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The paper analyzes, from a theoretical viewpoint, the effects of a switch of advertising resources from press to broadcasting, focusing on the implications for the quality of information provided by media outlets. Our main conclusions are that the alleged impact of advertising on newspapers' quality is ambiguous in the complementary case, while in the substitute case a shift of advertising resources from press to broadcasting would increase newspapers' quality.

1 Introduction

The present paper aims at analyzing the effects of a switch of advertising resources from press to broadcasting, with a focus on the quality of information. Newspapers' revenues from advertising have progressively shrunk over the years, as a consequence of a long-standing decrease in newspapers' audience and of the competition from other media: broadcasting in the early stages and, to an increasing extent in the last few years, web-based media.

Newspaper publishers maintain that further cuts to their share of the advertising market in favor of TV might end up either in their leaving the market or in reducing newspapers' quality¹, with quality resting on timeliness, veracity, impartiality, together with competence and fairness in analyses and comments (see e.g.: Halling and Mancini, 2004; Leroch and Welbrock, 2011; Picard, 2013; Battaggion and Vaglio, 2018).

In a framework of vertical differentiation with endogenous provision of quality we assess at a theoretical level the validity of the claim according to which a cut in advertising revenues unambiguously implies a decline in newspapers' quality (see e.g. Anderson, 2007). We assume two sources, representing a newspaper and a broadcasting channel. The two sources compete for the audience by the choice of price (only in the case of the "newspaper", TV being free) and of the level of information quality (both sources). We shall develop two models of competition between the sources. In the first one (*single-homing*, Section 3), individuals regard media as substitutes and choose either to read the newspaper or to watch the TV, or they refrain from using both. In the other model (*multi-homing*, Section 4) every individual who reads the newspaper also watches TV. Again, some individuals may choose to refrain from using both media. Heterogeneity of the individuals comes from their different skills in processing high-quality, sophisticated and complex information, while all individuals value information according to the same criteria.

Specifically, we emphasize two themes which are rather neglected in the media market debate: the possibility of *joint use of different media* (i.e. remarkable exceptions are Gabszewicz and Wauthy, 2003; Mullainathan and Shleifer, 2005) and *asymmetric market settings*, such as the competition between newspapers and broadcasters.

¹A recent EU proposal (2016/0151 (COD)) has been issued suggesting a number of measures supposedly meant to increase the attractiveness of TV advertising, by allowing for more flexibility in advertising time allocations. This raised concerns and protest in the press business community.

2 The value of information

Consider a market for media, with two firms, namely Source *One* and Source *Two*. Source *One* obtains its revenue from advertising only (at a per-viewer fee of a_1), while Source *Two*, in addition to an advertising fee (a_2), also earns a price p_2 , paid by the reader. Source *One* represents a stylized TV free-on-air broadcaster, while Source *Two* corresponds to a newspaper.

Individuals resort to the TV and to the newspaper to acquire not-further-specified utility k (which we assume to be constant across media sources) and useful information. To represent the value of information to the reader/viewer, here we apply a framework that we have developed elsewhere (Battaglion and Vaglio (2015)). Assume individuals make a choice between two actions (a and b) of which only one is appropriate, respectively with prior probabilities π and $1 - \pi$. Define A (B) as the expected utility the individual gets if (respectively) he chooses a (b) and his choice is appropriate, while if the individual makes the wrong choice, the expected utility is 0. We assume $A > B$. The media firms issue signals stating what the appropriate choice is, signals that are correct with probabilities q_1 and q_2 respectively. We call q_j with $j = 1, 2$, "information quality" or "accuracy" of source j , $q_j \in [q_{\min}, 1]$. The cost of "reading" or "viewing" has a cost nq for a type- n individual learning a signal of quality q . ($n(q_1 + q_2)$ if he/she learns both signals). Individual types are uniformly distributed on $[0, \bar{n}]$.

Therefore, the utility of a type- n individual resorting to source j only is given by

$$u^n(p_j, q_j) = k + (A + B)q_j - nq_j - p_j \quad (1)$$

where p_j , is the price paid by the individual to access the source ($p_1 = 0$ by assumption).

If instead an individual resorts to both sources, his/her utility is given by:

$$2k + [A(1 - q_2) + Bq_2]q_1 + Aq_2 - n(q_1 + q_2) - p_2 \quad (2)$$

We assume that sources have only first-copy costs related to the quality level :

$$\frac{c}{2}q_j^2$$

In the following the model will be articulated in three stages: in the first stage, the sources choose their quality levels; in the second one, Source *Two* chooses its price level; and, in the third stage, individuals choose whether to watch information on TV or to read a newspaper or both or to give up information. In this case their reservation utility is 0.

3 Single-homing individuals

We begin by assuming that individuals use one or the other medium, or neither (single-homing). We assume that $q_2 > q_1$, meaning that the newspaper is the highest-quality medium. If the following inequality

$$n \leq \frac{k}{q} + (A + B) \equiv n_{10}$$

holds true then the n -type individual prefers to resort to Source *One* (rather than giving up any kind of information). Analogously, if an individual of type n prefers Source *Two* to Source *One*, n must satisfy the following condition:

$$n \leq (A + B) - \frac{p_2}{q_2 - q_1} \equiv n_{12}$$

The demand functions for the two sources are therefore

$$D_1(p_2, q_1, q_2) = n_{10} - n_{12} = \frac{k}{q_1} + \frac{p_2}{q_2 - q_1}$$

and

$$D_2(p_2, q_1, q_2) = n_{12} = (A + B) - \frac{p_2}{q_2 - q_1}$$

In the second stage of the competition, Source *Two* chooses its price given the quality levels. By solving the problem:

$$\Pi_2(p_2, q_1, q_2, a_2) = \max(p_2 + a_2) \left[(A + B) - \frac{p_2}{q_2 - q_1} \right] - \frac{c}{2} q_2^2$$

Source *Two* chooses the following price:

$$p_2 = \frac{1}{2} [(A + B)(q_2 - q_1) - a_2] \quad (3)$$

Notice that p_2 is decreasing with respect to q_1 and a_2 and increasing with respect to q_2 .

In the first stage sources choose their quality levels. Source *One's* problem is:

$$\max a_1 \left(\frac{k}{q_1} + \frac{p_2}{q_2 - q_1} \right) - \frac{c}{2} q_1^2$$

After substituting (3), the first-order condition for this problem is:

$$-\frac{1}{2} \frac{a_1 a_2}{(q_1 - q_2)^2} - k \frac{a_1}{q_1^2} - c q_1 < 0 \quad (4)$$

Which implies that $q_1 = q_{\min}$.

Source *Two* instead maximizes

$$\max (p_2 + a_2) \left[(A + B) - \frac{p_2}{q_2 - q_1} \right] - \frac{c}{2} q_2^2$$

Using the envelope theorem and substituting (3) we find

$$\left(\frac{(A+B)(q_2-q_1)+a_2}{2} \right) \left(\frac{\frac{1}{2}[(A+B)(q_2-q_1)-a_2]}{(q_2-q_1)^2} \right) - cq_2 = 0 \quad (5)$$

Corner solutions are ruled out by the following condition

$$\frac{1}{4} \left[(A + B)^2 - \frac{a_2^2}{(1 - q_1)^2} \right] < c$$

We can now prove the following result.

Proposition 1 *A solution to (5) exists for $q_1 = q_{\min}$, if $A + B$ is sufficiently large. q_2 is decreasing with respect to a_2 .*

Proof. See the Appendix 6.1. ■

The above Proposition 1 implies that, while TV chooses the least quality level, independently of the advertising rates, at least under some conditions a decrease in advertising revenues for the newspaper would reduce its quality.

The economic intuition is straightforward: two effects (strategic and direct) are at work. As regards the strategic effect, according to (3) a decrease in the newspaper advertising rate increases the price p_2 . In order to compensate for the demand reduction associated to the price increase, the newspaper faces a stronger incentive to invest in quality. In other words less advertising makes it more profitable to compete by higher quality than lower prices. As regards instead the direct effect, a decrease in a_2 decreases the value to the newspaper of each additional reader, which discourages investment in quality. However, the strategic effect dominates the direct one.

4 Multi-homing individuals

We now assume that everyone who reads a newspaper also watches television, while the reverse is not necessarily true (multi-homing). Individuals refraining from media of either type are still allowed for. Considering (2) we can determine the demand for Source *Two* by setting

$$2k + [A(1 - q_2) + Bq_2]q_1 + Aq_2 - n(q_1 + q_2) - p_2 \geq k + (A + B)q_1 - nq_1$$

so that

$$D_2(q_1, q_2, p_2) = \frac{k + Aq_2(1 - q_1) - Bq_1(1 - q_2) - p_2}{q_2}$$

is the demand for Source *Two*.

In stage two, source *Two* solves

$$\max(p_2 + a_2) \left[\frac{k + Aq_2(1 - q_1) - Bq_1(1 - q_2) - p_2}{q_2} \right] - \frac{c}{2}q_2^2 \quad (6)$$

Thus obtaining the following price choice:

$$p_2 = \frac{[k + Aq_2(1 - q_1) - Bq_1(1 - q_2)] - a_2}{2} \quad (7)$$

At the quality choice stage, the decision problem for Source *One* is

$$\max a_1 \left(\frac{k}{q_1} + A + B \right) - \frac{c}{2}q_1^2 \quad (8)$$

with the first-order condition

$$-\frac{a_1 k}{(q_1)^2} - cq_1 < 0$$

which again determines $q_1 = q_{\min}$.

In stage 1, Source *Two* maximizes (6) with respect to q_2 , substituting (7). By the envelope theorem we get:

$$(p_2 + a_2) \left[\frac{A(1 - q_1) + Bq_1}{q_2} - \frac{k + Aq_2(1 - q_1) - Bq_1(1 - q_2) - p_2}{q_2^2} \right] - cq_2 = 0 \quad (9)$$

Proposition 2 *If q_{\min} lies in the neighborhood of $\frac{k+a_2}{B}$, a solution to (9) exists, for $q_1 = q_{\min}$. An increase in a_2 increases q_2 only if $q_{\min} > \frac{k+a_2}{B}$.*

Proof. See the Appendix 6.2. ■

The above Proposition 2 states that under some conditions the TV quality remains at the minimum level, while the press quality may react positively to an advertising change. In this respect a shift of advertising resources from newspapers to TV might also produce a lower-quality investment in the press market.

As regards the strategic effect, the intuition here is similar to the single-homing case: a decrease in the advertising rate increases price p_2 . However, in this case the direct effect might dominate the strategic one.

5 Conclusions

In this paper we propose a simple information-based framework to discuss whether and how news quality is constrained by advertising revenues.

Our main conclusion is that the alleged impact of advertising on quality is questionable. We find that the lowest-quality source (TV) chooses the minimum level of quality independently of the size of the advertising revenue, to attract the readers with the largest opportunity cost of reading/watching. As regards the highest quality source (the newspaper), the effect of an increase in the advertising rate is ambiguous in the multi-homing case and quality-averse in the single-homing case. The strategic effect (a decrease in the advertising rates leads to an increase in the newspaper price) is responsible of the inverse relationship between advertising rate and newspaper quality. The direct effect (a decrease in the advertising rate reduces the value of an additional reader) works instead in the opposite direction.

If both the price and the quality of Source *Two* decrease as a result of an increase in advertising rate a_2 , the share of the audience of Source *Two* unambiguously increases. However, the overall effect on welfare is ambiguous. First, it is true that some individuals who previously watched TV shift to reading the newspaper; this reveals that the new combination of lower price–lower quality improves over the alternative zero-price–minimum quality alternative. Secondly, individuals who were already readers of the newspaper (Source *Two*) will experience a reduction in price but also a reduction in quality.²

Our general conclusion and policy suggestion is that the effects of shifts in advertising resources from one medium to another should always be analyzed on the basis of well-specified models of the competition among the media. In this perspective, a further extension would consist in modelling the impact of policy incentives and regulations on a two-sided media market with endogenous advertising rates and network externalities.

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²The corresponding proposition and proof in the case TV is assumed to be the highest-quality medium are available upon request.

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6 Appendices

6.1 Proposition 1

Proof. After simplification the first-order condition (5) reduces to:

$$(A + B)^2 q_1^2 - a_2^2 - [2(A + B)^2 q_1 + 4cq_1^2] q_2 + [(A + B)^2 + 8cq_1] q_2^2 - 4cq_2^3 = 0 \quad (10)$$

The above polynomial in q_2 can be represented as follows: The minimum of the function lies at $q_2 = q_1$, and its value is $-a_2^2$, while the maximum is at $q_2 = \frac{1}{6c} [(A + B)^2 + 2cq_1]$. The value of the maximum is

$$\frac{1}{108c^2} [(A + B)^2 + 2cq_1]^2 [(A + B)^2 - 16cq_1] + (A + B)^2 q_1^2 - a_2^2 \quad (11)$$

It is immediate to prove that the sign of the derivative with respect to q_2 of (10) coincides with the sign of the second-order derivative of Source *Two's* objective function. Then only the most rightward of the three roots of (10) satisfies both $q_2 \geq q_{\min}$ and the second-order condition.

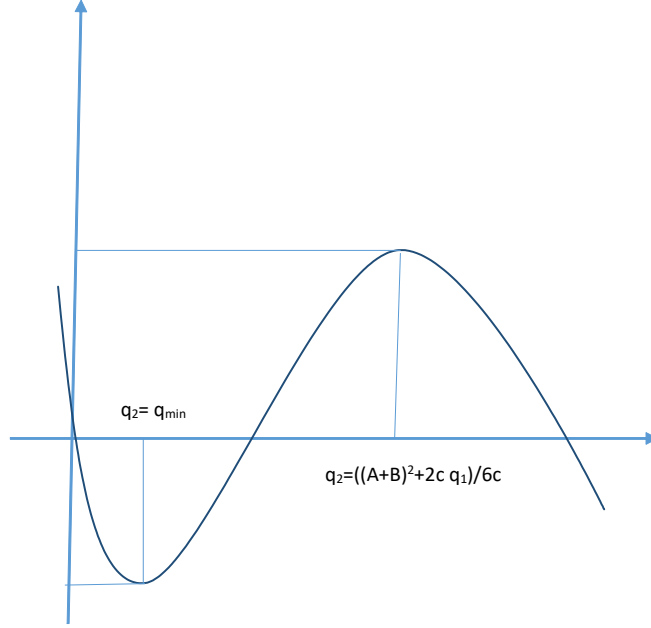


Figure 1: Equation (10)

For the existence of a solution we require the maximum of (10) to be strictly positive. Then setting $(A + B)^2 = Z$ and using (11)

$$\frac{1}{108c^2} (Z + 2cq_1)^2 (Z - 16cq_1) + Zq_1^2 - a_2^2 > 0 \quad (12)$$

This is a cubic polynomial in the Z variable, which is always increasing, so that if $A + B$ is sufficiently large, (11) is positive.

As for comparative statics, if one differentiates (5) with respect to a_2 , one finds that such a derivative is

$$-\frac{1}{2} \frac{a_2}{(q_1 - q_2)^2} < 0 \quad (13)$$

Together with the second-order condition for q_2 , this implies that q_2 is decreasing with respect to a_2 . ■

6.2 Proposition 2

Proof. After substituting (7) into (9) we get the equivalent expression

$$\begin{aligned} & \frac{1}{4q_2^2} \{(-4c) q_2^3 + [(A - B) ((A - B) q_1 - 2A) q_1 + A^2] q_2^2\} \\ & + \frac{1}{4q_2^2} (2Bkq_1 - B^2q_1^2 + 2Ba_2q_1 - k^2 - 2ka_2 - a_2^2) = 0 \end{aligned} \quad (14)$$

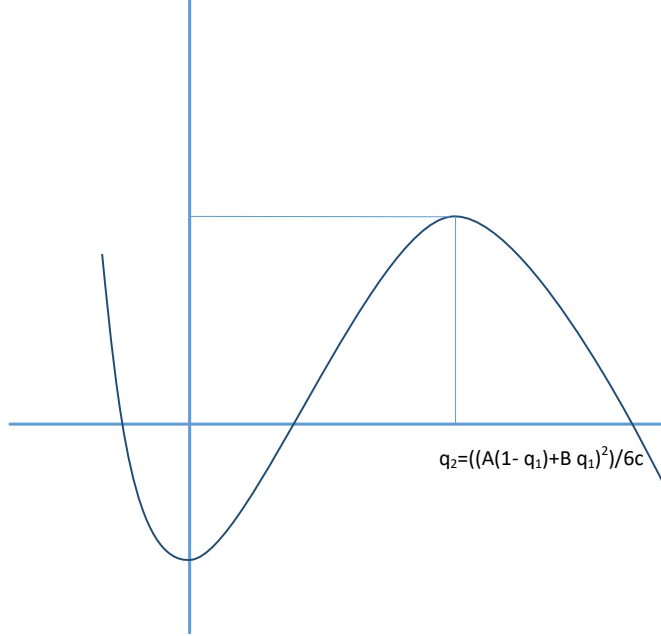


Figure 2: Equation (14)

The cubic polynomial in the parenthesis of condition (14) has a minimum at $q_2 = 0$ and a maximum at $q_2 = \frac{1}{6c} [A(1 - q_1) + Bq_1]^2$. As in the case of Appendix (6.1), of the positive roots only the most rightward satisfies the second-order condition for q_2 . For the existence of a solution we require the maximum of (14) being strictly positive. Substituting $q_2 = \frac{1}{6c} [A(1 - q_1) + Bq_1]^2$ into (14) we find

$$(k + a_2) \left[2Bq_1 - \frac{B^2 q_1^2}{k + a_2} - (k + a_2) \right] + \frac{4\{(A-B)q_1[(A-B)q_1 - 2A] + A^2\}^3}{27(-4c)^2} \quad (15)$$

The existence condition then reduces to

$$\frac{4\{(A-B)q_1[(A-B)q_1 - 2A] + A^2\}^3}{27(-4c)^2} \geq B^2 q_1^2 - 2B(k + a_2)q_1 + (k + a_2)^2 \quad (16)$$

The right-hand side of (16) has a minimum at $q_1 = \frac{k+a_2}{B}$, where its value is 0. At $q_1 = \frac{k+a_2}{B}$, the value of the left-hand side of (16) is: $\frac{1}{108B^6 c^2} (Ba_2 - Aa_2 + AB - Ak + Bk)^6$, which is certainly positive. Then if q_{\min} lies in a neighborhood of $\frac{k+a_2}{B}$, we can be sure that (15) is positive and therefore that a solution to (14) exists.

As regards comparative statics, it is sufficient to differentiate (9) with respect to a_2 to find the partial derivative

$$-\frac{1}{2q_2^2} (k + a_2 - Bq_1)$$

which is negative only if $\frac{k+a_2}{B} > q_{\min}$. Given the second-order condition for q_2 , the conclusion easily follows. ■