

# ***A discusión***

## **WHAT DO MEDIA OUTLETS COMPETE FOR?\***

**Ascensión Andina**

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# WHAT DO MEDIA OUTLETS COMPETE FOR?

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## ABSTRACT

This paper studies broadcasting competition, considering not only television stations that maximize profits but stations that want to influence voters. Following two strands of the psychological literature, we argue that media exert influence on two different ways: (i) they can reinforce viewers in their prior opinions, (ii) they can modify viewers' attitudes. We consider agents who flip through the outlets according to pleasantness. In this context, we show that the aim of maximizing profits and the objective of political influence result in different equilibrium ideological locations. This is so since the economic aspect pushes television stations to locate closer and political considerations lead them to polarize their locations. We also show that both results do not depend on the way media exert influence, but they do on the fact that viewers do channel hopping. In particular, we observe that, due to channel hopping, the equilibrium outcome may not be represented by the median viewer location when stations maximize profits and a extreme polarization arises when outlets aim is to maximize political influence.

**Keywords:** television, channel hopping, audience, political influence.

**JEL classification:** D2, H3, L8.

# 1 Introduction

This paper analyzes broadcasting competition, considering not only television stations that want to maximize profits but stations that want to influence voters. In this way, we try to capture the essence of mass media and to model what empirical evidence shows as a fact.

Television stations maximize profits like any economic institution. For this reason, it is natural that they appeal in their programs to large audiences.<sup>1</sup> But rather than this economic context, mass media present a great feature, and it is the possibility to expose the public to information, particularly to political news.<sup>2</sup> We consider it the main characteristic of the industry and the reason that explains the affairs among media outlets, interest groups and politicians. Some evidence prove these relations, like the fact that a large number of undeveloped countries have the state as the owner of the only media outlet of the country;<sup>3</sup> or Silvio Berlusconi, who besides being the Prime Minister of the Italian Republic controls the huge mass media conglomerate Finisvet; or the case of UK during the 19th Century, where most of the newspapers were directly subsidized by political parties.<sup>4</sup>

Based on this evidence, we conjecture that interest groups are concerned with the media industry in that media exert influence on the population. To this respect, we provide data for the British general elections of 1992 and 1997, showing that readers tend to vote the way of the newspapers they read. This can look misleading, in that conservative (resp. liberal) voters tend to read conservative (resp. liberal) newspapers and therefore vote right (resp. left). This would be the case of readers of *The Times* (resp. *The Guardian*). But data below also sheds light on a different dimension which concerns less political aware voters. This is the case of readers of *The Sun*. McKie (1995) says to this respect: “*The Sun appeals to the uncommitted and the apolitical voters and one would expect its readers to be more open to influence*”. This is supported by the evidence we present below, which shows that these readers voted right when *The Sun* held this ideology and left when it supported the Labour candidacy.

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<sup>1</sup>Strömberg (1999) references some cases where quite popular programmes were removed because of the characteristics of their audiences (rural or poor). Despite it, it is quite standard to identify audience with profits.

<sup>2</sup>Hrebenar et al., in a study for the U.S.A. in 1996, find that agents rank television (76%), newspapers (58%), radio (40%), talk radio (38%), magazines (34%), talk to other people (29%) and internet (6%), as the most important information sources about national candidates.

<sup>3</sup>Adserà et al. (2000) report that this is the case in countries like Angola, Belarus, Burundi, Cameroon, Chad, China, Ethiopia, Iran, Kazakhstan, Korea Dem. Republic, Mali, Niger, Syrian Arab Republic, Togo and Turkmenistan.

<sup>4</sup>Jean Seaton (1998).

	<b>Newspapers</b>				<b>Readers</b>			
	Circulat. 1992 ('000s)	Circul. 1997	Pref. Winner 92	Pref. Winner 97	How they vote 92 (%)		How they vote 97 (%)	
<b>Daily Mail</b>	1,675	2,151	Conservative	Conservative	Cons.	85	Cons.	49
					Lab.	14	Lab.	29
					Lib. Dem.	18	Lib. Dem.	14
<b>Daily Mirror</b>	2,903	3,084	Labour	Labour	Cons.	20	Cons.	14
					Lab.	63	Lab.	72
					Lib. Dem.	14	Lib. Dem.	11
<b>Guardian</b>	429	401	Lib. Dems	Labour	Cons.	15	Cons.	8
					Lab.	55	Lab.	67
					Lib. Dem.	25	Lib. Dem.	22
<b>Sun</b>	3,571	3,842	Conservative	Labour	Cons.	45	Cons.	30
					Lab.	36	Lab.	52
					Lib. Dem.	15	Lib. Dem.	12
<b>The Times</b>	386	719	Conservative	Eurosceptic	Cons.	64	Cons.	42
					Lab.	15	Lab.	28
					Lib. Dem.	19	Lib. Dem.	25

Source: McKie (1995) and Norris and Gavin (1997).

Table 1 shows readers' tendency to vote according to newspapers' preferences.

McKie (1995) also argued in the same direction, when he said: "*Conservative voters are more likely to stay loyal if they read a Conservative newspaper while uncommitted voters are more likely to choose the Conservatives if they read a Conservative newspaper*".

The psychological literature has been concerned with this feature of mass media for long time. As far as 1927, Lasswell stated: "*Propaganda is one of the most powerful instrumentalities in the modern world*". From then onward, this literature has been characterized by the rise of a number of strands that differ in the way they consider media exert influence. We regard two of these strands of special interest, which we use as guidings in the exposition of the paper: the "Reinforcement Approach" and the "Attitudinal Orientations Approach". Briefly, the idea underlying the first strand is that media reinforce agents in their prior opinions,<sup>5</sup> meanwhile the idea of the second approach is that media modify the ideology of the public.<sup>6</sup> We use these two approaches and we give them a voting interpretation. In this way, media will affect the probability of turnout in the first setup and will affect the vote itself in the second setup.

We propose a model of competition among television stations, focusing on television news. We restrict to this particular kind of outlets because we are going to consider viewers who observe more than one

<sup>5</sup> "*The main effect of media were to reinforce people in their already existing attitudes, rather than produce new ones*". Lazarsfeld et al. (1948).

<sup>6</sup> "*Among voters near the center of the political spectrum, whose political attitudes may be mixed, weakly held, or nonexistent, even subtle biases in news coverage may have a measurable impact on electoral preferences*". See Gunther and Mughan (2000).

station, what is more usual in television than in other media outlets, for example, newspapers.<sup>7</sup> We consider two television stations with different ideological preferences: left and right. The aim of these stations is to maximize either audience or political influence. Hence, the objective function depends both on economic and political aspects. There is a continuum of agents of measure one, distributed according to some continuous distribution function on the line segment  $[0,1]$ , who are characterized by two variables: ideological preference and precision.<sup>8</sup> Agents are viewers, who decide how much time to devote to each media, and they take this choice according to pleasantness. In this way, we allow viewers to mix between the two television programs depending on their political preference and what the outlets report. This is in line with the “Self selection of audience” theory, which states that people selectively expose themselves to like-minded media content.<sup>9</sup> In this setup, we study the kind of competition television stations are involved in. To this aim, we consider the two aforementioned ways in which media exert influence. Thus, we first suppose that television can reinforce agents in their initial opinions and then analyze the case where television can modify the ideology of the viewers. The first important result is that competition for audience and competition for influence leads to very different equilibrium locations. The reason is that the economic aspect pushes media outlets to locate closer, meanwhile the political considerations lead them to polarize their locations. The second important result is that because of channel hopping we are not constrained to the median viewer location as the equilibrium outcome when television stations maximize profits, but we get the extreme polarization when they maximize influence.

The literature on media is very sparse. Steiner (1952), Spence and Owen (1977) and Noam (1987) are the first works which consider the media industry, although they focus on the economic context. Political studies have not been carried out until much more recent times. However, a tendency of change seems to be taken place currently. In this literature, we find the papers of Schulz and Weimann (1989), Gabszewicz et al. (2001), Strömberg (2001) and Besley and Prat (2001). Schulz and Weimann (1989) focus on the location problem of newspapers and political parties, and highlight the pattern dependence of these choices. Gabszewicz et al. (2001) use the well-known Hotelling location model. In particular, they consider a game in which two editorials have to decide where to locate (ideologically), which price to charge to the newspaper, and the advertising tariff. They find that for several cases, newspapers’ editors moderate their locations instead of polarizing them. Strömberg (2001) studies the influence mass media have on political competition and on the determination of policy outcomes. He shows that because of the increasing returns to scale of the media industry, a political bias appears hurting small groups of voters while benefiting large groups. Finally, Besley and Prat (2001) use an adverse selection model to capture the possible influencing effects of a bad government on the media industry. They show that if this influence does exist, then the role of media as an informant channel is offset.

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<sup>7</sup>Usually, each newspaper has its own fixed readers who buy that newspaper, and not other, because of pleasantness. However, television viewers aren’t so loyal as radio listeners or newspaper readers. In television there is more room for chance, hazard... what turns TV into the best media source to catch confused viewers (voters).

<sup>8</sup>With precision we mean the grade of conviction an agent has in her beliefs.

<sup>9</sup>See Lazarfeld et al. (1954) or Katz (1981) for more details on this theory.

The paper is organized as follows. The next section presents the model and some preliminary concepts. Section 3 studies broadcasting competition under the assumption that television reinforce viewers in their prior opinions. In section 4 we analyze this competition assuming that television modify the ideology of the viewers. Finally, section 5 concludes.

## 2 The model

Let us consider an economy with two television stations, which have a political preference.<sup>10</sup> We labeled  $L$  the station with a left wing ideology, and  $R$  the one with a right wing ideology.<sup>11</sup> The role of media outlets is to choose where to locate, i.e. which ideology to air in their news. We denote  $\Pi^L$  the location chosen by the left wing station, and  $\Pi^R$  the location chosen by the right wing one. Ideologies belong to the close interval zero-one, i.e.  $\Pi^L, \Pi^R \in [0, 1]$ . We identify 0 with the extreme left ideology, and 1 with extreme right. Note that we use a model of spatial competition.

We focus on the competition developed by the two stations in their television news. To this respect, we assume that the two TV news are equal in all aspects (broadcast time, duration...) but in ideology.

Television stations are firms and as such should be profit maximizers. Then, as we assume audience to be directly related to revenues, media outlets will bother audience shares. But we have assumed they are ideology motivated, therefore they will also compete for political aims. Hence, the utility function of an outlet  $j$  combine both aspects, i.e.  $U^j(\Pi^j, \Pi^k) : [0, 1]^2 \rightarrow \mathbb{R}$  is such that

$$U^j(\Pi^j, \Pi^k) \quad : \quad = h(A^j(\Pi^j, \Pi^k), \gamma^j(\Pi^j, \Pi^k)) \quad (1)$$

for  $j, k = L, R$  and  $k \neq j$ ,

with  $h_1(\cdot) > 0$ ,  $h_2(\cdot) > 0$ , where the subindex (1, 2) stands for the variable  $h(\cdot)$  is derived with respect to. The function  $A^j(\Pi^j, \Pi^k) : [0, 1]^2 \rightarrow \mathbb{R}_+$ , represents the audience of the  $j$ th channel. The function  $\gamma^j(\Pi^j, \Pi^k) : [0, 1]^2 \rightarrow \mathbb{R}$ , represents the political influence exerted by channel  $j$ .

There is a continuum of agents of measure one. These agents are characterized by two features: ideological position,  $x$ , and ideological precision,  $\tau$ . As usual,  $x$  is distributed on the interval  $[0, 1]$  according to a continuous generic distribution function  $F(\cdot)$ , with a positive density function  $f(\cdot)$ . On the other hand, the ideological precision is a measure of the confidence an agent has on her initial opinions. A way to understand what the precision means is given by statistic techniques, where the precision is understood to be the inverse of the variance of an agent's ideology. Thus, if we think of the ideology of an agent as a random variable, we can identify the mean of that distribution with the ideology of the citizen,  $x$ , and its variance with the inverse of her precision.<sup>12</sup> As a direct consequence, we say that an agent with a

<sup>10</sup>Television is supposed to expose the public to information. Hence, interest groups could be interested in the broadcasting control because of the political advantages which derive from it. This could explain the political motivation of the stations.

<sup>11</sup>This ideological background does not imply that in some cases, if profitable, television stations can adopt the other political ideology.

<sup>12</sup> $\tau_i = \frac{1}{\text{Var}(x_i)}$  as in Blomberg and Harrington (2000), where  $x_i$  is the ideology (random variable) of the  $i$ th viewer.

high dispersion around her mean is not really convinced of her prior opinions, meanwhile an agent with a small variance is sure of them. In the model, we assume a fixed initial value for  $\tau$ , that is the same for all agents.

Agents are viewers in that they watch television. In the model, viewers decide how to watch both stations and they take this choice according to pleasantness. This means that we allow for agents who choose different time combinations to devote to each media. We formalize this idea assuming that agents have a Cobb-Douglas utility function whose arguments are the times devoted to observe each TV news. We define the time a viewer  $x$  watches the station  $j$  as  $T_j(x)$ , with  $j = L, R$ . Thus, the utility function of a viewer  $x$  is

$$u_x(T_{\min}, T_{\max}) := (T_{\min})^{a(x; \Pi^{\min}, \Pi^{\max})} (T_{\max})^{1-a(x; \Pi^{\min}, \Pi^{\max})}$$

where  $\min = i$ ,  $\max = j$  if  $\Pi^i \leq \Pi^j$ . In this specification,  $a(x; \Pi^{\min}, \Pi^{\max})$  stands for the preference viewer  $x$  has for the outlet that locates more to the left, therefore  $1 - a(x; \Pi^{\min}, \Pi^{\max})$  describes her preference for the outlet more to the right. We further assume<sup>13</sup>  $a(\bar{\Pi}; \Pi^{\min}, \Pi^{\max}) = \frac{1}{2}$  with  $\bar{\Pi} = \frac{\Pi^{\min} + \Pi^{\max}}{2}$  and  $a_1(x; \Pi^{\min}, \Pi^{\max}) < 0$ .

The constraint for a viewer  $x$  is that the time she spends watching television news must be equal to one, i.e.  $T_{\min} + T_{\max} = 1$ .

Solving the maximization problem, we obtain that in equilibrium a viewer watches more than one television station, i.e. viewers do channel hopping. This idea is empirically supported, and it enriches considerably the model. In actual fact, we will see that the main results of this paper rely on it. Nevertheless, and to the best of our knowledge, this is the first time an economic analysis considers the idea of channel hopping. We solve for the equilibrium and we obtain

$$T_{\min}^* = a(x; \Pi^{\min}, \Pi^{\max}) \quad T_{\max}^* = 1 - a(x; \Pi^{\min}, \Pi^{\max}).$$

For tractability reasons, we specify a piecewise linear function for  $a(x; \Pi^{\min}, \Pi^{\max})$ . This functional form is assumed to work whenever  $\Pi^{\min} \neq \Pi^{\max}$ . In case  $\Pi^{\min} = \Pi^{\max}$ , viewers are supposed to choose any pair  $\{T_{\min}, T_{\max}\}$  such that  $\sum_{j=L,R} T_j = 1$ . For the other cases, we assume

$$T_{\min}^* := \begin{cases} 1 - \frac{1}{2\bar{\Pi}}x & \text{if } x \leq \bar{\Pi} \\ \frac{1-x}{2(1-\bar{\Pi})} & \text{if } x \geq \bar{\Pi} \end{cases} \quad T_{\max}^* := \begin{cases} \frac{1}{2\bar{\Pi}}x & \text{if } x \leq \bar{\Pi} \\ \frac{1-2\bar{\Pi}+x}{2(1-\bar{\Pi})} & \text{if } x \geq \bar{\Pi} \end{cases} \quad (2)$$

Note that this specification assumes that the extreme viewers watch only one television station, which is their closest one. We think it is a reasonable assumption since they are radical agents. Below, we display the graphs of  $T_{\min}^*$ ,  $T_{\max}^*$ .

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<sup>13</sup>We assume these conditions in order to be consistent with the so-called ‘‘Self selection of audience’’. Lazarsfeld et al. (1954) assert to this respect: ‘‘Most individuals expose themselves most of the time to the kind of material with which they agree to begin with’’.

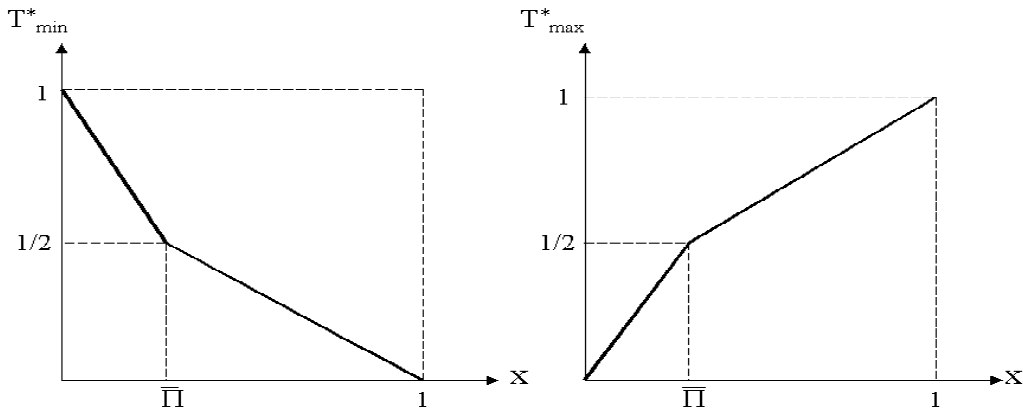


Figure 1. Time viewers watch television according to ideology.

As the “Self selection of audience” asserts, the specified structure sustains that the ideology an agent perceives as that aired (in mean) on television is not the same for all, but depends on each agent’s location. Thus, let  $m(x) = \Pi^{\min} \times T_{\min} + \Pi^{\max} \times T_{\max}$  be the function that represents this ideological mean viewer  $x$  observes on television. We obtain that

$$m(x) = \begin{cases} \Pi^{\min} + \frac{\Delta\Pi}{2\Pi}x & \text{if } x \leq \bar{\Pi} \\ \Pi^{\max} - \frac{\Delta\Pi}{2(1-\bar{\Pi})}(1-x) & \text{if } x \geq \bar{\Pi} \end{cases} \quad (3)$$

with  $\Delta\Pi = \Pi^{\max} - \Pi^{\min}$ .

We represent  $m(x)$  in Figure 2

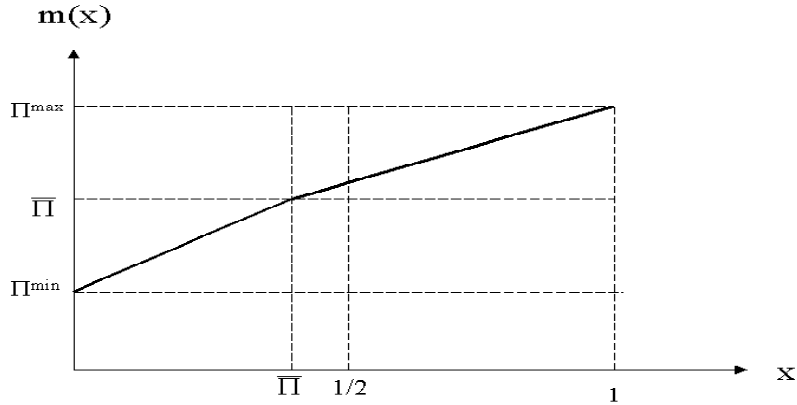


Figure 2. Mean ideology viewers observe on television as a function of  $x$ .

### 3 Media influence: the reinforcement approach

*Persuasive mass communication functions far more frequently as an agent of reinforcement than as an agent of change.*

— Klapper, 1960

In the mass communication theory, there is a well-known premise saying that mass media can influence viewers in four different ways: opinion affirmation, opinion deformation, opinion conformation and opinion reformation. In this section, we pursue the opinion affirmation aspect.<sup>14</sup> Thus, we will assume that television can reinforce the public in their prior opinions, i.e. it can make agents more confident in their initial attitudes. This is the so-called “Reinforcement doctrine of political communication impact”.

Suppose therefore television influence is exerted through reinforcement. Then, interest groups could be interested in media control because of two reasons.<sup>15</sup> On the one hand, because an agent more confident in her ideology is, *ceteris paribus*, an agent more willing to contributing money to the party.<sup>16</sup> On the other hand, because an agent more sure of her ideology is, *ceteris paribus*, an agent with a higher probability of turnout in the elections’ day.<sup>17</sup> We follow the second argument, what means that interest groups will be interested in the control of the television stations because of the possibility that the latter influence the probability of agents going to the pools. Nevertheless, the analysis we perform is also valid in case we decide to follow the first argument.

To the aim of model this idea we define the final precision of an agent at time one<sup>18</sup> as a function  $\tau^1(x) : \mathbb{R}_+ \rightarrow \mathbb{R}_+$ , that depends negatively on the distance between the ideology of the agent and the ideology she observes on television. Thus, the smaller the distance, denoted as  $d(x, m(x))$ , the bigger the final confidence of the viewer in her initial beliefs. In particular,

$$\tau^1(x) := g(d(x, m(x))) \tag{4}$$

where  $g(\cdot) : [0, 1] \rightarrow \mathbb{R}_+$ ,  $g'(\cdot) < 0$ ,  $d(x, m(x)) = (x - m(x))^2$  and

$$x - m(x) = \begin{cases} \frac{(x - \bar{\Pi})\Pi^{\min}}{\bar{\Pi}} & \text{if } x \leq \bar{\Pi} \\ \frac{(1 - \Pi^{\max})(x - \bar{\Pi})}{1 - \bar{\Pi}} & \text{if } x \geq \bar{\Pi}. \end{cases}$$

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<sup>14</sup>Next section can be considered as an analysis of any of the other three possibilities.

<sup>15</sup>Petty and Priester (1994) state: “A television commercial might be based on the idea that giving people information about a candidate’s issue position will lead to favorable attitudes toward the candidate and ultimately to contributing money to and voting for the candidate”.

<sup>16</sup>Aldrich (1983) uses this idea of motivated agents as activists.

<sup>17</sup>Zaller (1992) says: “It is interesting to note that political interest is a strong correlate of voter turnout”.

<sup>18</sup>French (1956) defines a unit of time as the time required by an agent to accommodate her initial precision to the final one.

Note that we are assuming that television stations can reinforce individuals in their prior opinions, but cannot weaken these thoughts.<sup>19</sup>

Once we have seen how the reinforcement approach works, we can define the objective functions for the media outlets. Recall they have two types of aims, an economic and a political one. We start with the former. In this case, the  $j$ th television has to maximize its audience, i.e. the time the viewers of the economy watch its TV news. Thus, as the time viewer  $x$  spends watching station  $j$  is given by the function  $T_j(x)$ , the total audience for this  $j$ th media outlet is

$$A^j(\Pi^j, \Pi^k) := \int_0^1 T_j(x) dF(x).$$

More specifically, the audience payoff functions are

$$A^L(\Pi^L, \Pi^R) = \begin{cases} \int_0^{\bar{\Pi}} \frac{2\bar{\Pi}-x}{2\bar{\Pi}} f(x) dx + \int_{\bar{\Pi}}^1 \frac{1-x}{2(1-\bar{\Pi})} f(x) dx & \text{if } \Pi^L < \Pi^R \\ \int_0^{\bar{\Pi}} \frac{1}{2\bar{\Pi}} x f(x) dx + \int_{\bar{\Pi}}^1 \frac{1-2\bar{\Pi}+x}{2(1-\bar{\Pi})} f(x) dx & \text{if } \Pi^L > \Pi^R \\ \lambda_1(\bar{\Pi}) & \text{if } \Pi^L = \Pi^R = \bar{\Pi} \end{cases}$$

$$A^R(\Pi^R, \Pi^L) = 1 - A^L(\Pi^L, \Pi^R)$$

where the function  $\lambda_1(\Pi) : [0, 1] \rightarrow [0, 1]$  defines the audience of the station  $L$  when  $\Pi^L = \Pi^R = \Pi$ . The functional form of  $\lambda_1(\Pi)$  will represent how viewers flip through the stations  $L$  and  $R$  when both are at the same location. Later, we prove that the existence of an audience equilibrium implies equal ideologies and a particular value of  $\lambda_1(\cdot)$ .

On the other hand, media outlets also compete for political influence. In this case, the  $j$ th television station has to maximize the expected number of votes for the party in its way. Thus, as we have assumed  $L$  to be the left wing station, and  $R$  to be the right wing one, the relevant interval for the former will be  $[0, 1/2]$ , meanwhile  $[1/2, 1]$  will be the one for the latter.<sup>20</sup>

$$\gamma^L(\Pi^L, \Pi^R) := \int_0^{1/2} \tau^1(x) dF(x)$$

$$\gamma^R(\Pi^R, \Pi^L) := \int_{1/2}^1 \tau^1(x) dF(x).$$

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<sup>19</sup>Petty and Priester (1994) say: “One of the most important determinants of motivation to think about a message is the perceived personal relevance of that message. Most of the media messages people receive are probably not perceived as directly relevant and they have few personal consequences”.

<sup>20</sup>Implicitly, we are assuming that there are two political parties in the economy which in equilibrium locate symmetrically around or at one half and that viewers vote for the closest party.

Note that in this setup the influence works on the precision. Therefore, what media outlets maximize is the probability of their viewers going to the polls. Below, we completely specify the political influence payoff functions.

$$\begin{aligned}
&\text{Television station } L : \gamma^L(\Pi^L, \Pi^R) = \\
&\cdot \int_0^{\bar{\Pi}} g\left(\left(\frac{(x-\bar{\Pi})\Pi^L}{\bar{\Pi}}\right)^2\right) f(x)dx + \int_{\bar{\Pi}}^{1/2} g\left(\left(\frac{(1-\Pi^R)(x-\bar{\Pi})}{1-\bar{\Pi}}\right)^2\right) f(x)dx \\
&\text{if } 0 \leq \Pi^L \leq \min\{1 - \Pi^R, \bar{\Pi}\}, \\
&\cdot \int_0^{1/2} g\left(\left(\frac{(x-\bar{\Pi})\Pi^L}{\bar{\Pi}}\right)^2\right) f(x)dx \text{ if } 1 - \Pi^R \leq \Pi^L \leq \bar{\Pi}, \\
&\cdot \int_0^{\bar{\Pi}} g\left(\left(\frac{(x-\bar{\Pi})\Pi^R}{\bar{\Pi}}\right)^2\right) f(x)dx + \int_{\bar{\Pi}}^{1/2} g\left(\left(\frac{(1-\Pi^L)(x-\bar{\Pi})}{1-\bar{\Pi}}\right)^2\right) f(x)dx \\
&\text{if } \bar{\Pi} \leq \Pi^L \leq 1 - \Pi^R, \\
&\cdot \int_0^{1/2} g\left(\left(\frac{(x-\bar{\Pi})\Pi^R}{\bar{\Pi}}\right)^2\right) f(x)dx \text{ if } \max\{\bar{\Pi}, 1 - \Pi^R\} \leq \Pi^L \leq 1.
\end{aligned}$$

$$\begin{aligned}
&\text{Television station } R : \gamma^R(\Pi^R, \Pi^L) = \\
&\cdot \int_{1/2}^1 g\left(\left(\frac{(1-\Pi^L)(x-\bar{\Pi})}{1-\bar{\Pi}}\right)^2\right) f(x)dx \text{ if } 0 \leq \Pi^R \leq \min\{\bar{\Pi}, 1 - \Pi^L\}, \\
&\cdot \int_{1/2}^1 g\left(\left(\frac{(1-\Pi^R)(x-\bar{\Pi})}{1-\bar{\Pi}}\right)^2\right) f(x)dx \text{ if } \bar{\Pi} \leq \Pi^R \leq 1 - \Pi^L, \\
&\cdot \int_{1/2}^{\bar{\Pi}} g\left(\left(\frac{(x-\bar{\Pi})\Pi^R}{\bar{\Pi}}\right)^2\right) f(x)dx + \int_{\bar{\Pi}}^1 g\left(\left(\frac{(1-\Pi^L)(x-\bar{\Pi})}{1-\bar{\Pi}}\right)^2\right) f(x)dx \\
&\text{if } 1 - \Pi^L \leq \Pi^R \leq \bar{\Pi}, \\
&\cdot \int_{1/2}^{\bar{\Pi}} g\left(\left(\frac{(x-\bar{\Pi})\Pi^L}{\bar{\Pi}}\right)^2\right) f(x)dx + \int_{\bar{\Pi}}^1 g\left(\left(\frac{(1-\Pi^R)(x-\bar{\Pi})}{1-\bar{\Pi}}\right)^2\right) f(x)dx \\
&\text{if } \max\{\bar{\Pi}, 1 - \Pi^L\} \leq \Pi^R \leq 1.
\end{aligned}$$

We now define what an audience and an influence equilibrium means.

**Definition 1** *An audience equilibrium is a pair of ideologies  $\{\Pi^{L*}, \Pi^{R*}\} \in [0, 1]^2$ , chosen by stations  $L$  and  $R$ , such that*

$$\begin{aligned}
A^L(\Pi^{L*}, \Pi^{R*}) &\geq A^L(\Pi^L, \Pi^{R*}) \quad \forall \Pi^L \in [0, 1] \\
A^R(\Pi^{R*}, \Pi^{L*}) &\geq A^R(\Pi^R, \Pi^{L*}) \quad \forall \Pi^R \in [0, 1]
\end{aligned}$$

**Definition 2** *An influence equilibrium is a pair of ideologies  $\{\Pi^{L*}, \Pi^{R*}\} \in [0, 1]^2$ , chosen by stations  $L$  and  $R$ , such that*

$$\begin{aligned}
\gamma^L(\Pi^{L*}, \Pi^{R*}) &\geq \gamma^L(\Pi^L, \Pi^{R*}) \quad \forall \Pi^L \in [0, 1] \\
\gamma^R(\Pi^{R*}, \Pi^{L*}) &\geq \gamma^R(\Pi^R, \Pi^{L*}) \quad \forall \Pi^R \in [0, 1]
\end{aligned}$$

Let us start with the results. We present a proposition and a corollary for the case where media outlets compete for audience, and a proposition for the case where they compete for political influence. We observe that in the former case the equilibrium implies television stations locating at the same point, which not necessarily coincides with the location of the median viewer. With respect to the latter setup, we show that in equilibrium outlets choose extreme locations. Finally, we make a brief comment on how deeply these results depend on channel hopping.

**Proposition 1** *Under the specified assumptions a unique audience equilibrium where television stations air the same ideology  $\Pi^{L*} = \Pi^{R*} = \Pi^*$ , and each one obtains  $A^L(\Pi^*, \Pi^*) = 1/2 = A^R(\Pi^*, \Pi^*)$ , exists.*

**Proof.** Let's define as  $\Upsilon_1^L(\Pi^L, \Pi^R)$  the objective function of the station  $L$  in case  $\Pi^L < \Pi^R$  :

$$\Upsilon_1^L(\Pi^L, \Pi^R) = \int_0^{\bar{\Pi}} \left(1 - \frac{1}{2\bar{\Pi}}x\right) f(x)dx + \int_{\bar{\Pi}}^1 \frac{1-x}{2(1-\bar{\Pi})} f(x)dx.$$

$$\text{Then, } \frac{\partial \Upsilon_1^L(\Pi^L, \Pi^R)}{\partial \Pi^L} = \int_0^{\bar{\Pi}} \frac{1}{4\bar{\Pi}^2} x f(x) dx + \int_{\bar{\Pi}}^1 \frac{1-x}{4(1-\bar{\Pi})^2} f(x) dx > 0.$$

Let's call now  $\Upsilon_2^L(\Pi^L, \Pi^R)$  the objective function of the station  $L$  in case  $\Pi^L > \Pi^R$  :

$$\Upsilon_2^L(\Pi^L, \Pi^R) = \int_0^{\bar{\Pi}} \frac{1}{2\bar{\Pi}} x f(x) dx + \int_{\bar{\Pi}}^1 \frac{1-2\bar{\Pi}+x}{2(1-\bar{\Pi})} f(x) dx.$$

$$\text{Then, } \frac{\partial \Upsilon_2^L(\Pi^L, \Pi^R)}{\partial \Pi^L} = \int_0^{\bar{\Pi}} \frac{-1}{4\bar{\Pi}^2} x f(x) dx + \int_{\bar{\Pi}}^1 \frac{-1+x}{4(1-\bar{\Pi})^2} f(x) dx < 0.$$

Thus, the best response of station  $L$  against  $\Pi^R$  is  $\Pi^L(\Pi^R) = \Pi^R$  or it doesn't exist. Using analogous arguments we get, for the station  $R$ , that either  $\Pi^R(\Pi^L) = \Pi^L$  or  $\nexists \Pi^R(\Pi^L)$ . Therefore, the equilibrium in pure strategies either holds  $\Pi^{L*} = \Pi^{R*} = \Pi^*$  or it does not exist.

Let  $\Upsilon(\Pi) = \int_0^{\Pi} \left(1 - \frac{1}{2\Pi}x\right) f(x)dx + \int_{\Pi}^1 \frac{1-x}{2(1-\Pi)} f(x)dx$ , and note that  $\Upsilon_1^L(\Pi, \Pi) = \Upsilon(\Pi)$ ,  $\Upsilon_2^L(\Pi, \Pi) = 1 - \Upsilon(\Pi)$ .

Now, suppose there exists an equilibrium such that  $\Pi^{L*} = \Pi^{R*} = \Pi^*$ . If this were the case, then  $A^L(\Pi^{L*}, \Pi^{R*}) = \lambda_1(\Pi^*)$ ,  $A^R(\Pi^{R*}, \Pi^{L*}) = 1 - \lambda_1(\Pi^*)$ . At this point, note that the definition of a Nash equilibrium implies

$$\lambda_1(\Pi^*) \geq \max\{\Upsilon(\Pi^*), 1 - \Upsilon(\Pi^*)\}$$

$$1 - \lambda_1(\Pi^*) \geq \max\{\Upsilon(\Pi^*), 1 - \Upsilon(\Pi^*)\}$$

and therefore  $\Upsilon(\Pi^*) = \frac{1}{2}$ ,  $\lambda_1(\Pi^*) = \frac{1}{2}$ . Moreover, since  $\Upsilon(\Pi)$  is a continuous increasing function with  $\Upsilon'(\Pi) > 0$ ,  $\Upsilon(0) = \frac{1-E[x]}{2} < \frac{1}{2}$ , and  $\Upsilon(1) = 1 - \frac{E[x]}{2} > \frac{1}{2}$ , we can assure that the equilibrium  $\Pi^{L*} = \Pi^{R*} = \Pi^*$  exists, is unique, and satisfies  $\Upsilon(\Pi^*) = A^L(\Pi^{L*}, \Pi^{R*}) = A^R(\Pi^{R*}, \Pi^{L*}) = \frac{1}{2}$ . ■

It is worth mentioning here that the precise relation between  $\Pi^*$  and the median viewer  $x_m$ , will depend on the asymmetry of  $f(x)$ . This points to an important result: the equilibrium outcome may not be necessarily represented by the median viewer location. To say it differently, our result breaks or sheds a different light on the well-known Median Voter Theorem (MVT), stating that it is not the median who is important but the fact that locations and gains are the same. The next corollary presents this result, where  $E[x]$  represents the mathematical expectation of  $x$ .

**Corollary 1** (i): If  $E[x] = x_m = 1/2$ , then  $\Pi^* = x_m$ . (ii): If  $E[x] < 1/2 < x_m$ , then  $\Pi^* < x_m$ . (iii): If  $x_m < 1/2 < E[x]$ , then  $\Pi^* > x_m$ .

**Proof.** Let's denote  $G(x_m) = \int_0^{x_m} xf(x)dx$ . Then we have  $\Pi^* \leq x_m \iff \frac{1}{2} \leq \Upsilon(x_m) \iff \frac{1}{2} \leq \frac{1}{2} - \frac{G(x_m)}{2x_m} + \frac{\frac{1}{2} - E[x] + G(x_m)}{2(1-x_m)} \iff (1 - 2x_m)G(x_m) \leq x_m(\frac{1}{2} - E[x])$ . From here, the corollary follows immediately. ■

Once we know how television stations behave when competing for audience, we go on to analyze the influence case. Next result shows that outlets competing for influence polarize their locations in equilibrium.

**Proposition 2** Under the specified assumptions an influence equilibrium exists. This equilibrium is unique and characterized by television stations adopting polarized locations  $\Pi^{L*} = 0$ ,  $\Pi^{R*} = 1$ .

**Proof.** Let us define as  $\Gamma_1^L(\Pi^L, \Pi^R)$ ,  $\Gamma_2^L(\Pi^L, \Pi^R)$ ,  $\Gamma_3^L(\Pi^L, \Pi^R)$ ,  $\Gamma_4^L(\Pi^L, \Pi^R)$  the objective functions for the station  $L$  in case  $\Pi^L \in [0, \min\{1 - \Pi^R, \Pi^R\}]$ ,  $\Pi^L \in [1 - \Pi^R, \Pi^R]$ ,  $\Pi^L \in [\Pi^R, 1 - \Pi^R]$  and  $\Pi^L \in [\max\{1 - \Pi^R, \Pi^R\}, 1]$  respectively. Since<sup>21</sup>

$$\begin{aligned} \frac{\partial \Gamma_2^L(\Pi^L, \Pi^R)}{\partial \Pi^L} &= \frac{-2\Pi^L}{\Pi^3} \int_0^{1/2} g'(\cdot) \left( \frac{1}{2}(x - \bar{\Pi})\Pi^L x - (x - \bar{\Pi})^2 \bar{\Pi} \right) f(x) dx < 0 \text{ as } g'(\cdot) < 0 \text{ and } \bar{\Pi} \geq x \\ \frac{\partial \Gamma_4^L(\Pi^L, \Pi^R)}{\partial \Pi^L} &= \frac{-(\Pi^R)^2}{\Pi^3} \int_0^{1/2} g'(\cdot)(x - \bar{\Pi})x f(x) dx < 0 \text{ as } g'(\cdot) < 0 \text{ and } \bar{\Pi} \geq x \end{aligned}$$

the equilibrium, in case of existence, will be such that  $\Pi^{L*} \in [0, 1 - \Pi^{R*}]$ . Proceeding in the same way for station  $R$  it is easy to get the analogous result  $\Pi^{R*} \in [1 - \Pi^{L*}, 1]$ . Then, in equilibrium  $\Pi^{R*} = 1 - \Pi^{L*}$ , what implies symmetry about one half. Going back to  $\Gamma_1^L(\Pi^L, \Pi^R)$  and  $\Gamma_3^L(\Pi^L, \Pi^R)$ , and using this condition we obtain

$$\begin{aligned} \frac{\partial \Gamma_1^L(\Pi^{L*}, \Pi^{R*})}{\partial \Pi^L} &= -8\Pi^{L*} \int_0^{1/2} g'(\cdot) \left( (x - \frac{1}{2})\Pi^{L*} x - (x - \frac{1}{2})^2 \right) f(x) dx < 0 \\ \frac{\partial \Gamma_3^L(\Pi^{L*}, \Pi^{R*})}{\partial \Pi^L} &= -4(\Pi^{R*})^2 \int_0^{1/2} g'(\cdot)(2x - 1)x f(x) dx < 0. \end{aligned}$$

Then, if  $\Pi^{L*} > 0$  we would have  $\frac{\partial \gamma^L(\Pi^{L*}, \Pi^{R*})}{\partial \Pi^L} < 0$ , which contradicts the necessary condition for the existence of an interior solution. Thus  $\Pi^{L*} = 0$ ,  $\Pi^{R*} = 1$  in the unique equilibrium. ■

It should be stressed that the channel hopping plays an important role in the model. To this aim, let us now skip this assumption and suppose that viewers watch only their closest located TV news. Under this new structure and further assuming  $x \sim U[0, 1]$  (what simplifies the analysis) the ideological equilibrium turns to be the pair  $\Pi^{L*} = \frac{1}{4}$ ,  $\Pi^{R*} = \frac{3}{4}$  instead of  $\Pi^{L*} = 0$ ,  $\Pi^{R*} = 1$ ; meanwhile the audience equilibrium is now necessarily located at  $\Pi^{L*} = \Pi^{R*} = x_m$ , instead of at  $\Pi^{L*} = \Pi^{R*}$ , which may differ from  $x_m$ . There are therefore important consequences relying on the channel hopping. With respect to the arguments underlying these results, we can say that: (i) In the audience scenario and without channel hopping, audience follows the same distribution as ideology, therefore the equilibrium for this case coincides with the median of the ideology distribution. On the other hand, if we assume channel hopping these distributions will not coincide any longer. Thus the result that the equilibrium location

<sup>21</sup>Note that  $g'(\cdot)$  stands for the derivative of  $g(\cdot)$ , evaluated following the chain rule.

may differ to that of the median viewer. (ii) In the influence setup and without channel hopping, no agent watches more than one television news. Therefore television stations do not have to care for the ideology aired by the other, since none of the relevant viewers of a station watch the other outlet. In this case television stations maximize the influence locating at  $\{\frac{1}{4}, \frac{3}{4}\}$ , since outlets engage in local monopolies. On the other hand, under the assumption of channel hopping, media stations have to offset the negative influence played by the other media on the relevant public of the former outlet. Hence the polarization.

## 4 Media influence: the attitudinal orientations approach

*Television matters insofar as it can subtly but significantly affect the attitudinal orientations of citizens, even to the point of shifting enough votes to determinate the outcome of an election under certain circumstances.*

— Gunther and Mughan, 2000

It is widely recognized that television can also modify the public ideology itself,<sup>22</sup> fact that hasn't been analyzed in the previous section. This will be our point here.

There are empirical works showing that media play a role in determining and modifying human preferences. These works mostly consist of experiments and sample surveys.<sup>23</sup> They both point to the same conclusions, although they discord on the grade the influence is exerted. Lazarsfeld et al. (1954) assert to this respect: “*The controlled experiments always greatly overrate effects, as compared with those that really occur, because of the self-selection of audiences*”. Despite it, experiments and sample surveys agree that media exert influence. They also agree that the effectiveness of the media influence on a particular viewer depends on the distance between the ideology of the agent and the mean ideology she observes on television,  $d(x, m(x))$ , and on the precision of the viewer,  $\tau$ .<sup>24</sup>

Since we are going to allow television to modify the ideology of a viewer, we have to define a new variable that stands for the final ideology of an agent. Let  $Y(x)$  be this final ideology of a viewer  $x$ . We use an updating rule similar to the one in Blomberg and Harrington (2000). Thus, we have

$$Y(x) = \frac{x\tau + m(x)g(d(x, m(x)))}{\tau + g(d(x, m(x)))} = \frac{x\tau|x - m(x)| + m(x)}{\tau|x - m(x)| + 1} \quad (5)$$

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<sup>22</sup> “*In Spain it was found that a shift to the Partido Socialista Obrero Español (PSOE) by undecided voters who believed that Felipe González had won the second televised debate produced an overall net shift in the national vote of 4 percent, which was just enough to offset his rival’s initial lead in the polls and reelect the prime minister to a fourth term. Even more convincing evidence found that because of media magnate Silvio Berlusconi used his private television networks to advance his party’s electoral prospects, while the public Radiotelevisione Italiana (RAI) channels were much more impartial, Berlusconi was able to benefit from a net shift of over 6 percent of all votes cast*”. See Gunther and Mughan (2000).

<sup>23</sup> See Hovland (1956) for a discussion on both.

<sup>24</sup> Hovland (1956) and Zaller (1992) make statements to this respect.

with  $g(d(x, m(x))) = \frac{1}{|d(x, m(x))^{1/2}|}$ , and  $d(x, m(x)) = (x - m(x))^2$ , as previously.

Note that the final ideology of a viewer is a convex combination between her initial ideology and the mean ideology she observes on television. Note also that

$$\frac{|Y(x) - x|}{|m(x) - x|} = \frac{1}{\tau |x - m(x)| + 1}$$

i.e., the relative value of the change (in absolute terms) is decreasing in the initial distance,  $d(x, m(x))$ , and in the initial precision,  $\tau$ , as empirical evidence shows.<sup>25</sup>

We study two instances: (i)  $\tau = 0$ , i.e. viewers have null confidence on their prior opinions; (ii)  $\tau = 1$ , i.e. viewers are ex-ante characterized by an ideological variance equal to one.<sup>26</sup>

Now, we define the audience function of a station  $j$ . Note that as audience shares are computed at the end of the period, media outlets have to take into account that their relevant ideology distribution is the transformed one. This means that they maximize their audiences over the distribution of  $Y$ , not over that of  $x$ .

$$A^j(\Pi^j, \Pi^k) := \int_{R_Y} T_j(y) d\widehat{F}(y; \Pi^j, \Pi^k)$$

with  $j = L, R$ ,  $j \neq k$ .  $\widehat{F}(y; \Pi^L, \Pi^R)$  stands for the new distribution of the viewers<sup>27</sup> once they have updated their thoughts,  $T_j(y)$  for the fraction of time viewer  $y$  watches television  $j$  (according to (2)), and  $R_Y$  is the range of the new variable  $Y$ .

On the other hand, the influence payoff functions are

$$\begin{aligned} \gamma^L(\Pi^L, \Pi^R) &: = \int_0^{1/2} \tau d\widehat{F}(y; \Pi^L, \Pi^R) = \tau \widehat{F}\left(\frac{1}{2}; \Pi^L, \Pi^R\right) \\ \gamma^R(\Pi^R, \Pi^L) &: = \int_{1/2}^1 \tau d\widehat{F}(y; \Pi^L, \Pi^R) = \tau \left[1 - \widehat{F}\left(\frac{1}{2}; \Pi^L, \Pi^R\right)\right]. \end{aligned}$$

These payoff functions are understood as the number of votes the station  $j$  gets. Note that in the previous section the influence worked on the precision meanwhile in this section it works on the ideology. Thus, the objective of television stations is now to maximize the mass of the public in their relevant intervals.

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<sup>25</sup>Zaller (1992) states: “During the early years of the Vietnam War, news coverage was generally slanted in the hawkish direction. As a result, support for the war grew among less aware liberals but declined among more aware liberals. But as news coverage became more anti-war, the same interaction occurred among conservatives; the less aware shifted in the dovish direction, the more aware remained pro-war”.

<sup>26</sup>We think it could be of interest the study of the case where the precision is a function of the ideology, i.e.  $\tau(x)$ . Gunther and Mughan (2000) assert to this respect: “The Spanish study found that individuals with strongly rooted opinions on either the left or the right are largely unfazed by the partisan bias of the media. Those near the middle of the ideological continuum (many of whom are presumably “false centrist”, with weakly rooted or nonexistent attitudes on most issues), by contrast, can be significantly influenced by media biases, whether these biases are exerted by television, radio, or newspapers. Since these centrists are often the crucial swing voters in many elections, their susceptibility to media influences has considerable political significance”. Nevertheless and due to the complex calculus this analysis carries on, we do not analyze this case although we comment on it later.

<sup>27</sup>The probabilistic distribution of  $Y$ , deduced from (5) and  $F(x)$ .

## 4.1 Null precision

Suppose viewers have an initial precision equal to zero, i.e.  $\tau = 0$ . As long as this means agents with no confidence on their initial thoughts, they will adopt as their final ideology the one watched on television

$$Y(x) = m(x)$$

i.e., viewer  $x$  update her political opinions resulting in  $m(x)$ , i.e. what she has observed on television for an specific period of time.

Note that when  $\tau = 0$ , only the economic objective of the station  $j$  is well defined. Thus, the audience payoff function of the outlet  $j$  is  $A^j(\Pi^j, \Pi^k) = \int_{R_Y} T^j(y) d\hat{F}(y; \Pi^j, \Pi^k) = \int_0^1 T^j(m(x)) dF(x)$ . We use the second specification because of simplicity reasons. From (2), (3), and since  $T^j(\bar{\Pi}) = \frac{1}{2}$  with  $j = L, R$ , and  $m(x) = \bar{\Pi} \forall x$  if  $\Pi^L = \Pi^R$ , we obtain

$$A^L(\Pi^L, \Pi^R) = \begin{cases} \int_0^{\bar{\Pi}} \left( \frac{\Pi^R}{2\bar{\Pi}} + \frac{\Pi^L - \Pi^R}{4\bar{\Pi}^2} x \right) f(x) dx + \int_{\bar{\Pi}}^1 \left( \frac{1 - \Pi^R}{2(1 - \bar{\Pi})} + \frac{\Pi^R - \Pi^L}{4(1 - \bar{\Pi})^2} (1 - x) \right) f(x) dx & \text{if } \Pi^L \neq \Pi^R \\ \frac{1}{2} & \text{if } \Pi^L = \Pi^R \end{cases}$$

$$A^R(\Pi^R, \Pi^L) = \begin{cases} \int_0^{\bar{\Pi}} \left( \frac{\Pi^L}{2\bar{\Pi}} + \frac{\Pi^R - \Pi^L}{4\bar{\Pi}^2} x \right) f(x) dx + \int_{\bar{\Pi}}^1 \left( \frac{1 - \Pi^L}{2(1 - \bar{\Pi})} + \frac{\Pi^L - \Pi^R}{4(1 - \bar{\Pi})^2} (1 - x) \right) f(x) dx & \text{if } \Pi^L \neq \Pi^R \\ \frac{1}{2} & \text{if } \Pi^L = \Pi^R \end{cases}$$

Below, we present the equilibrium for the case  $x \sim U[0, 1]$ .

**Proposition 3** *If  $\tau = 0$  and  $x \sim U[0, 1]$ , a continuum of audience equilibria arise, i.e. every pair  $\{\Pi^{L*}, \Pi^{R*}\} \in [0, 1]^2$  constitutes an audience equilibrium.*

**Proof.** Denote by  $\Omega^L(\Pi^L, \Pi^R)$  the audience of the station  $L$  in case  $\Pi^L \neq \Pi^R$ . Then, we get  $\Omega^L(\Pi^L, \Pi^R) = \frac{1}{2} + \frac{\Pi^L - \Pi^R}{8} + \frac{\Pi^R - \Pi^L}{4(1 - \bar{\Pi})} - \frac{\Pi^R - \Pi^L}{8(1 - \bar{\Pi})^2} (1 - \bar{\Pi}^2) = \frac{1}{2}$ .

Using similar reasoning we get analogous results for station  $R$ . Hence, as  $\Omega^j(\Pi^j, \Pi^k) = \frac{1}{2}$  for  $j = L, R$  with  $j \neq k$ , and  $A^j(\Pi^j, \Pi^k) = \frac{1}{2}$  if  $\Pi^j = \Pi^k$ , we conclude that every pair  $\{\hat{\Pi}^{L*}, \hat{\Pi}^{R*}\} \in [0, 1]^2$  constitutes an audience equilibrium. ■

The intuition of this result is that as  $Y(x) = m(x)$  and its range depends on  $\Pi^{\min}, \Pi^{\max}$ , whenever a television station moves to the center it wins the viewers it approaches to, but it loses the viewers it moves away from. This idea, together with the linearity, implies that any location gives the two stations the same audience shares. The idea is illustrated in Figure 3, where  $\Pi^L$  represents the initial position of outlet  $L$ , and  $\hat{\Pi}^L$  the new one.

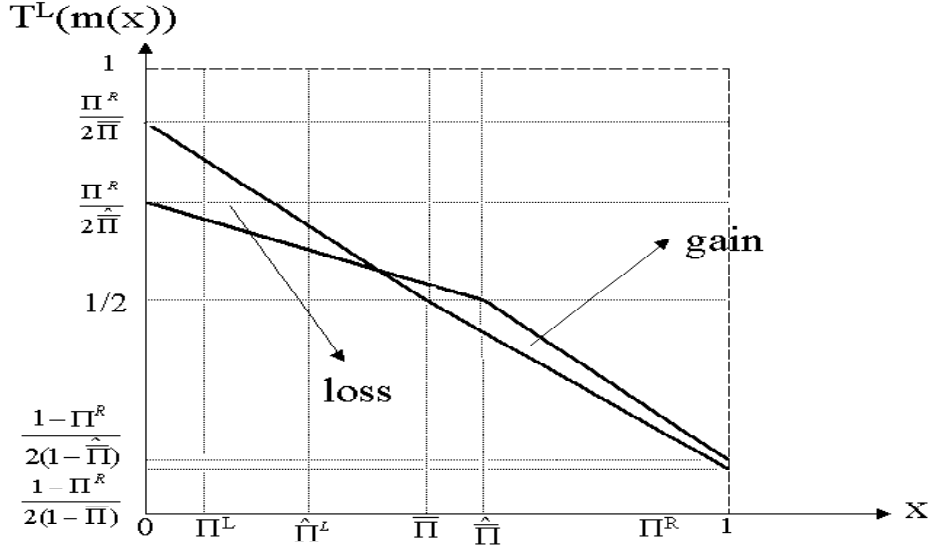


Figure 3. Gain and loss derived from a movement in the location of station  $L$ .

Next, we give some examples to illustrate what happens if we do not assume  $x \sim U[0, 1]$ . For these cases we do not present generic results, but some remarks.

**Case 1** Suppose  $x \sim \text{Beta}[p, p]$  with  $p \geq 2$ . Then, in the unique equilibrium  $\Pi^{L*} = \Pi^{R*} = \frac{1}{2} = x_m$ .

**Case 2** Suppose  $f(x) = 1 + b(x - \frac{1}{2})$  with  $b \in (0, 2)$  i.e. the family of linear increasing density functions. Then, in the unique equilibrium  $\Pi^{L*} = \Pi^{R*} = 1 > x_m$ .

**Case 3** Suppose  $f(x) = 1 + b(\frac{1}{2} - x)$  with  $b \in (0, 2)$  i.e. the family of linear decreasing density functions. Then, in the unique equilibrium  $\Pi^{L*} = \Pi^{R*} = 0 < x_m$ .

Note that the final equilibrium locations are determined by the shape of the distribution functions. Thus, the reason holding the median viewer location in the case  $x \sim \text{Beta}[p, p]$ , is that the largest mass of the viewers has moderate political preferences. On the other hand, in a situation where most of the individuals are conservatives, the equilibrium is the right extreme ideology. The final case where the mass of agents has liberal views is similarly analyzed. There, the equilibrium is the extreme left ideology as it is the dominant ideology in the population.

## 4.2 Unitarian precision

Suppose now viewers have an initial precision equal to one, i.e.  $\tau = 1$ . This is the case if viewers' ideology is a random variable with a variance equal to one. Under this assumption, viewer  $x$  will present a new ideology  $Y$ , once the update is done, which will be a convex combination between her initial ideology and the ideology she watches on television. In particular

$$Y(x) = \begin{cases} \frac{x \frac{\Pi^{\min}(\bar{\Pi} - x)}{\bar{\Pi}} + \Pi^{\min} + \frac{\Delta\Pi}{2\bar{\Pi}}x}{\frac{\Pi^{\min}(\bar{\Pi} - x)}{\bar{\Pi}} + 1} & \text{if } x \leq \bar{\Pi} \\ \frac{x \frac{(1 - \Pi^{\max})(x - \bar{\Pi})}{1 - \bar{\Pi}} + \Pi^{\max} - \frac{\Delta\Pi}{2(1 - \bar{\Pi})}(1 - x)}{\frac{(1 - \Pi^{\max})(x - \bar{\Pi})}{1 - \bar{\Pi}} + 1} & \text{if } x \geq \bar{\Pi}. \end{cases}$$

For the sake of simplicity and just in order to analyze the audience case, we assume  $x \sim U[0, 1]$ , i.e. viewers are initially distributed according to the uniform distribution function. It is important to note that the continuum of equilibria got previously is no longer arising. The reason is that if the precision is not zero, viewers present some grade of resistance against an ideological change. Therefore, what a television station gains with a movement to a more moderate location is higher than what it loses. We feel that this is a more realistic approach to the problem.

Next, we specify the audience payoff function of station  $L$ .<sup>28</sup> The derivation of the distribution function of the new variable  $Y$ , as well as its functional form are in the appendix.

$$A^L(\Pi^L, \Pi^R) = \begin{cases} \int_{\frac{\Pi^L}{1+\Pi^L}}^{\bar{\Pi}} \frac{2\bar{\Pi}-y}{2\bar{\Pi}} \hat{f}(y) dy + \int_{\bar{\Pi}}^{\frac{1}{2-\Pi^R}} \frac{1-y}{2(1-\bar{\Pi})} \hat{f}(y) dy & \text{if } \Pi^L < \Pi^R \\ \int_{\frac{\Pi^R}{1+\Pi^R}}^{\bar{\Pi}} \frac{y}{2\bar{\Pi}} \hat{f}(y) dy + \int_{\bar{\Pi}}^{\frac{1}{2-\Pi^L}} \frac{1-2\bar{\Pi}+y}{2(1-\bar{\Pi})} \hat{f}(y) dy & \text{if } \Pi^L > \Pi^R \\ \lambda_2(\Pi) & \text{if } \Pi^L = \Pi^R = \Pi \end{cases}$$

where  $\lambda_2(\Pi) : [0, 1] \rightarrow [0, 1]$  is a function that defines the audience of the outlet  $L$  whenever  $\Pi^L = \Pi^R = \Pi$ . Note that  $\hat{f}(y)$  is the density function of the transformed variable  $Y$ , since television stations look for the location which will maximize their audience shares (which are measured) at the end of the period. Working through the algebra we get Lemma 1.

**Lemma 1** *If  $\tau = 1$  and  $x \sim U[0, 1]$ , the audience payoff functions can be written as follows*

$$\begin{aligned} A^L(\Pi^L, \Pi^R) &= \begin{cases} \frac{1}{4} \left( 1 + \Pi^L + \Pi^R + \frac{2 \log[1+\Pi^L]}{\Pi^L} - \frac{2 \log[2-\Pi^R]}{1-\Pi^R} \right) & \text{if } \Pi^L < \Pi^R \\ \frac{1}{4} \left( 3 - \Pi^L - \Pi^R - \frac{2 \log[1+\Pi^R]}{\Pi^R} + \frac{2 \log[2-\Pi^L]}{1-\Pi^L} \right) & \text{if } \Pi^L > \Pi^R \\ \lambda_2(\Pi) & \text{if } \Pi^L = \Pi^R = \Pi \end{cases} \\ A^R(\Pi^R, \Pi^L) &= 1 - A^L(\Pi^L, \Pi^R) \end{aligned}$$

Next, we present the proposition for the audience, as well as a sketch of the proof.<sup>29</sup>

<sup>28</sup>The audience payoff function of station  $R$  is easily derived using an analogous argument.

<sup>29</sup>A complete proof of Proposition 4 is available from the author on request.

**Proposition 4** *If  $\tau = 1$  and  $x \sim U[0, 1]$ , the unique audience equilibrium is  $\widehat{\Pi}^{L*} = \widehat{\Pi}^{R*} = \frac{1}{2}$ , where each station gets one half of the audience.*

**Proof.** Let us define  $\Sigma_1^L(\Pi^L, \Pi^R)$  as the objective function of media outlet  $L$  in case  $\Pi^L < \Pi^R$ . It results from operations that  $\frac{\partial \Sigma_1^L(\Pi^L, \Pi^R)}{\partial \Pi^L} = \frac{1}{4} \left( 1 + \frac{2}{\Pi^L + (\Pi^L)^2} - \frac{2 \log[1 + \Pi^L]}{(\Pi^L)^2} \right)$ , expression which can be shown to be positive.

Let us define  $\Sigma_2^L(\Pi^L, \Pi^R)$  as the objective function of media outlet  $L$  in case  $\Pi^L > \Pi^R$ . Again through operations,  $\frac{\partial \Sigma_2^L(\Pi^L, \Pi^R)}{\partial \Pi^L} = -\frac{1}{4} \left( 1 + \frac{2}{(1 - \Pi^L)(2 - \Pi^L)} - \frac{2 \log[2 - \Pi^L]}{(1 - \Pi^L)^2} \right)$ , which can be shown to be negative.

Therefore, either the best response of station  $L$  against  $\Pi^R$  is  $\widehat{\Pi}^L(\Pi^R) = \Pi^R$ , or it doesn't exist. Using a similar reasoning we get for the station  $R$ , that either  $\widehat{\Pi}^R(\Pi^L) = \Pi^L$  or  $\nexists \widehat{\Pi}^R(\Pi^L)$ . Therefore, the unique equilibrium in pure strategies either holds  $\widehat{\Pi}^{L*} = \widehat{\Pi}^{R*} = \widehat{\Pi}^*$  or it does not exist.

To proof that this possible equilibrium satisfies  $A^L(\widehat{\Pi}^*) = A^R(\widehat{\Pi}^*) = 1/2$ , we use a similar argument to the one in Proposition 1, which give us the result that if the equilibrium exists, it must be the case that  $\lambda_2(\widehat{\Pi}^*) = \frac{1}{2} = \Sigma(\widehat{\Pi}^*)$ , with  $\Sigma(\widehat{\Pi}^*) = \frac{1}{4} \left( 1 + 2\widehat{\Pi}^* + \frac{2 \log[1 + \widehat{\Pi}^*]}{\widehat{\Pi}^*} - \frac{2 \log[2 - \widehat{\Pi}^*]}{1 - \widehat{\Pi}^*} \right)$ . On the other hand, the existence and uniqueness of this equilibrium follows from the fact that  $\Sigma(\widehat{\Pi})$  is continuous and increasing in  $\widehat{\Pi}$ , with  $\Sigma(0) < \frac{1}{2}$  and  $\Sigma(1) > \frac{1}{2}$ , therefore it exists a unique value  $\widehat{\Pi}^*$  such that  $\Sigma(\widehat{\Pi}^*) = \frac{1}{2}$ , which further coincides with  $\frac{1}{2}$ . ■

Proposition 4 states that the equilibrium locations coincide with the ideology of the new median viewer, which can be easily proved to be also one half (since equilibrium locations are symmetric about one half). We claim that this result comes from the fact that we have assumed  $x \sim U[0, 1]$ . We conjecture that the result would not be the same under any asymmetric density function.

On the other hand and in order to solve the influence problem, we do not need to assume any particular distribution function,<sup>30</sup> since a general result is here easily obtained. We characterize it in the next proposition.

**Proposition 5** *If  $\tau = 1$ , the unique influence equilibrium is  $\widehat{\Pi}^{L*} = 0$ ,  $\widehat{\Pi}^{R*} = 1$ .*

**Proof.** Since  $Y(x)$  is increasing in  $\Pi^L$  and the influence payoff function is given by  $\widehat{F}(\frac{1}{2}; \Pi^L, \Pi^R)$  for outlet  $L$ , we have that  $\widehat{F}(\frac{1}{2}; \Pi^L, \Pi^R) > \widehat{F}(\frac{1}{2}; \widehat{\Pi}^L, \Pi^R)$  for every  $\widehat{\Pi}^L > \Pi^L$ , therefore  $\widehat{\Pi}^{L*} = 0$ . Analogously, since  $Y(x)$  is increasing in  $\Pi^R$  and  $1 - \widehat{F}(\frac{1}{2}; \Pi^L, \Pi^R)$  is the payoff function of station  $R$ , we have that  $\widehat{F}(\frac{1}{2}; \Pi^L, \Pi^R) > \widehat{F}(\frac{1}{2}; \Pi^L, \widehat{\Pi}^R)$  therefore  $1 - \widehat{F}(\frac{1}{2}; \Pi^L, \Pi^R) < 1 - \widehat{F}(\frac{1}{2}; \Pi^L, \widehat{\Pi}^R)$  for every  $\widehat{\Pi}^R > \Pi^R$ . Thus, it is optimal for station  $R$  to locate at  $\widehat{\Pi}^{R*} = 1$ . ■

Once more, the result for the case of media outlets competing for influence shows that in equilibrium the locations are extremely polarized.

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<sup>30</sup>The unique requirement on the distribution function is, as usual, that it has positive probability in all the interval  $[0, 1]$ .

We conclude with some remarks:

(i) Suppose  $\tau$  is a function on  $x$  which holds the required empirical properties.<sup>31</sup> Then we conjecture that the ideological equilibrium would be  $\widehat{\Pi}^{L*} = 0, \widehat{\Pi}^{R*} = 1$ . The reason is that if the moderate viewers are the less resistant to a change, then television stations would have even more reasons for the polarization, as they are now more interested in the centrist viewers.

(ii) Suppose  $\tau(x) \rightarrow \infty \forall x$ . Then,<sup>32</sup>  $\lim_{\tau(x) \rightarrow \infty} Y(x) = x$ . Hence, the audience payoff function station  $j$  would face (in the limit) would be  $A^j(\Pi^j, \Pi^k) = \int_0^1 T^j(x) dF(x)$ , the one in Section 3. Thus, the audience equilibrium would approach the audience equilibrium in that case. On the other hand, if  $\tau(x) \rightarrow \infty \forall x$ , media outlets would not be interested in the political influence as viewers in this case are totally rigid, i.e. do not let media to influence them under any circumstance.

## 5 Conclusions

Mass media is supposed to expose the public to information. It is an important fact, as this exposure allows the media to play a role in the formation of the public opinion. So much so that many interest groups are involved in the control of media outlets.

The aim of this paper is to model the two objectives television stations usually present, as well as to study the type of competition and the outcomes that arise in equilibrium. Thus, we have analyzed the economic and the political aim. The reason for television stations having an economic objective is that they are firms which should be profit maximizers. The reason for these outlets having a political objective comes from the aforementioned possibility of interest groups being concerned with the control of the media. We have analyzed these two aims in two different setups. The first one refers to the case where television play a role in modifying viewers' voting probabilities. The second one consider the case where television can change the viewers' political preferences.

We derived from the model two clear results: competition for audience results in a minimal differentiation, whereas competition for influence leads to a maximal differentiation. These results hold both in the reinforcement and in the attitudinal orientation approach.

Another important outcome is that when television stations compete for the economic aim, the equilibrium location does not necessarily coincide with the location of the median viewer. We interpret this result as a break with MVT, although as previously pointed out, it can also be thought as a remark on the theorem, saying that it is not the median what is important but the fact that locations and gains are the same. Whatever the interpretation is, the point is that it is the channel hopping what gives this new flavour of the MVT. To this respect, we showed that: (i) If viewers only watch their closest television station<sup>33</sup> and the ideology is uniformly distributed, the ideological equilibrium for the reinforcement

<sup>31</sup>This means that extreme viewers are more rigid than the moderate ones, who are more open to influence.

<sup>32</sup>If  $\tau(x) \rightarrow \infty \forall x$ , then  $\lim_{\tau(x) \rightarrow \infty} Y(x) = \lim_{\tau(x) \rightarrow \infty} \frac{x\tau(x)d(x,m(x))+m(x)}{\tau(x)d(x,m(x))+1} = \frac{xd(x,m(x))}{d(x,m(x))} = x$ .

<sup>33</sup>As it is in the standard models of political economy where voters vote for their closest located political party.

setup does not imply a polarization of locations but a less important differentiation; (ii) The audience equilibrium is directly linked with the MVT. Both results are different if we introduce the possibility of channel hopping. This contrast therefore highlights the role played by this assumption in the model.

The paper is somehow related to the literature on advertising. This literature usually distinguishes between informative and persuasive advertising,<sup>34</sup> a distinction that can also apply to the political information mass media deliver. In this way, we consider our viewers as agents who realize these two features of information, and therefore choose to attend to both TV news in order to offset the persuasiveness effect each station introduces in its news transmission.

We also consider that one of the main contributions of this paper is the proposal of a new argument justifying the political bias observed in real life, where by political bias we mean media outlets favoring different politicians and therefore giving more coverage to one party than to the other. Up to now, and to the best of our knowledge, this bias has received little attention by economists. Besley and Prat (2001) referred to this bias and explained it as a consequence of the viewers' preferences for ideology. More specifically, they argued that media outlets procure political ideologies in their news because agents like so. We claim that this bias could be a consequence of the knowledge media have on their influencing power. This is a new argument for the economic literature, but not at all new within the psychological literature.

Last, let us finish justifying the title of the paper, which we consider the broader question to the results we provide. In this way, if empirical evidence shows a minimal political differentiation between television stations, we derive that they maximize profits; whereas if the evidence points to political biases, we infer that they compete to influence voters.

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<sup>34</sup>By informative advertising is understood that kind of advertising which gives basic product information (prices, characteristics), whereas persuasive advertising usually means advertising that intends to enhance consumer tastes for a certain product, trying to boost the industry demand for that advertised product. See Oz (1995).

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## 6 Appendix: Derivation of the distribution function of the transformed variable $Y$ when $\tau=1$ .

First of all, note that the function  $Y(x)$  is increasing and concave for every  $x \leq \bar{\Pi}$ , and increasing but convex for every  $x \geq \bar{\Pi}$ . We represent this result graphically.

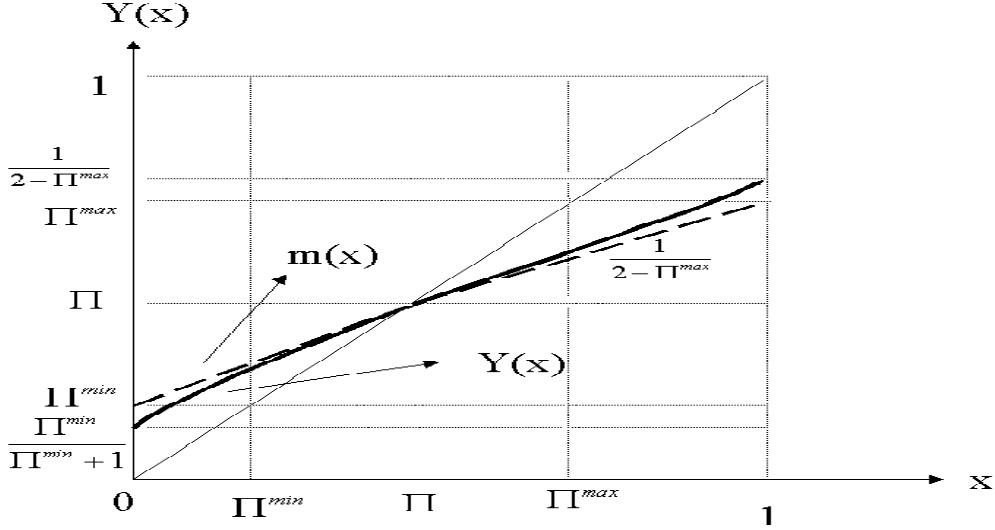


Figure 4. Final ideology as a function of the initial ideology.

On the other hand, since  $x$  is a random variable with  $f(x) > 0 \forall x \in [0, 1]$ , and  $Y(x) : [0, 1] \rightarrow [\frac{\Pi^{min}}{\Pi^{min}+1}, \frac{1}{2-\Pi^{max}}]$  is Borel measurable (it is continuous in  $x$ ),  $Y(x)$  is a continuous random variable with a continuous distribution function  $\hat{F}(y; \Pi^L, \Pi^R) = F(Y^{-1}(y)) \forall y \in [\frac{\Pi^{min}}{\Pi^{min}+1}, \frac{1}{2-\Pi^{max}}]$ . More precisely,

$$\hat{F}(y; \Pi^L, \Pi^R) = \begin{cases} 0 & \forall y < \frac{\Pi^{min}}{\Pi^{min}+1} \\ F\left(\frac{a(y, \Pi^L, \Pi^R) - \sqrt{b(y, \Pi^L, \Pi^R)}}{c(\Pi^L, \Pi^R)}\right) & \forall \frac{\Pi^{min}}{\Pi^{min}+1} \leq y \leq \bar{\Pi} \\ F\left(\frac{d(y, \Pi^L, \Pi^R) + \sqrt{e(y, \Pi^L, \Pi^R)}}{r(\Pi^L, \Pi^R)}\right) & \forall \bar{\Pi} \leq y \leq \frac{1}{2-\Pi^{max}} \\ 1 & \forall y > \frac{1}{2-\Pi^{max}} \end{cases}$$

with

$$\begin{aligned} a(y, \Pi^L, \Pi^R) &= \Delta\Pi + (\Pi^{min})^2 + \Pi^L\Pi^R + 2\Pi^{min}y \\ b(y, \Pi^L, \Pi^R) &= (-\Delta\Pi - (\Pi^{min})^2 - \Pi^L\Pi^R - 2\Pi^{min}y)^2 \\ &\quad - 8\Pi^{min}(-(\Pi^{min})^2 - \Pi^L\Pi^R + \Pi^{min}y(1 + \Pi^{min}) + \Pi^{max}y(1 + \Pi^{min})) \end{aligned}$$

$$\begin{aligned}
c(\Pi^L, \Pi^R) &= 4\Pi^{\min} \\
d(y, \Pi^L, \Pi^R) &= 2\Pi^{\min} - \Pi^L\Pi^R - (\Pi^{\max})^2 + 2y(1 - \Pi^{\max}) \\
e(y, \Pi^L, \Pi^R) &= \left(2\Pi^{\min} - \Pi^L\Pi^R - (\Pi^{\max})^2 + 2y(1 - \Pi^{\max})\right)^2 \\
&\quad - 4(-2 + 2\Pi^{\max})(-2\bar{\Pi} + \Pi^L\Pi^R + (\Pi^R)^2 + 2y(1 - \Pi^L) - \Pi^{\min}y(2 - \Pi^{\min}) + \Pi^L\Pi^Ry) \\
r(\Pi^L, \Pi^R) &= 4(1 - \Pi^{\max})
\end{aligned}$$

and density function,  $\hat{f}(y; \Pi^L, \Pi^R)$  or  $\hat{f}(y)$ .