration of news to the web, news firms will have to develop novel business models adapted to the Internet in order to survive. Only then, news firms will be able to finance business strategies, such as customization, which are so needed to face a tougher media market. At present, however, it is very uncertain how the news market will evolve in terms of the monetization of the online business platforms. Our model, though, suggests

that this will depend crucially on the size of the ad market and the ability of news firms to generate advertising revenues.

A Appendix

SOCs: Non-Advertising Game. SOC for prices:

$$\frac{\partial^2 \Pi_i}{\partial p_i^2} = -\frac{1}{t(1-(x_i+x_j+k_i+k_j))},\ i,j = L,R \text{ and } i \neq j. \tag{44}$$

The SOC for prices requires that $(1-(x_i+x_j+k_i+k_j)) > 0$. This is a very intuitive SOC, since it implies that the sum of the news firms' location and customization levels cannot be bigger than the length of the line.

SOC for location:

$$\frac{\partial^2 \Pi_i}{\partial x_i^2} = -\frac{t(1-(k_j+x_j)+2(k_i+x_i))(3-(k_j+x_j)+(k_i+x_i))}{9(1-(x_i+x_j+k_i+k_j))},\ i,j = L,R \text{ and } i \neq j. \tag{45}$$

SOC for customization:

$$\frac{\partial^2 \Pi_i}{\partial k_i^2} = -\frac{(1-(k_j+x_j)+2(k_i+x_i))t(3-(k_j+x_j)+(k_i+x_i))}{9(1-(x_i+x_j+k_i+k_j))} + \frac{tk_i-2\gamma}{2},\ i,j = L,R \text{ and } i \neq j. \tag{46}$$

Cross SOC:

$$\frac{d^2\Pi_i}{dx_i^2}\frac{d^2\Pi_i}{dk_i^2} - \left(\frac{\partial^2 \Pi_i}{\partial x_i \partial k_i}\right)^2 =$$
$$\frac{(2\gamma-tk_i)(1-(k_j+x_j)+2(k_i+x_i))(3-(k_j+x_j)+(k_i+x_i))t}{18(1-(x_i+x_j+k_i+k_j))} > 0,\ i,j = L,R \text{ and } i \neq j. \tag{47}$$

Solution: Non-Advertising Game.

$$\begin{gathered}
(1)\ \ k_i = \tfrac{4\gamma}{t}, k_j = 0,\ x_i = -\tfrac{(t+16\gamma)}{4t} < 0 \text{ and } x_j = -\tfrac{1}{4} < 0 \Rightarrow x_i = x_j = 0 \\
(2)\ k_i = 0,\ k_j = \tfrac{4\gamma}{t},\ x_i = -\tfrac{1}{4} < 0 \text{ and } x_j = -\tfrac{(t+16\gamma)}{4t} < 0 \Rightarrow x_i = x_j = 0 \\
(3)\ k_i = k_j = \tfrac{4\gamma}{t} \text{ and } x_i = x_j = -\tfrac{(t+16\gamma)}{4t} < 0 \Rightarrow x_i = x_j = 0 \\
(4)\ k_i = k_j = 0 \text{ and } x_i = x_j = -\tfrac{1}{4} < 0 \Rightarrow x_i = x_j = 0,\ i,j = L,R \text{ and } i \neq j.
\end{gathered} \tag{48}$$

Since $\frac{\partial \Pi_i}{\partial x_i} < 0$, then also $x_i = 0$ under all the previous solutions. The asymmetric solutions (1) and (2) fail to satisfy simultaneously 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.: $\frac{d^2\Pi_i}{dx_i^2}\frac{d^2\Pi_i}{dk_i^2} - \left(\frac{\partial^2 \Pi_i}{\partial x_i \partial k_i}\right)^2 < 0$). 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 $\frac{d^2\Pi_i}{dx_i^2}\frac{d^2\Pi_i}{dk_i^2} - \left(\frac{\partial^2 \Pi_i}{\partial x_i \partial k_i}\right)^2 > 0$).

SOCs: Advertising Game. The SOC for prices in the advertising game is the same as for the non-advertising game.

SOC for advertising:

$$\frac{d^2\Pi_i}{da_i^2} = -\frac{((a_j-a_i)(\beta(a_i+a_j)-\alpha)+t(3-(k_j+x_j)+(k_i+x_i))(1-(x_i+x_j+k_i+k_j)))\beta}{3(1-(x_i+x_j+k_i+k_j))t}, \; i,j = L,R \text{ and } i \neq j. \tag{49}$$

Note that the SOC for advertising is always satisfied if $a_i = a_j$.

SOC for location:

$$\frac{d^2\Pi_i}{dx_i^2} = \frac{3\alpha^2(k_j+x_j+1)}{36\beta(1-(x_i+x_j+k_i+k_j))^2} - \frac{4\beta t(3-(k_j+x_j)+(k_i+x_i))(1-(k_j+x_j)+2(k_i+x_i))}{36\beta(1-(x_i+x_j+k_i+k_j))}, \; i,j = L,R \text{ and } i \neq j. \tag{50}$$

SOC for customization:

$$\frac{d^2\Pi_i}{dk_i^2} = \frac{3\alpha^2(k_j+x_j+1)-4\beta t(1-(x_i+x_j+k_i+k_j))(3-(k_j+x_j)+(x_i+k_i))(1-(k_j+x_j)+2(k_i+x_i))}{36\beta(1-(x_i+x_j+k_i+k_j))^2} + \frac{1}{2}tk_i - \gamma, \; i,j = L,R \text{ and } i \neq j. \tag{51}$$

Cross SOC:

$$\frac{d^2\Pi}{dx_i^2}\frac{d^2\Pi}{dk_i^2} - \left(\frac{\partial^2 \Pi}{\partial x_i \partial k_i}\right)^2 = (2\gamma - tk_i) \begin{pmatrix} \frac{4\beta t(3-(k_j+x_j)+(k_i+x_i))(1-(k_j+x_j)+2(k_i+x_i))}{72(1-(x_i+x_j+k_i+k_j))\beta} \\ -\frac{3\alpha^2(k_j+x_j+1)}{72(1-(x_i+x_j+k_i+k_j))^2\beta} \end{pmatrix} > 0, \; i,j = L,R \text{ and } i \neq j. \tag{52}$$

Solution: Advertising Game.

$$\begin{aligned} 1)\ k_i &= \tfrac{4\gamma}{t};\ k_j = 0 \\ x_i &= \tfrac{\alpha^2-4\beta(32\gamma-t)+\sqrt{\alpha^4+24t\beta(6t\beta-5\alpha^2)}}{32\beta t} \\ x_j &= \tfrac{4t\beta+\alpha^2+\sqrt{\alpha^4+24t\beta(6t\beta-5\alpha^2)}}{32\beta t},\ i,j = L,R \text{ and } i \neq j, \end{aligned}$$

$$\begin{aligned} 2)\ k_i &= 0 \\ x_i &= \tfrac{4t\beta+\alpha^2+\sqrt{\alpha^4+24t\beta(6t\beta-5\alpha^2)}}{32\beta t},\ i = L,R, \end{aligned}$$

$$\begin{aligned} 3)\ k_i &= \tfrac{4\gamma}{t} \\ x_i &= \tfrac{\alpha^2-4\beta(32\gamma-t)+\sqrt{\alpha^4+24t\beta(6t\beta-5\alpha^2)}}{32\beta t},\ i = L,R, \end{aligned}$$

$$\begin{aligned} 4)\ k_i &= 0;\ k_j = \tfrac{4\gamma}{t} \\ x_i &= \tfrac{4t\beta+\alpha^2+\sqrt{\alpha^4+24t\beta(6t\beta-5\alpha^2)}}{32\beta t} \\ x_j &= \tfrac{\alpha^2-4\beta(32\gamma-t)+\sqrt{\alpha^4+24t\beta(6t\beta-5\alpha^2)}}{32\beta t},\ i,j = L,R \text{ and } i \neq j. \end{aligned} \tag{53}$$

All solutions satisfy the SOC for prices, advertising and location. However, only solution (3) satisfies the Cross SOC. In turn, the SOC for customization for solution (3) is:

$$\frac{d^2\Pi_i}{dk_i^2} = \frac{\alpha^4(t+2\gamma)+8\beta t\left(\alpha^2(t-18\gamma)+6\beta t(6\gamma-t)\right)+\left(\alpha^2(t+2\gamma)+4\beta t(t-6\gamma)\right)\sqrt{\alpha^4+24t\beta(6t\beta-5\alpha^2)}}{2\left(\alpha^4+72\beta t(2t\beta-\alpha^2)+(\alpha^2-12t\beta)\sqrt{\alpha^4+24t\beta(6t\beta-5\alpha^2)}\right)} < 0,\ i = L,R. \tag{54}$$

It can be easily checked that the denominator is always negative. Then, the SOC is only satisfied if the numerator is also negative. The numerator has two solutions: $\beta_1 = 0$ and $\beta_2 = -\frac{\alpha^2(t+2\gamma)}{6(2\gamma-t)(6\gamma-t)}$. Also, the second derivative of the numerator in relation to β, equals $-1536\alpha^4t^2\,(2\gamma-t)\,(6\gamma-t)$.

Three cases can arise. First, if $t < 2\gamma$, $\beta_2 = -\frac{\alpha^2(t+2\gamma)}{6(2\gamma-t)(6\gamma-t)} < 0$, and $-1536\alpha^4 t^2 (2\gamma - t)(6\gamma - t) < 0$ (concave inverse-U shaped). The SOC for customization is then satisfied for $\beta > 0$. Second, if $2\gamma < t < 6\gamma$, $\beta_2 = -\frac{\alpha^2(t+2\gamma)}{6(2\gamma-t)(6\gamma-t)} > 0$, and $-1536\alpha^4 t^2 (2\gamma - t)(6\gamma - t) > 0$ (convex U shaped). Therefore, the SOC for customization is satisfied for $0 < \beta < -\frac{\alpha^2(t+2\gamma)}{6(2\gamma-t)(6\gamma-t)}$. Third, if $t > 6\gamma$, $\beta_2 = -\frac{\alpha^2(t+2\gamma)}{6(2\gamma-t)(6\gamma-t)} < 0$, and $-1536\alpha^4 t^2 (2\gamma - t)(6\gamma - t) < 0$ (concave inverse-U shaped). As a consequence, the SOC for customization is satisfied for $\beta > 0$. Summing up, the advertising game holds: (1) if $t < 2\gamma$ and/or $t > 6\gamma$ and $\beta > 0$; (2) if $2\gamma < t < 6\gamma$ and $0 < \beta < -\frac{\alpha^2(t+2\gamma)}{6(2\gamma-t)(6\gamma-t)}$.

Advertising Game: Sign of x_i. The numerator of x_i has two solutions $\beta_1^{'} = 0$ and $\beta_2^{'} = \frac{\alpha^2(2\gamma-t)}{(t+16\gamma)(8\gamma-t)}$. Also the second derivative of the numerator in relation to β equals: $-256(8\gamma - t)(t + 16\gamma)$. Then three cases arise. First, if $t < 2\gamma$, $\beta_2^{'} = \frac{\alpha^2(2\gamma-t)}{(t+16\gamma)(8\gamma-t)} > 0$ and $-256(8\gamma - t)(t + 16\gamma) < 0$ (concave inverse-U shaped). Therefore: $x_i > 0$ for $0 < \beta < \frac{\alpha^2(2\gamma-t)}{(t+16\gamma)(8\gamma-t)}$ and $x_i < 0$ for $\beta > \frac{\alpha^2(2\gamma-t)}{(t+16\gamma)(8\gamma-t)}$. Second, if $2\gamma < t < 8\gamma$, $\beta_2^{'} = \frac{\alpha^2(2\gamma-t)}{(t+16\gamma)(8\gamma-t)} < 0$ and $-256(8\gamma - t)(t + 16\gamma) < 0$ (concave inverse-U shaped). We then have $x_i < 0$ for $\beta > 0$. Third, if $t > 8\gamma$, $\beta_2^{'} = \frac{\alpha^2(2\gamma-t)}{(t+16\gamma)(8\gamma-t)} > 0$ and $-256(8\gamma - t)(t + 16\gamma) > 0$ (convex U shaped). As such, $x_i < 0$ for $0 < \beta < \frac{\alpha^2(2\gamma-t)}{(t+16\gamma)(8\gamma-t)}$ and $x_i > 0$ for $\beta > \frac{\alpha^2(2\gamma-t)}{(t+16\gamma)(8\gamma-t)}$.

Summing up, from equation 38, the sign of x_i has three cases. First, if $t < 2\gamma$, $x_i > 0$ for $0 < \beta < \frac{\alpha^2(2\gamma-t)}{(t+16\gamma)(8\gamma-t)}$; $x_i < 0 \Rightarrow x_i = 0$ for $\beta > \frac{\alpha^2(2\gamma-t)}{(t+16\gamma)(8\gamma-t)}$; and $x_i = 0$ for $\beta = \frac{\alpha^2(2\gamma-t)}{(t+16\gamma)(8\gamma-t)}$. Second, if $2\gamma < t < 8\gamma$, $x_i < 0 \Rightarrow x_i = 0$ for $\beta > 0$. Third, if $t > 8\gamma$, $x_i < 0 \Rightarrow x_i = 0$ for $0 < \beta < \frac{\alpha^2(2\gamma-t)}{(t+16\gamma)(8\gamma-t)}$; $x_i > 0$ for $\beta > \frac{\alpha^2(2\gamma-t)}{(t+16\gamma)(8\gamma-t)}$; and $x_i = 0$ for $\beta = \frac{\alpha^2(2\gamma-t)}{(t+16\gamma)(8\gamma-t)}$.

The central issue with regard to the sign of x_i is that $x_i \in [0, 1]$. However, as we have seen x_i can either be negative or positive. Then when $x_i < 0$, we have to make $x_i = 0$. The problem with this is that the SOC for prices only assures that the customized segments of the two news firms never intercept (i.e.: $x_i + x_j + k_i + k_j < 1$, $i, j = L, R$ and $i \neq j$) when x_i equals the value in equation 38, but not when it follows $x_i = 0$, since x_i is negative (i.e.: if we could have $x_i < 0$, the previous issue would not arise). In this sense, for $x_i < 0 \Rightarrow x_i = 0$, the SOC for prices is not sufficient to assure that the

two customized segments do not overlap and therefore we need to introduce an extra condition to satisfy this restriction. It can be shown that with $x_i < 0 \Rightarrow x_i = 0$, $k_i < \frac{1}{2}$ only for $t > 8\gamma$. This together with the above, it results that only the third solution above can be considered in the advertising game.

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