Media Plurality: Private versus Mixed Duopolies

Armando J. Garcia Pires *

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Abstract

In this paper, we analyze the effects on media plurality of competition between a private news firm that maximize profits and a publicly owned news firms that maximizes social welfare. News firms decide on media plurality in terms of the level of adaption of news to readers' political preferences. We show that the difference between the private duopoly and the mixed duopoly market structure holds on the relation between the costs to adapt news to readers' political preferences and the intensity of the readers' political preferences. When the costs to adapt news to readers' political preferences are high relatively to the intensity of the readers' political preferences, in the mixed duopoly, profits in the industry are lower, but prices, media plurality, consumer surplus, and social welfare are higher than in the private duopoly case. The contrary occurs when the costs to adapt news to readers' political preferences are low relatively to the intensity of the readers' political preferences. In this way, when the costs to adapt news to readers' political preferences are low relatively to the intensity of the readers' political preferences, a mixed duopoly achieves "regulation by participation" in terms of media plurality.

Keywords: Media Plurality, Media Firms, Private Duopoly, Mixed Duopoly.

JEL Classification: H42, L13, L82.

*Institute for Research in Economics and Business Administration (SNF), Norwegian School of Economics (NHH), Helleveien 30, 5045 Bergen, Norway. Tel: +(47)55959622, Fax: +(47)55959439; E-mail: armando.pires@snf.no.

1 Introduction

Media plurality refers to the diversity of political opinions with voice in the news market. Many ascertain that media plurality increases social welfare, since it satisfies readers' diverse political preferences in the market and it promotes democracy (see Coase, 1974; Downs, 1957; Hayek, 1945; and Mill, 1859). However, some fear that news markets with only private actors cannot guarantee media plurality, since private actors follow mostly profits motives (Herman and Chomsky, 1998). This can be so mainly for two reasons. First, the provision of media plurality can increase the costs of news firms due to the extra costs to gather information and to adapt news to the readers' political preferences. Second, the provision of media plurality can imply that news firms have to focus in non-mainstream political opinions that generate less demand and therefore revenues.

Due to this, some defend that governments can try to solve this market failure with the introduction of publicly owned news firms that have as objective to maximize social welfare and that compete directly with private news firms that maximize profits. Markets characterized by the presence of both public firms and private firms are usually called mixed oligopolies. The idea behind mixed oligopolies in the news market is that by maximizing social welfare, publicly owned news firms could balance the news market between the need to generate profits and to provide media plurality. In particular, the role of the publicly owned news firms would be to influence the behavior of privately owned news firms in terms of media plurality. If the presence of a public news firm promotes media plurality, then according to the literature on mixed oligopolies, we would say that the mixed oligopoly has achieved "regulation by participation" (see Harris and Wiens, 1980; Vickers and Yarrow, 1988; Bös, 1991; Cremer et al., 1989; De Fraja and Delbono, 1990; Estrin and de Meza, 1995; and Matsumura, 1998).

In fact, the literature on mixed oligopolies starts from the premise that when private actors do not provide the market with some socially desirable good (as for instances media plurality), governments have two options. The first option is to introduce a regulatory body that regulates and controls industry behavior in terms of this good. The second option is to introduce a publicly owned firm that produces this good and that competes directly with private firms. In the news market, the media industry tends to oppose fiercely the first option, since one of the founding principles of journalism is independence, and an external regulator in some cases would have to inter-

vene directly in the editorial decisions of a newspaper. See for instance the debate in England about the phone-hacking scandal (The Economist, 2012). However, mixed oligopolies in the news market are a very widespread across many countries (see BBC in England, for example).

In this paper, we study the proposition that markets with public owned news firms can contribute to the increase of media plurality.[1] In particular, we analyze the effects on media plurality of competition between a private news firm that maximizes profits and a publicly owned news firm that maximizes social welfare, when news firms can adapt news to readers' political preferences.

In order to do this, we use the standard modeling strategy of the media plurality literature, the Hotelling (1929) model (see Kaitatzi-Whitlock, 1996; Gabszewicz et al., 2001, 2002; and Roger 2009).[2] In this sense, we represent the news firms' political orientation and readers' political preferences on the Hotelling (1929) line. Readers subscribe to an ideal-political ideology and they experience disutility when consuming news, which do not conform to their political views.

We differ from this literature in two ways. First, we introduce the possibility of news firms to adapt news to readers' political preferences. Media firms can choose between a single-ideology strategy (i.e., a point on the Hotelling line), or a multi-ideology strategy by adapting news to readers' political preferences (i.e., a line segment). In order to model this, we follow the product adaptation set-up for consumer markets by Dewan et al. (2003), and Alexan-

[1] Public owned news firms can arguably also be more prone to political pressure. We are therefore implicitly assuming that publicly owned news firms are only restricted to maximize welfare (news firms' profits plus consumer surplus), but apart from this they have all freedom to choose editorial political orientations. The empirical evidence shows that there are some examples of independent publicly owned news firms, like BBC, but also of public owned news firms in countries like Russia that are captured by the government (see Djankov et al., 2003).

[2] In this way, we follow the literature in media plurality. This literature tries to disentangle what can affect the level of media plurality in a market. Some of the factors that influence media plurality are the following: the concentration of the media industry (Kaitatzi-Whitlock, 1996; and George, 2007 and Roger, 2009); advertising (Gabszewicz et al., 2001, 2002; Argentesi and Filistrucchi, 2007; Ellman and Germano, 2009; and Affeldt et al., 2013); the diversity of readers' political preferences (Garcia Pires, 2013); market structure (Steiner, 1952; George and Waldfogel, 2003; and George and Oberholzer-Gee, 2011); subsidies (Lerocha and Wellbrock, 2011); party political competition (Noam, 1987; and Schulz and Weimann, 1989); and technology (Gentzkow, 2007; and George and Hogendorn, 2012).

drov (2008). In particular, when a news firm decides to adapt products it has to weight the costs of adaptation (i.e., adapting news products to readers' political preferences) with the benefits (i.e., extra demand).

Second, we consider two different market structures: a private duopoly, with only privately owned news firms that maximize profits; and a mixed duopoly, with a private news firm that maximizes profits and a publicly owned news firm that maximizes social welfare (profits of the private and the public news firms and consumer surplus).

In this set up, we show that the difference between the private duopoly and the mixed duopoly holds on the relation between the costs to adapt news to readers' political preferences and the intensity of the readers' political preferences. When the costs to adapt news to readers' political preferences are high relatively to the intensity of the readers political preferences, profits in the industry are lower, but prices, media plurality, consumer surplus, and social welfare are higher. The contrary occurs when the costs to adapt news to readers' political preferences are low relatively to the intensity of the readers' political preferences.

The rationale for this result is the following. When the costs to adapt news to readers' political preferences are high relatively to the intensity of the readers political preferences, news firms in the private duopoly case reduce media plurality (reducing consumer surplus) in order to restrain price competition (increasing profits). In the mixed duopoly, the public news firm increases media plurality (to increase consumer surplus) even at the costs of fiercer price competition (that decreases profits), given that the objective of the public news firm is to maximize social welfare, and not only profits. However, the positive effects of media plurality on consumer surplus dominate the negative effects of higher prices on profits. In this way, when the costs to adapt news to readers' political preferences are high relatively to the intensity of the readers' political preferences, a publicly owned news firm can achieve "regulation by participation."

We organize the rest of the paper as follows. In the next section, we present the base model of media plurality. In section three, we analyze the private duopoly case. In section four, we look to the mixed duopoly case. In section five, we compare the private duopoly case with the mixed duopoly case. In section six, we analyze some extensions of the model. In section seven, we discuss our main results.

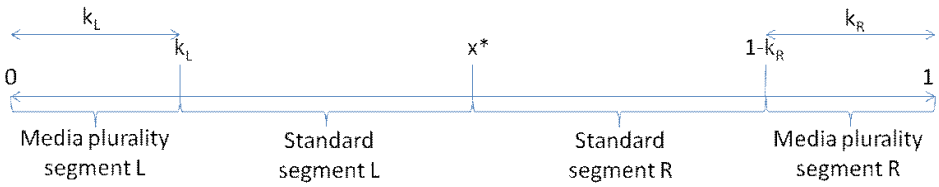
2 The Model

In this paper, we study the effects on media plurality of the participation of publicly owned news firms in media markets with private actors. In order to do this, we adopt the standard model in the media plurality literature, the Hotelling (1929) duopoly model. In this sense, the political preferences of readers are distributed on the Hotelling line (see figure 1). See for instance Kaitatzi-Whitlock (1996), Gabszewicz et al. (2001, 2002), and Roger (2009).[3] To the Hotelling model, we add the standard assumption of the mixed duopoly literature. In particular, we assume that while private news firms maximizes profits, publicly owned news firms maximize social welfare, measured as the sum of consumer surplus and the profits of the news firms in the media market (private plus public). See Harris and Wiens (1980), Vickers and Yarrow (1988), Bös (1991), Cremer et al. (1989), De Fraja and Delbono (1990), Estrin and de Meza (1995), and Matsumura (1998). We then consider two cases: (1) a private duopoly where both news firms are privately owned and maximize profits; and (2) a mixed duopoly with a privately owned news firm that maximizes profits and a public owned news firm that maximizes social welfare.

We differ from the standard media plurality approach of Gabszewicz et al. (2001) in one important way. With the aim of studying the effects of mixed duopolies (i.e., markets with both private and public news firms) on media plurality, we depart from the single-ideology media firms' framework, by considering multi-ideology media firms. In other words, media firms can choose between a single-ideology and a multi-ideology strategy. Single-ideology news firms only cover a point on the line, while multi-ideology news firms cover a line segment (see figure 1).

To model multi-ideology media firms (i.e., adaptation of news to readers' political preferences), we follow the approach by Alexandrov (2008), and De-

[3]The media plurality literature relates with the literature on 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 Groseclose and Milyo, 2005; Mullainathan and Shleifer, 2005; Baron, 2006; Gentzkow and Shapiro, 2006; Reuter and Zitzewitz, 2006; DellaVigna and Kaplan, 2007; Ellman and Germano, 2009; Stone, 2011; Durante and Knight, 2012; and Germano and Meier, 2013). Higher media plurality can conduce to lower media bias, since the news market covers more political opinions. However, higher media plurality do not necessarily always leads to lower media bias, since even when many opinions are covered in the media market the truth might still not emerge (see Gentzkow and Shapiro, 2008; and Gentzkow et al., 2012).



Note: Newspapers L and R are located at points 0 and 1, respectively. Reader x^* is indifferent between buying from L or R. Point k_L is the end point of the set of political opinions offered by L. If k_L=0, L only offers political opinion 0 and all readers between [0,x^*] consume 0. If k_L>0, L offers the set of political opinions [0,k_L]. In this case, readers located in [0,k_L] consume the political opinion that they prefer, while readers in [k_L,x^*] consume k_L. Similar interpretation holds for R.

Figure 1: Media plurality: L located at 0 and R at 1

wan et al. (2003) to customization and fat products in consumer markets, respectively. Customization and fat products are related but not identical concepts. With customization, a firm adapts a standard product and transforms it in several customized products, which consumers can acquire at an additional price. With fat products, a firm offers only one product that contains a set of characteristics amongst which consumers can choose, without being charged extra for this.[4] Then, under customization, and contrary to fat products, price discrimination is central. In the case of media markets, it seems more adequate to think in terms of fat products than customization, since a newspaper is always just one product and price discrimination, in spite of some attempts, is not the standard business practice in the industry. For this reason, price discrimination is not present in our formalization.

Readers' Preferences. As in Hotelling (1929), readers are uniformly distributed on a line of length one: $[0, 1]$. The line represents political orientation (see figure 1). The different political orientations are ordered from left to right: 0 equals far left and 1 represents far right. We define t as the inten-

[4] An example of customization is Dell, where consumers can choose between different components of a computer but at a different price. An example of a fat product is a TV set that can be adjusted for brightness, focus and color and so forth. In other words, fat products can be defined as access products. When consumers pay to access a given product, they can choose amongst what is offered inside. In this way, in the context of the news market, we talk about fat news when the same media outlet caters to different political opinions, and each reader can pick what they prefer more.

sity of the readers' political preferences (i.e., transport costs in Hotelling). Readers patronize only one media outlet (i.e., readers have unit demands)[5]. In this way, readers have an ideal-political opinion and they incur a disutility cost from buying a newspaper with a different political orientation from their ideal one.

The location of a media firm on the line represents the political orientation(s) covered by the news firm. The two news firms are labeled as $i = L, R$. We assume that newspaper L is left oriented and newspaper R is right oriented and that the two media firms are located at the opposite extremes of the line: news firm L is located at point $x_L = 0$ and news firm R is located at point $1 - x_R = 1$ (see figure 1)[6].

To our knowledge, with the exception of Garcia Pires (2013), the models that use the Hotelling framework to study media plurality assume that media firms can only supply the media market with one political opinion, x_i, with $i = L, R$ (i.e., single-ideology media firms). In this sense, media firms sell the same political view to different readers. We differ from this approach by opening up for media firms to adapt news to readers' political preferences. In particular, in our set-up news firms can become multi-ideology news firms by covering different political locations.

To model multi-ideology media firms, we adapt for media markets the approach by Dewan et al. (2003), and Alexandrov (2008) for fat products and customization in consumer markets, respectively. In particular, we denote by k_i the media firm's media plurality scope, which equals the length of the Hotelling line covered, $0 \leq k_i \leq 1$, 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 ($x_L = x_R = 0$),

[5] According to the Pew Project for Excellence in Journalism (2010), readers do not read many newspapers and in particular, they tend not to read newspapers from opposite political areas from their preferred political area.

[6] In this way, we follow the literature in media economics in that media outlets only give voice to one political area, i.e.: a media outlet does not provide two opposite political ideas. This can be so for at least three reasons. First, newspaper owners might prefer a given political ideology. For instance, all newspapers and TV channels belonging to Rupert Murdoch (the News Inc. group) move in the conservative area. Second, it can be very costly for a newspaper to report in opposite political areas, given that investigative journalism is expensive. The idea is that a newspaper to report in two different political areas has very little economies of scope. Third, a newspaper that reports in opposite political ideologies can lose credibility amongst readers. In fact, readers seem to be very sensitive about news biased to the opposite political that they support.

while a multi-ideology orientation corresponds to a line segment ($[0, k_L]$ and $[1 - k_R, 1]$)[7].

With a single-ideology strategy, a media firm only reports one political orientation and therefore it offers a standard news to readers with different political orientations. In turn, with a multi-ideology strategy, a media firm covers different political ideologies and as such it offers adapted news to readers located inside the news firm's media plurality segment, and standard news to readers outside the news firms' media plurality segment (see figure 1). In other words, readers located inside the media plurality segment of a news firm consume news reflecting exactly the political orientation that they subscribe to, while readers located outside the media plurality segment consume news that are closest to their ideal-opinion. Below we present the specific technology available to media firms to adapt news to readers' political preferences.

In this sense, the utility of a reader x located in the left hand side segment of the line outside the media plurality segment of news firm L is:

$$U = v - p_L - t\left(x - k_L\right), \tag{1}$$

where k_L is the end point of the media plurality segment of news firm L, v is a positive constant that captures readers' reservation price, t is the intensity of the readers' political preferences and p_L is the price charged by news firm L. A similar expression applies for a reader x' located in the right hand side segment of the line outside the media plurality segment of news firm R. Note then that a higher t represents that readers have higher disutility from consuming news that do not conform with their political preferences. Note also that if reader x is located inside the multi-ideology segment of news firm L, the reader's utility is: $U = v - p_L$, since $t = 0$ (i.e., the reader's ideal opinion is offered).

Like in Dewan (2003), we assume that in order to provide media plurality, news firms have to incur an adaptation cost (C) that equals:

[7]We therefore assume that a newspaper does not adapt news away from where they are politically located. The reasons for this to be the case can be the same as the ones mentioned in the previous footnote in relation to a newspaper supporting more than one political ideology. In addition, note that in the context of the Hotelling model when firms move in the direction of the line they increase price competition. Consequently, for a news outlet is always preferable to adapt from their political location than away from it because the effects on price competition are smaller.

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

where γ represents the informational and flexibility costs to adapt news to the readers' political preferences. In this sense, the adaptation costs increase with the level of media plurality offered. Also the higher the informational and flexibility costs to adapt news to the readers' political preferences (γ) more costly becomes for news firms to provide different political opinions for the news market.

Profits for news firm i are then:

$$\pi_i = p_i D_i - C_i,\ i = L, R, \tag{3}$$

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

We define consumer surplus (CS) as:

$$CS = (v - p_L)\, x^* - t \int_{k_L}^{x^*} (x - k_L)\, dx + (v - p_R)\,(1 - x^*) - t \int_{x^*}^{1-k_R} ((1 - x) - k_R)\, dx. \tag{4}$$

In turn, we measure social welfare (W) as the sum of the two news firms' profits ($\pi_L + \pi_R$) and consumer surplus (CS):

$$W = \pi_L + \pi_R + CS. \tag{5}$$

The reader who is indifferent between buying from news firm L and news firm R, x^*, is the one that makes:

$$v - p_L - t\,(x^* - k_L) = v - p_R - t\,(1 - k_R - x^*)\,. \tag{6}$$

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

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

Consumer surplus then simplifies to:

$$CS = \frac{(p_R - p_L)^2 - t\left(t(k_L + k_R - 1)^2 + 2(p_L - 2v + p_R + (p_R - p_L)(k_R - k_L))\right)}{4t}. \tag{8}$$

3 Private Duopoly

We now analyze the case of two private editorial outlets, $i = L, R$, which are located at point 0 and point 1, respectively, and that maximize profits. As usual, we solve the model by backward induction.

Stage 2: Prices. In the second stage, news firms choose prices p_i, with $i = L, R$. Prices are found by maximizing the profit expression (equation 3) with respect to p_i. The FOC for prices equals:

$$\frac{\partial \pi_i}{\partial p_i} = \frac{(t(k_i - k_j + 1) + (p_j - 2p_i))}{2t},\ i, j = L, R \text{ and } i \neq j. \tag{9}$$

The SOC for prices in the duopoly case is then always satisfied since $\frac{d^2\pi_i}{dp_i^2} = -\frac{1}{t} < 0$, $i = L, R$.

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

$$p_i = \frac{t(k_i - k_j + 3)}{3},\ i, j = L, R \text{ and } i \neq j. \tag{10}$$

Stage 1: Media Plurality. In the first stage, news firms choose media plurality levels k_i, with $i = L, R$. The FOC for media plurality equals:

$$\frac{\partial \pi_i}{\partial k_i} = \frac{1}{3} p_i - \gamma k_i, i, j = L, R \text{ and } i \neq j. \tag{11}$$

From here we can derive the SOC for media plurality: $\frac{d^2\pi_i}{dk_i^2} = -\gamma < 0$, $i = L, R$. Hence, the SOC for media plurality is always satisfied.

We can simplify the FOC for media plurality (equation 11) by substituting for p_i from equation 10:

$$\frac{d\pi_i}{dk_i} = \frac{t(3 - k_j + k_i)}{9} - \gamma k_i,\ i, j = L, R \text{ and } i \neq j. \tag{12}$$

Solving $\frac{d\pi_i}{dk_i}$ and $\frac{d\pi_j}{dk_j}$ simultaneously for k_i and k_j (with $i, j = L, R$ and $i \neq j$), we obtain the equilibrium media plurality levels:

$$k_i = \frac{t}{3\gamma} > 0,\ i = L, R. \tag{13}$$

To derive equilibrium prices substitute for k_i ($i = L, R$) from equation 13 in equation 10:

$$p_i = t,\ i = L, R. \tag{14}$$

The price of the standard product in a private duopoly with exogenous choice of location equals then the level of intensity of the readers' political preferences. More interesting, the duopolists always choose positive levels of media plurality (see equation 13). Furthermore, media plurality increases with the intensity of the readers' political preferences (t), but decreases with the informational and flexibility costs to adapt to the readers' political preferences (γ). We can also note that given the prices in equation 14 and media plurality levels in equation 13, then the demand levels D_i are always positive, since $D_i = \frac{1}{2}$, with $i = L, R$ (i.e., the news firms divide the news market in half).

We have, however, to assure that the media plurality segments do not overlap. It can be shown that $k_i \leq D_i = \frac{1}{2}$ $(i = L, R)$ for $\gamma \geq \frac{2t}{3}$. In this sense, for $\gamma = \frac{2t}{3}$ all possible political opinions in the line are covered, since then $k_i = \frac{1}{2}$ $(i = L, R)$. This is the case when the costs of media plurality are not too large relatively to the intensity of the readers' political preferences.

We can show that in the private duopoly model, profits equal:

$$\pi_L = \pi_R = \tfrac{(9\gamma - t)t}{18\gamma}. \tag{15}$$

We can see that $\pi_L = \pi_R > 0$ for $\gamma \geq \frac{t}{9}$. Since, the private duopoly model holds for $\gamma \geq \frac{2t}{3}$, then profits are always positive.

In turn, consumer surplus is:

$$CS = v + \tfrac{\left(t\left(4t(3\gamma - t) - 45\gamma^2\right)\right)}{36\gamma^2}. \tag{16}$$

And, social welfare:

$$W = v + \tfrac{t\left(\gamma(8t - 9\gamma) - 4t^2\right)}{36\gamma^2}. \tag{17}$$

4 Mixed Duopoly

In this section, we assume that news firm L is a publicly owned news firm that maximizes social welfare, while news firm R is a private news firm that maximizes profits. We continue to assume that the two editorial outlets, L and R are located at point 0 and point 1, respectively. Given the symmetry of the model, the results are the same if the publicly owned news firm is located at point 1 in the Hotelling line.

Stage 2: Prices. In the second stage, news firms choose prices p_i, with $i = L, R$. For news firm R, the privately owned news firm, prices are obtained by maximizing the profit expression (equation 3) with respect to p_i. It is straightforward to check that the FOC for prices for news firm R is the same as in the private duopoly case (equation 9).

For news firm L, the public owned news firm, the FOC is found by substituting D_L from equation 7 in the social welfare function (equation 5). It results:

$$\frac{\partial W_L}{\partial p_L} = \frac{(p_R - p_L)}{2t}. \tag{18}$$

The SOC for prices for the news firm L is always satisfied since it equals $\frac{d^2 W_L}{dp_L^2} = -\frac{1}{2t} < 0$.

Solving $\frac{\partial W_L}{\partial p_L}$ and $\frac{d\pi_R}{dp_R}$ simultaneously for p_L and p_R, we obtain:

$$p_L = p_R = t\left(k_R - k_L + 1\right). \tag{19}$$

Stage 1: Media Plurality. In the first stage, news firms choose media plurality levels k_i, with $i = L, R$. The FOC for media plurality for the private news firm is the same as in the private duopoly case (equation 11). We can then simplify the FOC for media plurality for the privately owned news firm (equation 11) by substituting for p_R from equation 19:

$$\frac{d\pi_R}{dk_R} = \frac{1}{3}\left(t\left(k_R - k_L + 1\right)\right) - \gamma k_R. \tag{20}$$

In turn, for the publicly owned news firm, after substituting for p_L and p_R from equation 19, we have that the FOC for media plurality equals:

$$\frac{dW_L}{dk_L} = \frac{1}{2}\left(t\left(1 - \left(k_L + k_R\right)\right) - 2\gamma k_L\right). \tag{21}$$

The SOC for media plurality for the news firm L is $\frac{d^2 W_L}{dk_L^2} = -\frac{(t+2\gamma)}{2} < 0$. Then, the SOC for media plurality for news firm L is always satisfied.

Solving $\frac{d\pi_L}{dk_L}$ and $\frac{d\pi_R}{dk_R}$ simultaneously for k_L and k_R, we obtain the equilibrium levels of media plurality level:

$$\begin{aligned} k_L &= \frac{(3\gamma - 2t)t}{(2t+3\gamma)(2\gamma - t)} \\ k_R &= \frac{2\gamma t}{(2t+3\gamma)(2\gamma - t)}. \end{aligned} \tag{22}$$

We can derive equilibrium prices by substituting for k_i $(i = L, R)$ from equation 22 in equation 19:

$$p_L = p_R = \frac{6\gamma^2 t}{(2t+3\gamma)(2\gamma-t)}. \tag{23}$$

From equations 22 and 23, we obtain the demand levels for news firm L and news firm R:

$$\begin{aligned} D_L &= \frac{(t+\gamma)(3\gamma-2t)}{(2t+3\gamma)(2\gamma-t)} \\ D_R &= 1 - \frac{(t+\gamma)(3\gamma-2t)}{(2t+3\gamma)(2\gamma-t)}. \end{aligned} \tag{24}$$

We need to restrict demand levels to be positive, otherwise, there is no demand for news. We can see that D_L and D_R are positive for:

$$\gamma \geq \frac{2t}{3}. \tag{25}$$

We assume that this condition holds in the rest of the paper.

Next, we would also like to know the relation between k_L and k_R:

$$k_L - k_R = \frac{(\gamma-2t)t}{(2t+3\gamma)(2\gamma-t)}. \tag{26}$$

It can be shown that $k_L > k_R$ for $\gamma > 2t$. Then the publicly owned news firm only provides more media plurality than the privately owned news firm when the costs of adapting news are high in relation to the intensity of readers' political preferences. The contrary occurs when the costs of adapting news to readers' political preferences are low in relation to the intensity of readers' political preferences.

The reason for this is the following. When γ is low in relation to t, the private news firm has no difficulties to provide media plurality without affecting profits greatly, since the costs of adapting news are relatively low. Therefore the public owned news firm can reduce the level of media plurality it provides to reduce price competition. In fact, we know from the Hotelling model that as news firms approach the center of the line price competition becomes fiercer. In turn, when γ is high in relation to t, the privately owned news firm reduces the level of media plurality, since now adaptation of news is relatively more costly. Due to this, the publicly owned news firm increases the level of media plurality in order not to reduce consumer surplus. In other words, the public owned news firms only "intervenes" in media plurality when

the private news firm reduces the levels of media plurality it provides. This is the case when the costs to adapt news are larger relatively to the readers' intensity of political preferences.

As in the private duopoly case, we have also to guarantee that the media plurality segments of L and R do not overlap. Since the publicly owned news firm and the privately owned news firm provide different levels of media plurality (see equation 22), now we need two conditions for the two media plurality segments of the news firms do not overlap: $k_L \leq D_L$ and $1 - k_R \geq D_L$. We can show that these two conditions are satisfied if $\gamma \geq \frac{2t}{3}$. This is the same condition needed to guarantee that demand levels are positive, which we assume is always satisfied. Then the two media plurality segments never overlap in the mixed duopoly case.

Having prices and media plurality levels, we can show that profits of the two news firms equal:

$$\begin{aligned} \pi_L &= \frac{\left(9t\gamma+2t^2+12\gamma^2\right)(3\gamma-2t)t\gamma}{2(2t+3\gamma)^2(2\gamma-t)^2} \\ \pi_R &= \frac{2(9\gamma-t)t\gamma^3}{(2t+3\gamma)^2(2\gamma-t)^2}. \end{aligned} \tag{27}$$

Since $\gamma \geq \frac{2t}{3}$, it can be easily shown that π_L and π_R are positive.

In turn, consumer surplus simplifies to:

$$CS = v + \frac{\gamma^2 t\left(2t(4t+3\gamma)-45\gamma^2\right)}{(2t+3\gamma)^2(2\gamma-t)^2}. \tag{28}$$

From here, we can also derive social welfare:

$$W = v + \frac{\gamma t\left(\gamma t(4t+11\gamma)-2\left(2t^3+9\gamma^3\right)\right)}{2(2t+3\gamma)^2(2\gamma-t)^2}. \tag{29}$$

5 Private Duopoly versus Mixed Duopoly

In this section, we compare the equilibriums of the private duopoly and the mixed duopoly cases, in terms of prices, media plurality, consumer surplus, and social welfare.

We can start to see that the difference between prices in the private duopoly case and the mixed duopoly case is:

$$\Delta p = p_{MD} - p_{PD} = -\frac{(\gamma-2t)t^2}{(2t+3\gamma)(2\gamma-t)}, \tag{30}$$

where the subscripts PD and MD stand for private duopoly case and mixed duopoly case. Given that we assume that $\gamma \geq \frac{2t}{3}$, it results that $p_{MD} < p_{PD}$ for $\frac{2t}{3} < \gamma < 2t$ and $p_{MD} > p_{PD}$ for $\gamma > 2t$. We then have that only when the costs of adapting news to readers' political preferences (γ) is low in relation to the intensity of readers' political preferences (t), prices are lower in the mixed duopoly case in comparison with the private duopoly case. The contrary occurs for high γ in relation to t, where prices are higher in the mixed duopoly case. In order to understand this outcome, we need to proceed to compare media plurality in the private and mixed duopoly cases.

We have that the difference between media plurality in the private duopoly case and the mixed duopoly case equals:

$$\Delta K = K_{MD} - K_{PD} = \frac{(3\gamma-2t)(\gamma-2t)t}{3(2t+3\gamma)(2\gamma-t)\gamma}, \tag{31}$$

where $K_{MD} = k_{MD,L} + k_{MD,R}$ and $K_{PD} = k_{PD,L} + k_{PD,R}$. Since $\gamma \geq \frac{2t}{3}$, the sign of this expression depends only on the numerator. The numerator has two solutions, $\frac{2t}{3}$ and $2t$, and is a convex function. Then $K_{MD} < K_{PD}$ for $\frac{2t}{3} < \gamma < 2t$ and $K_{MD} > K_{PD}$ for $\gamma > 2t$. As such, when the costs of adapting news to readers' political preferences (γ) are high relatively to the intensity of readers' political preferences (t), media plurality is higher in the mixed duopoly case in comparison with the private duopoly case. The contrary occurs for low γ in relation to t. Therefore, only for high γ in relation to t, participation in the news market of a publicly owned news firm that maximizes social welfare can achieve "regulation by participation" in terms of media plurality. In other words, for high γ in relation to t, the public news firm can influence the behavior of the private news firm and conduce to higher media plurality than when only privately owned news firms are active in the news market. When this is so, there is also no need for the government to intervene in the industry through a regulator that controls the level of media plurality in the industry.

We can now also understand the behavior of prices in the private and in the mixed duopoly cases. For $\frac{2t}{3} < \gamma < 2t$, prices and media plurality are lower under the mixed duopoly than under the private duopoly case. The contrary occurs for $\gamma > 2t$, where prices and media plurality are higher under the mixed duopoly than under the private duopoly case. This results because when media plurality is higher, price competition is fierce since news firms move in the direction of the center of the line. In other words, news firms have to compete more aggressively on prices for readers since their political

offers are less differentiate.

From the above, when comparing the mixed and the private duopoly cases, we have then two combinations of prices and media plurality. First, lower prices and lower media plurality under the mixed duopoly than under the private duopoly case for $\frac{2t}{3} < \gamma < 2t$. Second, higher prices and higher media plurality under the mixed duopoly than under the private duopoly case for $\gamma > 2t$. Lower prices and lower media plurality has the following effects on consumer surplus and profits. Lower prices increases consumer surplus, but lower media plurality decreases it. The opposite occurs for higher prices and higher media plurality. However, lower prices can either increase or decrease profits, given that from one side it reduces revenues per newspaper sold, but it can also increase demand. In addition, lower media plurality can either increase or decrease profits, since from one side it reduce costs of adapting news to readers' political preferences but from the other side it can reduce demand. The opposite effects on profits arise for higher prices and higher media plurality.

Looking at profits under the two regimes, we have:

$$\Delta\Pi = \Pi_{MD} - \Pi_{PD} = \frac{\left(\gamma\left(2t(19t+12\gamma)-153\gamma^2\right)-4t^3\right)(\gamma-2t)t^2}{18(2t+3\gamma)^2(2\gamma-t)^2\gamma}. \tag{32}$$

The sign of the expression depends only on the numerator. The second term in the numerator, $(\gamma - 2t)$, is positive for $\gamma > 2t$ and negative for $\gamma < 2t$. We can also show that the first term is always negative in the interval, $\gamma \geq \frac{2t}{3}$, where our model is valid[8]. It then results that $\Pi_{MD} > \Pi_{PD}$ for $\gamma < 2t$ and $\Pi_{MD} < \Pi_{PD}$ for $\gamma > 2t$.

We then have that profits under the mixed duopoly case are higher than profits under the private duopoly case when the costs of adapting news to readers' political preferences (γ) are low relatively to the intensity of readers' political preferences (t). This coincides with lower prices and lower media plurality under the mixed duopoly case. Furthermore, this indicates that the lower costs associated with lower levels of media plurality dominate the lower revenues from lower prices, and that the lower demand that results from lower levels of media plurality dominates the higher demand due to lower prices. The opposite arises for high γ relatively to t, where profits are

[8]To see this note that $\left(2t\left(19t+12\gamma\right)-153\gamma^2\right)$ has two solutions, $\frac{t\left(4-\sqrt{662}\right)}{51}$ and $\frac{t\left(4+\sqrt{662}\right)}{51}$, and is a concave function in γ. Since $\frac{2t}{3} > \frac{t\left(4+\sqrt{662}\right)}{51} > \frac{t\left(4-\sqrt{662}\right)}{51}$, the proof follows.

lower but prices and media plurality are higher under the mixed duopoly case. This means that the extra costs associated with higher levels of media plurality dominate the extra revenues from higher prices, and that the extra demand from higher levels of media plurality dominates the lower demand due to higher prices.

In terms of consumer surplus, we have that the difference between consumer surplus under the private duopoly case and the mixed duopoly case is:

$$\Delta CS = CS_{MD} - CS_{PD} = \frac{\left(4t^3(7\gamma-2t)+9\gamma^2\left(\gamma(36\gamma-11t)-6t^2\right)\right)(\gamma-2t)t^2}{36(2t+3\gamma)^2(2\gamma-t)^2\gamma^2}. \quad (33)$$

The sign of the expression only depends on the numerator. The second term in the numerator, $(\gamma - 2t)$, is positive for $\gamma > 2t$ and negative for $\gamma < 2t$. We can also show that the first term is always positive in the interval, $\gamma \geq \frac{2t}{3}$, where our model is valid[9]. It then results that $CS_{MD} < CS_{PD}$ for $\gamma < 2t$ and $CS_{MD} > CS_{PD}$ for $\gamma > 2t$.

We then have that consumer surplus under the mixed duopoly case is higher than the consumer surplus under the private duopoly case when the costs of adapting news to readers' political preferences (γ) are high relatively to the intensity of readers' political preferences (t). This coincides with higher prices and higher media plurality under the mixed duopoly case. In this way, the positive effects of higher media plurality (more readers that consume news that mirror exactly their political preferences) compensate for the negative effects of higher prices. The opposite occurs for high γ relatively to t, where consumer surplus, prices and media plurality are lower under the mixed duopoly case. This means that negative effects of lower media plurality (less political opinions with voice in the news market) dominate the positive effects of lower prices.

In turn, in terms of social welfare (consumer surplus plus news firms' profits), we have that the difference between social welfare under the private duopoly case and the mixed duopoly case is:

$$\Delta W = W_{MD} - W_{PD} = \frac{(\gamma-2t)^2\left(4t^3+\gamma\left(18\gamma^2-t(8t+15\gamma)\right)\right)t^2}{36(2t+3\gamma)^2(2\gamma-t)^2\gamma^2}. \quad (34)$$

[9] To see this note first that $4t^3(7\gamma - 2t)$ is always positive for $\gamma \geq \frac{2t}{3}$. The same occurs with the term $\left(\gamma(36\gamma - 11t) - 6t^2\right)$. In fact, $\left(\gamma(36\gamma - 11t) - 6t^2\right)$ has two solutions, $\frac{t\left(11-\sqrt{985}\right)}{72}$ and $\frac{t\left(11+\sqrt{985}\right)}{72}$, and is a convex function in γ. Since $\frac{2t}{3} > \frac{t\left(11+\sqrt{985}\right)}{72} > \frac{t\left(11-\sqrt{985}\right)}{72}$, the proof follows.

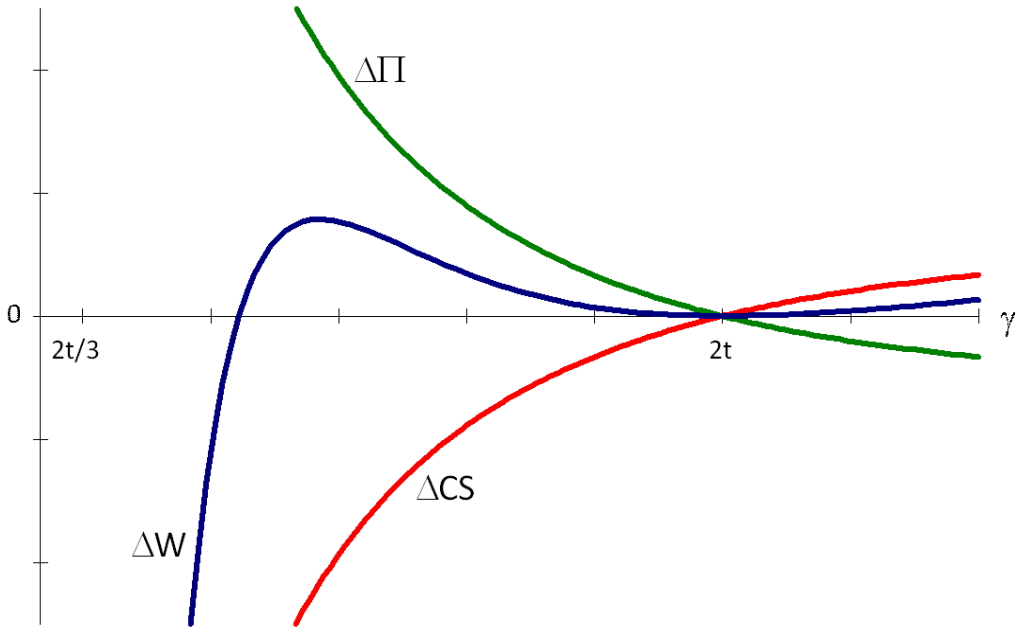


Figure 2: Mixed versus Private Duopoly

We can show that only for $\frac{2}{3}t < \gamma < \frac{\left(5+\sqrt{89}\right)t}{12}$, we have that $W_{MD} - W_{PD}$ is negative[10]. This can be seen more clearly in figure 2 that depicts $\Delta\Pi$, ΔCS and ΔW.

We can then conclude that social welfare is higher under the private duopoly case when the costs of adapting news to readers' political preferences are low relatively to the readers' intensity of political preferences (i.e., low γ in relation to t). In turn, social welfare is higher under the mixed duopoly case when the costs of adapting news to readers' political preferences are high relatively to the readers' intensity of political preferences (i.e., high γ in relation to t). This occurs because when γ is low relatively to t, private firms can profitably provide media plurality. As a result, when γ is low relatively to t, a private duopoly provides more media plurality than a mixed duopoly,

[10]To see this note that all terms in equation 34 are unambiguously positive with the exception of $18\gamma^2 - t\left(8t + 15\gamma\right)$. This term has two solutions, $\frac{\left(5-\sqrt{89}\right)t}{12}$ and $\frac{\left(5+\sqrt{89}\right)t}{12}$. Furthermore, $18\gamma^2 - t\left(8t + 15\gamma\right)$ is a convex function. Note also that our model is valid in the interval $\gamma \geq \frac{2t}{3}$, and that $\frac{\left(5-\sqrt{89}\right)t}{12} < \frac{2t}{3} < \frac{\left(5+\sqrt{89}\right)t}{12}$. Then the proof follows.

which reflects in lower profits in the former relatively to the latter market structure. Accordingly, when γ is low relatively to t, in the mixed duopoly the public firm reduces the level of media plurality in order to increase the profits of the media firms. However, the increase in profits does not compensate for the reduction in consumer surplus.

In this sense, it only seems worthwhile for the government to participate in the news market via a publicly owned news firm, when the costs of adapting news to readers' political preferences are high relatively to the readers' intensity of political preferences. Accordingly, when γ is low relatively to t, private news firms provide sufficient levels of media plurality.

6 Extensions

In the context of our model that are two extensions that are worth discussing. The first one is to analyze the consequences of a public firm with inefficiencies and that is subject to political pressure. The second one is to evaluate what occurs if the public firm gives different weights to own profits, the profits of the rival and consumer surplus.

First, in the model in this paper, the public firm has no inefficiencies. Note that in spite of this, the model generates an area where the private duopoly provides higher social welfare than with mixed duopoly. In other words, even when the public firm is as efficient as the private firm, it is not guaranteed that the presence of a public firm will maximize social welfare. We can still ask, what would happen if the public firm has a higher cost to provide media plurality (higher γ) or is more prone to political pressure. When this is the case, the public firm would find it more costly to provide media plurality. In any case this only strength our result of higher negative social welfare under the public duopoly case than under the mixed duopoly case, when the costs of media plurality are low relatively to the intensity of readers' political preferences.

Second, in the model in this paper, the public firm gives equal weights to all terms in the social welfare function (own profits, profits of the rival private firm and consumer surplus). If the public firm gives more weight to own profits, the mixed duopoly case approaches the private duopoly case. If the public firm gives more weight to the profits of the rival, the incentives to provide media plurality decrease in order to reduce price competition. If the public firm gives more weight to consumer surplus, the incentives to provide

media plurality on the contrary increase. In this way, the provision of media plurality by the public firm will depend on the importance that it attributes to the different terms in the social welfare function. Media plurality will be higher if the public firm prioritizes consumer surplus and lower if it values more the profits of the rival.

7 Discussion

In this paper, we have analyzed the effects on media plurality of competition between a private news firm that maximizes profits and a public news firm that maximizes social welfare (news firms' profits plus consumer surplus).

We show that public news firms can achieve "regulation by participation" in terms of media plurality when the costs of adapting news to readers' political preferences are high relative to the intensity of readers' political preferences. In other words, when the costs of adapting news to readers' political preferences are low relative to the intensity of readers' political preferences, private news firms, even without the presence of public news firms, can provide the level of media plurality that maximizes social welfare.

The relation between the costs of adapting news to readers' political preferences and the intensity of readers' political preference can bring the Internet to the discussion. Some media experts argue that the Internet is changing the way of doing business in the news market, since amongst other things, it is boosting media firms' capacity to adapt news to readers' political preferences and of readers to access more content (Gentzkow, 2007; and George and Hogendorn, 2012). If this is the case, then the Internet is reducing the costs to adapt news to readers' political preferences. However, at same time readers show a stronger attachment to their own preferred ideology (Sunstein, 2006; and Pew Project for Excellence in Journalism, 2010). This indicates that the intensity of readers' political preferences has also increased. It is then not clear, if news market dominated by private news firms have become or not more inclined to provide media plurality. In other words, we cannot dismiss the role of public news firms to "regulation by participation" in terms of media plurality.

The model in this paper assumes a very simplified version of media markets. First, like all standard models of media plurality based on the Hotelling model, the distribution of demand in the line is uniform. If there are peaks of demand in the line (due for example to mainstream political opinions), then

the incentives to provide media plurality can be lower (see Mullainathan and Shleifer, 2005). Second, we have disregard a central aspect of news market, advertising. If advertising is introduced, from one side, news firms might have stronger incentives to provide news that maximize revenues (Gabszewicz et al., 2001), but from other side advertising might provide extra revenues for media firms to finance the adaption of news to readers' political preferences (Garcia Pires, 2013). Third, we have not introduced supply side pressures that reduce media plurality, like interest groups and political parties (Baron, 2006; and Besley and Prat, 2006). When interest groups and political parties capture news firms, media plurality can decrease, since then news firms might end up only publishing the views supported by these groups. However, these effects can be attenuated if there is competition between interest groups and political parties for media capture. Fourth, media outlets in our model have a fixed political location. If media firms can choose political location, the incentives to adapt news to readers' political preferences can be affected, since price competition can become fiercer as media outlets choose locations more close to the center of the line.

Future work should try to extend our model to tackle some of the limitations that we have just discussed, like non-uniform demand, advertising, interest groups, and choice of political location. It would be also interesting to analyze empirically when the presence of publicly owned news firms in media markets contributes or not to more media plurality, i.e., when public news firms can achieve regulation by participation in terms of media plurality.

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