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The demand for and the supply of pluralism: a model of media market.

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Abstract

Preliminary draft

1 Introduction

Media play a crucial role in transmitting information to mass audience. People using it them understand the world-around, make decisions and vote. Therefore it is widely recognized that media pluralism is a cornerstone of democratic organizations. It is also true that pluralism is a multifaceted notion. The Council of Europe, for instance, adopts the following definition of media pluralism: "the scope for a wide range of social, political and cultural values, opinions, information and interests to find expression through the media".

According to the above definition, media studies have devoted remarkable efforts to clarifying and analyzing the concept of media freedom, while much less effort as been straight devoted to the concept of pluralism. The economic literature on media pluralism is basically related to the concepts of media capture and media bias, both at theoretical and empirical level. From the empirical viewpoint, several contributions explain media influence over politics and individual behavior, for instance: Gentzkow, Shapiro (2004) and Della Vigna, Kaplan (2005)). At the theoretical level, in the strand of media capture, for instance, Besley and Prat (2005) show that as the number of independent media grows, media capture become less profitable, without any concerns about the reports. In this respect media plurality is a safeguard against media capture, since it is more costly for the government to silence them. Similarly, Corneo (2006) analyzes the role played by firm ownership and interest groups to capture media and, in general, to affect media independence. He shows that an increase in the level of wealth concentration can raise the probability of media capture, because media has much to benefit from manipulating the electorate. More generally, media bias is more likely to happen in the case society is polarized. Also, Stromberg (2004) identifies various channel whose trough media matter on politics. Given the existence of increasing return to scale, news media will provide more space to issues of interest to large groups. This news bias translates in a distortion of public policy against small groups of voters.

The way this literature deals with the notion of pluralism is not entirely satisfactory. Provided it is mentioned at all, pluralism is measured by the number of sources (voices) in the media markets, while keeping into account some index of concentration. Two examples might help in understanding why this notion deserves further attention. First, suppose that there exist a large number of sources, covering only a narrow subset of potentially relevant issues. Second, imagine that many sources share the same point of view on some controversial issue and therefore are likely to tell the same story. In both cases is hard to say that the degree of pluralism is satisfactory.

In the present paper, we define and model pluralism as the availability of information about a wide of range of issues and as the possibility, for the individual, to compare different points of view on the same issue. Therefore, pluralism means that any issue which is of interest to the individual is covered by at least one source of information and that each issue is debated by at least two mutually independent sources. In this respect the existence of a large number of sources constitutes a favorable condition for pluralism, but in general not a sufficient one. Moreover, while in the recent literature on media economics, analysis focuses on media bias caused either by capture or by opportunistic behavior on the supply side, in this paper we stress the size and structure of market demand for information as determinants of pluralism. Since, according to empirical evidence, a key determinant of the propensity to get informed is the individual's education level (see Figure 1) we shall be discussing the role of human capital in promoting pluralism. In this respect we are closer to the work of Mullainathan and Shleifer (2005) in whose paper demand and audience heterogeneity play a significant role. Under the hypothesis that the quality of information is its accuracy, while media can omit specific bits of news, they show that reader heterogeneity is more important that than competition per se. Also, Vaglio (2006), explicitly introduce the concept of pluralism as the existence of at least two sources with different political preferences; for instance a pro-government press versus pro-minority press.

The paper is organized as follows: Section 2 presents the basic set up,

Newspaper readers, in Italy, by education classes, percentage. (2006)			
Degree			
Bachelor		100	91,7
High school		100	89,4
Secondary school		100	84,7
Prymary school		100	70,8
No degree		100	39,4
Source: Audipress, 2006-1			

in the case where each individual is willing to read at most one source on each issue he is interested in. Section 3 analyzes the conditions such that the individual is willing to read more than one report on each relevant issue. Section 4 provides some tentative conclusions.

2 The general framework

Imagine a situation where there exist a set of a potentially relevant issues, described by an interval $L \subset \mathbb{R}$, a population of individuals (which for the time being can be seen as composed by one individual only) and n media outlets (sources).

The core of the model consists in the choice between two actions, a and b, which the individual(s) must make for each issue in L. For each issue, there are two possible states of the world, A and B respectively: if the state is A (B) on some issue, the most appropriate choice as regards that issue is a (b). At time 0, Nature selects one issue, $i \in L$ which we define as the "hot" issue, and selects a state (A or B) for each issue in L. When the individual makes his choice, he knows what the hot issue is, while he does not know what the state of the world is for any issue; π is the prior probability that the state of the world is A. The issues are not all equivalent from the point of view of the individual: the utility from choosing the appropriate action depends on how different ("far") the concerned issue is from the "hot" one. Formally:

- $\omega^A(i,j) \equiv \omega^A - |i-j|$ is the *ex-post* utility of the individual when he picks up the appropriate action about the j issue and the state of the world is A. $\omega^B(i,j) \equiv \omega^B - |i-j|$ has the same meaning when the state of the world is B.

- l^A (l^B) is the *ex-post* utility of the individual when he picks up the least appropriate action when the state of the world is A (B).

Also at time 0, Nature selects a value $v \in L$ for each of the n sources. We call v the *focal* issue for the corresponding source. Each source chooses an interval $\delta \subseteq L$, centered at v, which we call the *scope* of the source and that can be interpreted as the set of issues covered. Each source faces a fixed setup cost Z. Moreover, when choosing a scope δ, a source incurs a cost $F(\delta)$. We assume that $F'(\delta) > 0$ and $F''(\delta) \geq 0$. Then the function $\frac{Z+F(\delta)}{\delta}$ is U-shaped with a minimum at some $\widehat{\delta}$ where $\frac{Z+F(\widehat{\delta})}{\widehat{\delta}} = F'(\widehat{\delta})$. As regards revenues, the source earns a reward of w for every reader who chooses the source's report. At time 1, the sources observe a signal σ_j for each $j \in \delta$. If the state of the world is A (B), the signal σ_j is A $(B)$with probability q. q might be interpreted as the reliability of a newspaper or the accuracy of the information, or again as an index of the quality. Each source then publishes a report containing a truthful statement the signals that it has observed.

Since the individual does not know the states of the world, then he may choose on the basis of his prior π or he may resort to the additional information contained in the reports. Reading is a costly activity. Reading costs have, in principle, two components: one is the price of the report, the other is the opportunity cost of time. In this paper we assume that the first component is absent, so that the reward w that the sources receive consists entirely of advertising revenue. Notice that, we focus on information accuracy and on the technology of information provision rather than on the strategic behavior of the supply side.

Define $s_1, s_2, ..., s_n \subseteq L$ as the collection of disjoint closed intervals which the individual reads about. Further, define $S \equiv \bigcup_{i=1}^{N} s_i$. Reading one report concerning a issue i requires a time $\dfrac{1}{h}$, where h measures the individual capability of processing information in a given time interval. The larger h, the shorter the time required to read. If instead the individual reads two reports about a given issue, this requires a time $\dfrac{k(h)}{h}$, where $k(h)$ is a continuous decreasing function of h, bounded below at 1 (it is impossible to read two reports in a time smaller than the time required to read one). Then, given an interval S on L, $\dfrac{S}{h}$ is the time required to read one report for each issue in S, while $\dfrac{k(h)}{h}S$ is necessary to read two reports. We assume that h is related to the education level of the individual, and with some degree of approximation shall refer to h as the stock of human capital available to the individual. Then, given h and the hot issue i, the individual chooses $S(i)$. In this model it will turn out that the choice of S is independent of i, but this is not the necessarily the case in general.

Sources do not observe i , but they know what $S(i)$ is for every value of $i \in L$ and incorporate such knowledge in their choice of δ. Also, the choice of S by the individual depends on what the individual expects the δ's to be.

Finally, the individual reads the reports he has selected and makes his choices about all the issues in L.

3 Single-report vs multiple-report reading

We now proceed in the analysis of reader's behavior. In particular, we are interested in understanding under which conditions an individual is willing to read one, two or no reports on a given issue. We assume that the reader *ex-ante* best is a, given the prior π, for any j and i. Formally:

$$\begin{gathered} V(a;i,j) = \pi\omega^{A}(i,j) + (1-\pi)\, l^{B} > \\ \pi l^{A} + (1-\pi)\,\omega^{B}(i,j) = V(b;i,j) \end{gathered} \tag{1}$$

The above expression (1) rewrites as:

$$V(a;i,j) = V(a) - \pi\,|i-j| \tag{2}$$

where $V(a) \equiv \pi\omega^{A} + (1-\pi)\, l^{B}$. The expected utility for an individual who reads a single report is:

$$V_1(i,j) = V_1 - q\,|i-j| \tag{3}$$

where

$$V_1 = q\left[\pi\omega^{A} + (1-\pi)\,\omega^{B}\right] + (1-q)\left[(1-\pi)\, l^{B} + \pi l^{A}\right] \tag{4}$$

The expected utility for an individual who reads two reports is instead:

$$V_2(i,j) = V_2 - \alpha\,|i-j| \tag{5}$$

where

$$V_2 = \pi q\,[2-q]\,\omega^{A} + (1-\pi)\, q^2\omega^{B} + \pi\,(1-q)^2\, l^{A} + (1-\pi)\left(1-q^2\right) l^{B} \tag{6}$$

and

$$\alpha = q\left[2\pi\left(1-q\right)+q\right] \tag{7}$$

Let us now turn to the decision problem for an individual who knows what the hot issue i is and must decide which issues to read about, and whether to read one or two reports. We shall assume throughout what follows:

$$V_2 - V(a) > 0 \text{ and } V_1 - V(a) > 0 \tag{8}$$

We explore first a pattern where the individual reads

- two reports on each issue contained in an interval Σ centered at i,
- one report on two intervals, namely $\left[i+\frac{\Sigma}{2}, i+\frac{S}{2}\right]$ and $\left[i-\frac{S}{2}, i-\frac{\Sigma}{2}\right]$
- no reports on the issues contained in the intervals $\left[0, i-\frac{S}{2}\right]$ and $\left[i+\frac{S}{2}, L\right]$

The intuition is that the individual devotes less reading time to issues which are less related to ("farthest" from) the hot one and concentrates his reading effort on the hot issue and the closest ones. The expected utility function to be maximized by choosing S and Σ is:

$$\begin{gathered} U=\int_{i-\frac{\Sigma}{2}}^{i+\frac{\Sigma}{2}} V_2-\alpha\left|i-j\right|dj+\int_{i+\frac{\Sigma}{2}}^{i+\frac{S}{2}} V_1-q\left|i-j\right|dj+ \\ +\int_{i-\frac{S}{2}}^{i-\frac{\Sigma}{2}} V_1-\left|i-j\right|qdj+\int_{0}^{i-\frac{S}{2}} V(a)-\pi\left|i-j\right|dj+ \\ +\int_{i+\frac{S}{2}}^{L} V(a)-\pi\left|i-j\right|dj+c^{\gamma} \end{gathered} \tag{9}$$

Since $S=\Sigma+\Delta$, the last expression can be rewritten as

$$\begin{gathered} U=V_2\Sigma-\alpha\frac{\Sigma^2}{4}+V_1\Delta-q\left(\frac{\Delta^2+2\Sigma\Delta}{4}\right)+ \\ +V(a)\left(L-\Sigma-\Delta\right)+\pi\left(\frac{\Delta^2+2\Sigma\Delta+\Sigma^2}{4}+i^2+\frac{L^2}{2}-iL\right)+c^{\gamma} \end{gathered} \tag{10}$$

The individual faces the following budget constraint:

$$c \leq \left(T-\frac{\Delta+k\left(h\right)\Sigma}{h}\right), L \geq \Sigma+\Delta, \Sigma, \Delta \geq 0. \tag{11}$$

The first-order conditions (for interior solutions) are:

$$V_2 - V(a) + (\pi - \alpha)\,\frac{\Sigma}{2} + (\pi - q)\,\frac{\Delta}{2} - \lambda\frac{k(h)}{h} = 0 \qquad (12)$$

$$V_1 - V(a) + (\pi - q)\,\frac{\Sigma + \Delta}{2} - \frac{\lambda}{h} = 0 \qquad (13)$$

$$\gamma c^{\gamma - 1} - \lambda = 0 \qquad (14)$$

Discussing in full the conditions (12) and (13) would require the inspection of a large array of special cases, corresponding to many sensible assumptions on parameter values.

We shall therefore adopt the following simplifying assumption :

$$\gamma = 1 \qquad (15)$$

which implies $\lambda = 1$. Moreover, we shall focus on the subset of cases which emerge when

$$\pi < q < \alpha \qquad (16)$$

This restriction implies that the marginal value from expanding the range of issues covered by the reader is always decreasing, both when the individual reads just one report and when he reads two reports on the marginal issue. Given assumption (15) focusing on this case means avoiding the systematic occurrence of corner solutions, namely, cases where, as h falls below some threshold value, the individual reads nothing about all issues, while for h larger than the threshold he reads at least one report about all issues in $[0, L]$.

We now introduce an assumption concerning the derivative of the $k(h)$ function:

$$\frac{k'(h)}{h} > \frac{1}{h^2}\left[k(h) - \frac{\pi - \alpha}{\pi - q}\right] \qquad (17)$$

We shall now discuss the existence and the properties of the solutions to the decision problem of the individual. First of all, let us define the following key values for h and let, for notational ease, be $\frac{k(h)}{h} \equiv c(h)$:

- h_2^0 such that: $V_2 - V(a) = c(h_2^0)$

- h_1^0 such that : $V_1 - V(a) = \frac{1}{h_1^0}$
- $\underline{h}_2$ such that: $V_2 - V_1 = c(\underline{h}_2) - \frac{1}{\underline{h}_2}$
- $\underline{h}_1$ such that: $\frac{1}{\underline{h}_1}\frac{\pi-\alpha}{\pi-q} - c(\underline{h}_1) = \frac{\pi-\alpha}{\pi-q}\left[(V_1 - V(a))\right] - \left[(V_2 - V(a))\right]$

h_2^0 (h_1^0) can be interpreted as the level of education which makes Σ (Δ) equal to 0 as Δ (Σ)) is equal to 0, while $\underline{h}_2$ $(\underline{h}_1)$ can be interpreted as the level of education which makes $\Sigma\,(\Delta)$ equal to 0 as $\Delta\,(\Sigma)$ is positive. The next proposition shows an important implication of assumption (17)

Proposition 1 *Under assumptions (15), (16) and (17)* $h > \underline{h}_1$ *implies* $\frac{\pi-\alpha}{\pi-q}\left[(V_1 - V(a))\right] - \left[(V_2 - V(a))\right] > \frac{1}{\underline{h}_1}\frac{\pi-\alpha}{\pi-q} - c(\underline{h}_1)$

Proof. *The derivative of* $\frac{1}{\underline{h}_1}\frac{\pi-\alpha}{\pi-q} - c(\underline{h}_1)$ *with respect to* h *is* $\frac{k'(h)}{h} + \frac{1}{h^2}\left(\frac{\pi-\alpha}{\pi-q} - k(h)\right)$ *which is negative by assumption (17).By the definition of* $\underline{h}_1$*, the result easily follows.* ■

The next two Propositions state what happens for very low and very high values of h.

Proposition 2 *Suppose* $V_2 - V(a) > 0$ *and* $V_1 - V(a) > 0$*. Under assumptions (15) and (16) , then there exists some value* $\underline{h}^0$ *such that* $h \leq \underline{h}^0$ *implies that the individual does not read at all about any issue.*

Proof. Define $\underline{h}^0 \equiv \min\left[h_1^0, h_2^0\right]$.Then according to the necessary conditions (12) and (13), as $h \leq \underline{h}^0$ the solution can only be $\Delta = \Sigma = 0$.

Proposition 3 *Under assumptions (15), (16) and (17) for sufficiently high values of* h*, it is* $\Delta, \Sigma > 0$*.*

Proof. *Define* $\underline{h} \equiv \max\left[\underline{h}_1, \underline{h}_2\right]$*.Then according to the necessary conditions (12) and (13), as* $h \geq \underline{h}$ *there exist solutions with* $\Delta, \Sigma > 0$*,*

■

■

To see what happens for values of h in between $\underline{h}^0$ and $\underline{h}$, consider first the next proposition

Proposition 4 *Under the assumptions* (*16*) *and* (*17*) *the following implications obtain:*

a) $h_2^0 > \underline{h}_2 \Longrightarrow h_2^0 < \underline{h}_1^0$; $h_2^0 < \underline{h}_2 \Longrightarrow h_2^0 > \underline{h}_1^0$

b) $h_1^0 > \underline{h}_2 \Longrightarrow h_1^0 > h_2^0$; $h_1^0 < \underline{h}_2 \Longrightarrow h_1^0 < h_2^0$

Proof. *We begin by proving, for a), b) the first of the two implications; the second one then easily follows.*

a) $h_2^0 > \underline{h}_2 \Longrightarrow V_2 - V_1 > c(h_2^0) - \frac{1}{h_2^0} = V_2 - V(a) - \frac{1}{h_2^0} \Longrightarrow V_1 - V(a) < \frac{1}{h_2^0} \Longrightarrow h_2^0 < h_1^0$.

b) $h_1^0 > \underline{h}_2 \Longrightarrow\ V_2 - V_1 >\ c(h_1^0) - \frac{1}{h_1^0}$*; since* $V_1 - V(a) = \frac{1}{h_1^0}$*, we have* $V_2 - V(a) >\ c(h_1^0) \Longrightarrow h_1^0 > h_2^0$ ■

An important implication of the previous proposition is that, of the many possible configurations of the values $\underline{h}_1, \underline{h}_2, h_1^0, h_2^0$ only the following ones are consistent with them, namely:

$$h_1^0 < h_2^0 < \underline{h}_1 < \underline{h}_2 \tag{18}$$
$$\underline{h}_1 < h_1^0 < h_2^0 < \underline{h}_2 \tag{19}$$
$$h_1^0 < \underline{h}_1 < h_2^0 < \underline{h}_2 \tag{20}$$
$$\underline{h}_2 < h_2^0 < \underline{h}_1 < h_1^0 \tag{21}$$
$$\underline{h}_2 < h_2^0 < h_1^0 < \underline{h}_1 \tag{22}$$
$$\underline{h}_1 < \underline{h}_2 < h_2^0 < h_1^0 \tag{23}$$

$$\underline{h}_2 < \underline{h}_1 < h_2^0 < h_1^0 \tag{24}$$

$$h_1^0 < h_2^0 < \underline{h}_2 < \underline{h}_1 \tag{25}$$

Proposition 5 *Under assumptions* (*15*),(*16*) *and*(17)*, and any of* (18)*,*

(19) , (20) *holds, individuals read one report on all the issues they read about when* $h_1^0 < h < \underline{h}_2$*. If* (21) *or* (22) *holds, individuals read two reports on all the issues they read about when* $h_2^0 < h < \underline{h}_1$*. In cases* (23) *and* (24) *individuals never read one report or two reports on the issues they read about, but,if they read at all read two reports on some issue and one on some others. In case* (25) *, individuals read one report on all the issues they read about when* $h_1^0 < h < \underline{h}_2$*, and two reports an all issues they read about as* $\underline{h}_2 < h < \underline{h}_1$*.*

Proof. By simple inspection of the relevant intervals the proof follows ■

4 The single-report reading model

4.1 The case of full coverage-no overlapping

In this paragraph we consider a special case where q is equal to 1. This is sufficient (although not necessary) to make reading a single report the optimal choice. Let the utility function of the individual be:

$$\begin{array}{c} U = \int_{i-\frac{S}{2}}^{i+\frac{S}{2}} \left[\pi\omega^{A} + (1-\pi)\,\omega^{B} - |i-j|\right] dj + \\ + \int_{0}^{i-\frac{S}{2}} V(a;i,j)dj + \int_{i+\frac{S}{2}}^{L} V(a;i,j)dj + c^{\gamma} \end{array} \tag{26}$$

where c is the consumption of an outside good and

$$V\left(a;i,j\right) = V(a) - \pi\left|i-j\right|$$

where $V(a) = \pi\omega^{A} + (1-\pi)\, l^{B}$.This formulation implicitly means that, in sufficiently large neighborhood of the hot issue, all issues are expected to be covered by some media outlet.

The individual maximizes the utility, (26) under the following budget constraint:

$$c \leq T - \frac{S}{h} \tag{27}$$

T is the time endowment of the individual and we implicitly assume that both the price of time and consumption are unit. $\Omega = \pi\omega^{A} + (1-\pi)\,\omega^{B}$ is the value which V_1 takes when $q = 1$. Then the utility function (26) becomes:

$$\Omega S - \frac{S^2}{4} + V(a)\,(L-S) + \pi L\left(i - \frac{L}{2}\right) - \pi i^2 + \pi\frac{S^2}{4} \tag{28}$$

We cannot derive exact expressions for the optimal values of c and S. However we can write a condition implicitly determining S

$$S = Th - \left[\left(\Omega - V\left(a\right) + \frac{\pi - 1}{2}S\right)\frac{1}{\gamma}\right]^{\frac{1}{\gamma-1}} h^{\frac{\gamma}{\gamma-1}} \tag{29}$$

Two existence conditions must hold. First, the right-hand side of the last expression is decreasing with respect to S and increasing with respect to h. Then, supposing there exists some minimum value for h, $h_{\min}$, the condition

$$Th_{\min}-\left[\frac{\Omega-V(a)}{\gamma}\right]^{\frac{1}{\gamma-1}}h_{\min}^{\frac{\gamma}{\gamma-1}}>0 \tag{30}$$

is sufficient to ensure that (29) has a unique solution. Secondly, the solution must satisfy $\frac{2(\Omega-V(a))}{1-\pi}>S$. Notice, as a final remark on 29 , S increases with h.

Assume that the hot issue is drawn from a uniform distribution on L. Now consider a source whose focal issue is at some $z\in L$. Suppose that the scope of this source is δ_z. Then, given the individual choice of S, the probability that the individual read the report of the z source is $S+\delta_z$.

The advertising fee,w, is set in the advertising market. We just assume that w is decreasing in the number of sources; therefore $\frac{dw(n)}{dn}<0$. Let us remind that the sources do not know which is the piece of news i, but they do know S.

Assuming symmetry of sources, we investigate the relationship among S, δ and n. An equilibrium with full coverage and no overlapping entails a number of necessary conditions. First of all, by definition it must be $n\delta=L$. Second, in equilibrium the zero profit condition must holds in the outlet market. Finally firms maximize profits. The optimization problem for one generic outlet is as follows:

$$\begin{cases}\max\Pi=(S+\delta(w(n)))\,w(n)-F(\delta)\\ \text{s.t. } S+\delta\leq L\end{cases} \tag{31}$$

The corresponding first order conditions for (31) is:

$$\frac{\partial\Pi}{\partial\delta}=F'(\delta)-w(n)=0 \tag{32}$$

which implicitly defines $\delta^*=\delta(w(n))$.

The following Proposition states the conditions for the equilibrium of full coverage no overlapping to exist.

Proposition 6 *If $n\delta(w(n))$ is monotonically increasing, an equilibrium with full coverage and no overlapping exists and it is unique, if L is larger than some minimum value $\underline{L}$.*

Proof. An equilibrium in the case of full coverage and no overlapping is characterized by the two following conditions,

$$(S+\delta(w(n)))\,w(n)-F(\delta(w(n)))=0 \tag{33}$$

$$n\delta\left(w\left(n\right)\right)=L \tag{34}$$

Considering the zero profit condition (33),and substituting the first order condition (32), we get:

$$SF'\left(\delta\left(w\left(n\right)\right)\right)+\delta\left(w\left(n\right)\right)F'\left(\delta\left(w\left(n\right)\right)\right)-F\left(\delta\left(w\left(n\right)\right)\right)=0 \tag{35}$$

Notice that 35 holds for a positive S, only if $F'\left(\delta\left(w\left(n\right)\right)\right)<\dfrac{F\left(\delta\left(w\left(n\right)\right)\right)}{\delta\left(w\left(n\right)\right)}$, which requires

$$w\left(n\right)<\frac{F\left(\widehat{\delta}\right)}{\widehat{\delta}}=\widehat{w} \tag{36}$$

.

Since $n\delta\left(w\left(n\right)\right)$ is monotonically increasing (34) has a unique solution for each L. Such a solution increases with L. Then in order to meet the condition $w\left(n\right)<\widehat{w}$ it must be L larger then some minimum value we call $\underline{L}$. ■

Notice that, if $L<\underline{L}$, an equilibrium with full coverage and no overlapping does not exist. in the case the market configuration collapses

into two alternative cases, namely the incomplete coverage case and the partial overlapping one as illustrated further on.

Proposition 6 characterizes the equilibrium. A step further, in a neighborhood of S, we like to investigate the relationship between the issues demand by the individual, S, and the issues coverage by the sources, δ.

Proposition 7 *The news coverage of a source, δ, negatively depends upon S.*

Proof. j's outlet optimization problem under constraint is as follows:

$$\begin{cases}\max\Pi_j=\left(S+\delta\left(w\left(n\right)\right)\right)w\left(n\right)-F\left(\delta\right)\\ \text{s.t. } S+\delta\leq 1\end{cases} \tag{37}$$

The first order condition for (31) is:

$$\frac{\partial\Pi_j}{\partial\delta}=F'\left(\delta\right)-w\left(n\right)=0 \tag{38}$$

which implicitly defines $\delta^*=\delta\left(w\left(n\right)\right)$. Given the convexity of $F\left(\delta\right)$, we have $\delta'\left(w\left(n\right)\right)>0$. Rearranging the zero profit condition,

$\left(S+\delta\left(w\left(n\right)\right)\right)w\left(n\right)-F\left(\delta\left(w\left(n\right)\right)\right)=0$ as follows

$$\frac{F\left(\delta\left(w\left(n\right)\right)\right)}{w\left(n\right)}-\delta\left(w\left(n\right)\right)=S \tag{39}$$

we can easily calculate the total differential:

$$\left[\frac{F'(\delta(w(n)))\,\delta'(w(n))}{w(n)} - \frac{F(\delta(w(n)))}{w(n)^2} - \delta'(w(n))\right] dw = dS \quad (40)$$

Finally, substituting the equilibrium level from (38) and rearranging the above equation , we get:

$$\frac{dw^*}{dS} = -\frac{w(n)^2}{F(\delta(w(n)))} < 0 \quad (41)$$

Recalling that $\frac{dw(n)}{dn} < 0$, we can sign the following derivative:

$$\frac{dn}{dS} = \frac{dw(n)}{dn}\left(-\frac{w(n)^2}{F(\delta(w(n)))}\right) > 0 \quad (42)$$

Finally:

$$\frac{d\delta(w(n),S)}{dS} = \delta'(w(n),S)\left(\frac{dw(n)}{dn}\right)^2\left(-\frac{w(n)^2}{F(\delta(w(n),S))}\right) < 0 \quad (43)$$

■

The proposition 6 analytically shows that an increase in S, the news market size, implies an increase in the number of outlet, n, which in turn decrease the advertising price w. In turn, the decrease in the source's reward reduce the scope of the single outlet δ. Consequently, the impact of the human capital on δ, is immediately stated by the next Proposition.

Corollary 8 *An increase of the human capital endowment, h, negatively affects the news coverage of the single source, δ.*

Proof. Just remind that S is increasing in h. Then the previous proposition 6 applies. ■

Now we like to investigate the existence of an equilibrium in the case of full coverage and no overlapping, we can turn on the issue of pluralism as measured by the whole degree of news coverage $n\delta(w(n))$.

Proposition 9 *The degree of news coverage $n\delta(w(n),S)$ is increasing in S, if the condition $n\frac{\delta'(n\delta(w(n),S))}{\delta(w(n),S)}w\frac{dw(n)}{dn}\frac{n}{w} > -1$ is verified, .*

Proof. Let define the news coverage as $n\delta(w(n),S)$. The effect of S on the news coverage is represented by the following derivative:

$$\frac{d(n\delta(w(n),S))}{dS} = n\frac{d\delta(w(n),S)}{dS} + \delta(w(n),S)\frac{dn}{dS} \quad (44)$$

Rearranging the above expression, (44), multiplying and dividing by $w(n)$, we get:

$$\frac{d\left(n\delta\left(w\left(n\right),S\right)\right)}{dS}=\frac{dn}{dS}\delta\left(w\left(n\right),S\right)\left(1+n\frac{\delta'\left(n\delta\left(w(n),S\right)\right)}{\delta\left(w(n),S\right)}w\frac{dw(n)}{dn}\frac{n}{w}\right)\quad(45)$$

where $\delta'\left(n\delta\left(w\left(n\right),S\right)\right)=\dfrac{d\delta\left(w\left(n\right),S\right)}{dS}$. In order (45) be positive, the following condition should be satisfied:

$$n\frac{\delta'\left(n\delta\left(w\left(n\right),S\right)\right)}{\delta\left(w\left(n\right),S\right)}w\frac{dw\left(n\right)}{dn}\frac{n}{w}>-1\quad(46)$$

or

$$\frac{\delta'\left(n\delta\left(w\left(n\right),S\right)\right)}{\delta\left(w\left(n\right),S\right)}w<\left|\frac{dn}{dw\left(n\right)}\frac{w\left(n\right)}{n}\right|\quad(47)$$

If $\dfrac{dn}{dw\left(n\right)}\dfrac{w\left(n\right)}{n}=0$ or $\dfrac{\delta'\left(n\delta\left(w\left(n\right),S\right)\right)}{\delta\left(w\left(n\right),S\right)}w=0$ then $\frac{d(n\delta(w(n),S))}{dS}>0$. ■

Notice that, the term $\dfrac{\delta'\left(n\delta\left(w\left(n\right),S\right)\right)}{\delta\left(w\left(n\right),S\right)}w>0$, is a kind of elasticity on the supply side, related to the technology and the cost function. While $\dfrac{dw\left(n\right)}{dn}\dfrac{n}{w}<0$ is a kind of elasticity on the demand side. When the market size increases, n increases as well, but δ falls. Thus the whole effect on the degree of news coverage is ambiguous. Proposition 9 states that the product between the two elasticities is not too big the news coverage grows up. In other words, if the elasticity of advertising demand is relatively low and the supply function is relatively rigid the extension of issues coverage is increasing in S. Finally, the following proposition explains the relationship between human capital level and the extension of news coverage.

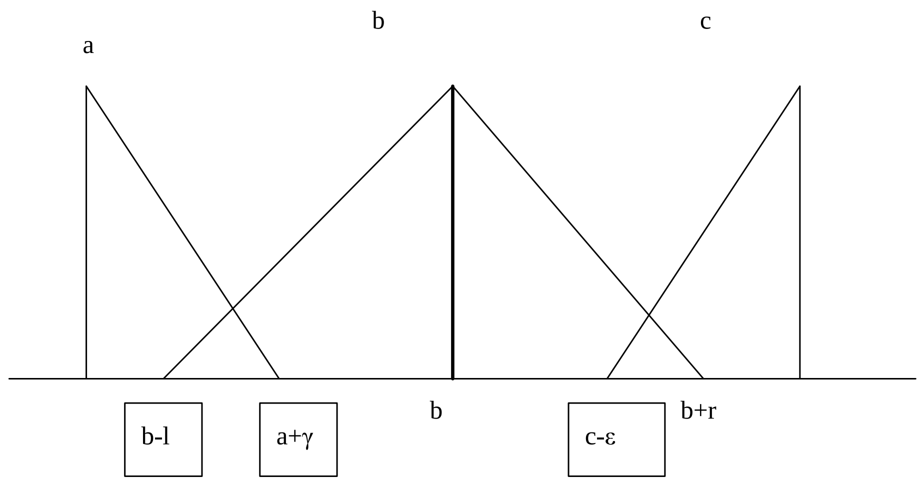
Corollary 10 *If the condition (46) holds, an increase of the human capital endowment, h, positively affects the news coverage $n\delta\left(w\left(n\right),S\right)$.*

Proof. Just remind that S is increasing in h. Then the previous Proposition 9 applies. ■

Even in the case single report reading, Proposition 9 and Proposition 10 grant that an increase in the level of human capital enlarge the range of news coverage.

4.2 The case of full coverage and partial overlapping

Let start with partial overlapping. Consider three neighboring sources, located in the interval L at a distance a, b and c from the origin. (Thereafter the three sources will be denoted by a, b and c.) We analyze the



decision problem of source b, which decides its scope $\delta = l + r$, taking as given the scope of competitors a and c. Such a scopes are respectively 2γ and 2ε. Notice that, $c - \varepsilon > a + \gamma$, so that there is a positive interval of issues not covered by a and c. Suppose also that $b - l < a + \gamma$ and $b + r > c - \varepsilon$. (See Figure 2).

If all the issues contained in the intersection between S and δ are covered by any of the two competing sources, than the expected revenue for source b is $\frac{w}{2}$. Easy calculations show that the probability of this event is $[S + (c - \varepsilon) - (a + \gamma)]$. If instead in the intersection between S and δ some issues are contained which are dealt with exclusively by source b, the expected revenue is w. Easy calculations show that the probability of this event is $[l + r + (a + \gamma) - (c - \varepsilon)]$. We are ready now to write the expected profit function of b:

$$\Pi_b = [S + (c - \varepsilon) - (a + \gamma)] \, w(n) + [\delta + (a + \gamma) - (c - \varepsilon)] \, \frac{w(n)}{2} - F(\delta) \tag{48}$$

Maximizing (48) with respect to δ, we get the following first order condition:

$$F'(\delta) = \frac{w(n)}{2} \tag{49}$$

which implicitly defines $\delta^* \left(\frac{w}{2} \right)$ as the profit maximizing scope. Partial overlapping occurs if:

$$\delta^* \left(\frac{w(n)}{2} \right) > ((c - \varepsilon) - (a + \gamma)) \tag{50}$$

The main feature of expression (50) is that it is independent on S, in fact all matter are the technological conditions.

Assume now a symmetric structure, such that:

1. $b-a=c-b=D$ (sources are equally spaced)

2. $\delta=2\varepsilon=2\gamma$ (sources have the same scope)

The expression of expected profit becomes:

$$\Pi_b^s=(S+D)\,w(n)-F(\delta) \tag{51}$$

Proposition 11 *An increase of S implies an increase in the equilibrium number of sources, n, if* $\delta'\left(\frac{w(n)}{2}\right)<\frac{4}{w}\left[S+\frac{L}{n}\left(1-\frac{w}{w'}\frac{1}{n}\right)\right]$

Proof. Substituting $D=\frac{L}{n}$ in the zero profit condition

$$\left(S+\frac{L}{n}\right)w(n)-F\left(\delta^*\left(\frac{w(n)}{2}\right)\right)=0$$

we get by differentiation:

$$\frac{dn}{ds}=-w(n)\left\{w'(n)\left[S+\frac{L}{n}\left(1-\frac{w(n)}{w'(n)n}\right)-\frac{F'\left(\delta\left(\frac{w(n)}{2}\right)\right)\delta'\left(\frac{w(n)}{2}\right)}{2}\right]\right\}^{-1} \tag{52}$$

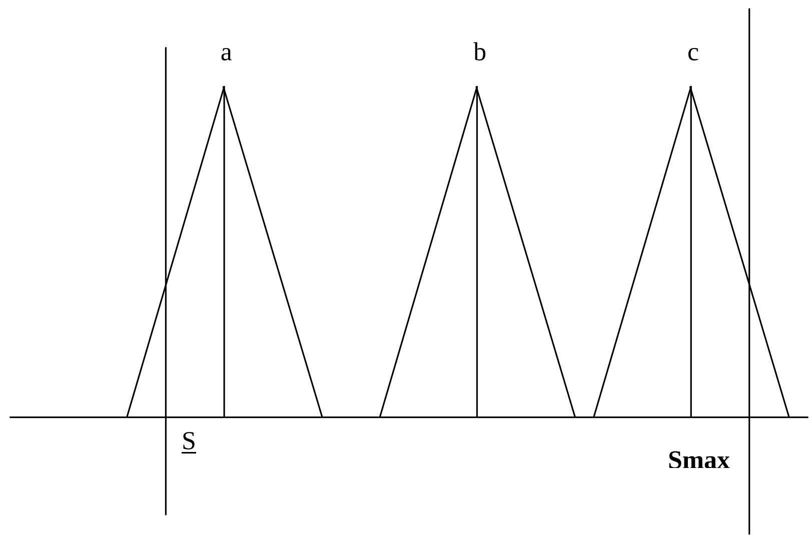
Using (49) we get $\dfrac{dn}{ds}>0$ if:

$$\delta'\left(\frac{w(n)}{2}\right)<\frac{4}{w}\left[S+\frac{L}{n}\left(1-\frac{w}{w'}\frac{1}{n}\right)\right] \tag{53}$$

■

Other things being equal, an increase in S increases profit and new sources enter the news and the advertising markets. In turn, this induce a reduction in w. So far the entry of new firms has reduced profit. However the fall in w induces a reduction in δ which is not matched by a further reduction in revenues. The reason is, if all firms reduce simultaneously their scopes, the size of overlapping intervals shrink, while the range of exclusive issues expands to an exactly equivalent extent. The reduction in δ instead leads to a decrease in costs. If this latter effect is sufficiently strong, the net effect of entry of new firms might be a further increase in profits. If this were the case, the increase in S would lead to a reduction in the number of firms in equilibrium, with a larger δ.

Proposition 12 *If the condition* (53) *holds, an increase of the human capital endowment, h, negatively affects the scope $\delta(w(n),S)$.*



4.3 The case of partial coverage and no overlapping

Suppose now that not all the issues in a neighborhood of the hot issue are covered by some information outlet. Let $E = \{e_1, e_2, ..., e_n\} \subset L$ be the collection of disjoint closed sub-intervals covered by some information outlet. Finally let $\theta(j) : L \rightarrow \{0, 1\}$ be a function which is 1 on the intervals in E and 0 elsewhere. Given the hot issue i, the utility function of the individual becomes

$$U = \int_{\underline{S}}^{\overline{S}} [\Omega - |i - j|] \theta(j) \, dj +$$

$$+ \int_{\underline{S}}^{\overline{S}} (1 - \theta(j)) \left[\left(\pi \omega^A (i, j) + (1 - \pi) l^B \right) \right] dj + \tag{54}$$

$$\int_{L-S} \left(\pi \omega^A (i, j) + (1 - \pi) l^B \right) dj + c^{\gamma}$$

Here, $\overline{S}$ and $\underline{S}$ are the upper and lower bound of the interval containing the issues which the individual reads about and Ω stands for V_1 when $q = 1$. $\overline{S} \in \overline{e}$ and $\underline{S} \in \underline{e}$, with $\overline{e}, \underline{e} \subset C$. B is the upper bound of $\underline{e}$ and b the lower bound of $\overline{e}$. Remember that the interval $\left(\overline{S} - \underline{S}\right)$ contains also sub-intervals not covered by the existing media outlets. The objective function can be rewritten as follows:

$$
\begin{aligned}
U = \Omega\left(\overline{S}-\underline{S}\right)+i\left(\overline{S}+\underline{S}\right)+V(a)\left(L-\left(\overline{S}-\underline{S}\right)\right)+ \\
+i\pi\left(L-\left(\overline{S}+\underline{S}\right)\right)-(1-\pi-2i\pi)\left(\tfrac{\overline{S}^2+\underline{S}^2}{2}\right)+ \\
-\frac{\pi}{2}L^2+-\left((\Omega+i)\,b-\tfrac{b^2}{2}\right)+(\Omega-i)\,B+\tfrac{B^2}{2}+ \\
+\textstyle\int_B^b(1-\theta(j))\left[\left(\pi\omega^A(i,j)+(1-\pi)\,l^B\right)\right]dj+ \\
+\textstyle\int_B^b[\Omega-|i-j|]\,\theta(j)\,dj+c^\gamma
\end{aligned}
\tag{55}
$$

Which is to be maximized under the constraint

$$c \leq \left(T-\frac{\Gamma}{h}\right), \text{where:} \quad \Gamma \equiv \int_{\underline{S}}^{\overline{S}} \theta(j)\,dj \tag{56}$$

Now we try and compare $\left(\overline{S}-\underline{S}\right)$ with the interval S which the individual would choose under full coverage (i.e. the case of the previous paragraph). To make this comparison possible, let us assume that $i+\dfrac{S}{2}\in\overline{e}$ and $i-\dfrac{S}{2}\in\underline{e}$.

Proposition 13 *Let S be the range of issues the individual reads about under full coverage and assume that $i+\frac{S}{2}\in\overline{e}$ and $i-\frac{S}{2}\in\underline{e}$. Then, under incomplete coverage and with the same hot issue, $\left(\overline{S}-\underline{S}\right)\geq S$.*

Proof. Since at $\overline{S}$ and $\underline{S}$, $\theta(j)=1$, the first-order conditions are as follows

$$\frac{\partial U}{\partial \overline{S}}=\Omega-V(a)+\left(\overline{S}-i\right)(\pi-1)-\frac{\lambda}{h}=0 \tag{57}$$

$$\frac{\partial U}{\partial \underline{S}}=-(\Omega-i)+\underline{S}(\pi-1)+V(a)-i\pi+\frac{\lambda}{h}=0 \tag{58}$$

$$\frac{\partial U}{\partial c}=\gamma c^{\gamma-1}-\frac{\lambda}{h}=0 \tag{59}$$

Suppose now, by contradiction, that $\overline{S}-\underline{S}=S$. Since

$$\Gamma \equiv \int_{\underline{S}}^{\overline{S}} \theta(j)\,dj<S$$

the equilibrium level of c in the present case is not smaller than in the full coverage case. Then the value of λ resulting from (59) is not larger than the one prevailing under full coverage. Consequently, the values $\overline{S}$,

$\underline{S}$ satisfying (57), (58) cannot be such that $\overline{S} - \underline{S} = S$. In particular, $\overline{S} \geq i + \frac{S}{2}$ and $\underline{S} \leq i - \frac{S}{2}$. In the case where $\gamma = 1$, $\overline{S} - \underline{S} = S$ and consumption only increases. ■

An implication of this result is that, in general, the optimal $\widetilde{S} \equiv \overline{S} - \underline{S}$ depends on $n\delta$, in a negative way. However, the above result is the consequence of the assumption that $i + \frac{S}{2} \in \overline{e}$ and $i - \frac{S}{2} \in \underline{e}$. Without this assumption, very little more can be said about this problem without a specific description of the sets in E, and almost no description would be unacceptable. Let us consider one, among the many possible, to illustrate the point when the assumption is violated. Suppose that E consist of two disjoint intervals $\{\underline{e}, \overline{e}\}$, defined as follows: $\underline{e} = [\underline{b}, \underline{B}]$, $\overline{e} = [\overline{b}, \overline{B}]$, with $\overline{b} > \underline{B} > \underline{b} > i$. Then no issue to the "left" of i is covered by any source. On the other hand , assume $\overline{b} > i + \frac{S}{2} > \underline{B}$, i.e $i + \frac{S}{2}$ lies in the uncovered interval between $\underline{e}$ and $\overline{e}$. Obviously, $i - \frac{S}{2}$ lies in the uncovered region to the left of i . Then $\overline{S}$ can be larger or smaller than $i + \frac{S}{2}$: in the latter case $\overline{S}$ would equal the upper bound of $\underline{e}$ and the following corner condition would obtain in place of (57):

$$\Omega - V(a) + \underline{B}(\pi - 1) \geq \frac{\gamma \left[T - \dfrac{\underline{B} - \underline{b}}{h} \right]^{\gamma - 1}}{h} \tag{60}$$

$$\Omega - V(a) + \overline{b}(\pi - 1) < \frac{\gamma \left[T - \dfrac{\underline{B} - \underline{b}}{h} \right]^{\gamma - 1}}{h} \tag{61}$$

The obvious comparative statics implication in this situation is that small changes of h do not necessarily imply an increase in the range of the issues the individual is willing to read about.

5 Concluding remarks

The main aim of this paper to build the foundations for the economic analysis of pluralism, an issue that so far has been treated by economists in not entirely satisfactory way. We tried to model explicitly the value of (and therefore the demand for) the news and the technology of news provision. On these two building blocks we tried to explain both the degree and the type of pluralism. In particular, we determined the conditions under that the change of the level of education, through its effect on information demand, affects the extent of news coverage and the availability of different points of view on controversial issues.

So far this simple model came up with some preliminary results, but we are confident it can be further exploited. For instance, interesting issues that can be addressed, within this framework are: double reading in pursuing pluralism, modelling the choice of the level of accuracy, introducing a non-advertising revenues for the sources, treating agenda-setting in a more sophisticated way.

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