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ARTICLE

Media bias with asymmetric media quality

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ABSTRACT
This paper develops a location model of media bias with asymmetric media quality. In the model, media quality is defined as an ability to reduce the boundedly rational consumers' efforts in reasoning information. The model shows that an equilibrium bias exists unless the cost of a high-quality media outlet for adjusting bias is small enough. The size and location of the equilibrium bias gap between media outlets depend on the quality difference. The results may provide a comprehensive understanding of the existing views that competition increases or lessens the media bias.

KEYWORDS
Media bias; media quality; bounded rationality; digital technology

JEL
D83; L13; L82

I. Introduction

In studies on media bias, bias has often been regarded as harmful to the quality of information, and thus highly biased news has been treated as low-quality news. For example, Baron (2006) defines quality as a media outlet's ability to investigate the true state of the world. Gentzkow and Shapiro (2006) add 'honest reporting' to this definition.[1] Incidentally, media bias – of media outlets in selecting which events are reported and how they are covered – is defined as 'systematic differences in the mapping from facts to news reports'. (Gentzkow, Shapiro, and Stone 2015)

Nonetheless, these studies neglect the dimension of genuine quality of the presentation of information.[2] Due to cognitive capacity limitations, consumers reason a set of information better when presented with a clearer context or logic than when presented coarsely and less logically. Also, consumers generally prefer concisely presented news, perhaps with a graphical summary, over lengthy, wordy news. Naturally, consumers are likely to be more drawn to easier-to-reason news as well as intuition-friendly news. Precisely, among the news items on the same event with the same political bias, consumers prefer the item that is the easiest to reason, i.e. this nature of news can be defined as a vertical factor: quality.

Therefore, the model assumes that consumers are boundedly rational (Simon 1972) and have dual cognitive systems, intuition and reasoning, that differ by whether or not consumers' efforts are put in (Kahneman 2003); media quality is a media outlet's ability to reduce consumers' efforts in reasoning a set of information.

In this paper's location model, quality is interpreted as a type of transport technology. Asymmetric transport rates represent asymmetric qualities. This idea is originated from Launhardt (1885), introduced by Ferreira and Thisse (1996).[3] They state that *the product easier to transport* may be viewed as a product of a higher quality. Hence, *the news easier to reason* is regarded as higher quality news in the model. Launhardt's idea is more appropriate than Hotelling (1929)'s when the quality is

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[1]Gentzkow and Shapiro (2006) develop a model in which this quality definition is combined with asymmetrically given media quality and a Bayesian consumer who will tend to judge information to be higher quality when it matches the consumer's bias.

[2]Mullainathan and Shleifer (2005) think about the presentation of information demanded by consumers, such as explanation, interpretation, persuasion, and entertainment. However, they assume symmetric quality; thus, do not consider the differences in presentation as differences in quality, but only as means to meet consumers' bias.

[3]Ferreira and Thisse (1996) present only the symmetric location cases while this paper analyzes all location cases under given prices.

defined as the ability to better transport information to consumers.[4]

So far, there is disagreement among economists on whether competition affects bias and in which direction. In contrast, in the model, those different effects diverge by the quality difference. These results are mainly from this paper's new features: media quality as an ability to help the reasoning of boundedly rational consumers independently of media bias.

II. Model

Consumers are uniformly distributed over the real interval [0, 1], depending on their political preferences. 0 and 1 represent the extreme left and right, respectively. Each consumer consumes one item of news. They prefer both news closer to their biases and easier to reason. The former gives them more utility, and the latter reduces their disutility due to efforts.

Two profit-maximizing media outlets, M1 and M2, locate at $x_1 = a$ and $x_2 = 1 - b$ respectively, which represent their reporting bias. Their initial locations are a_0 and $1 - b_0$. q_1 and q_2 are transport rates of each outlet, representing the given media qualities. Lower q represents higher quality. Without loss of generality, $a \leq 1 - b$, and M2 is a high-quality outlet; $0 < q_2 < q_1$.

Besides, the media outlet's bias is realized through its individual journalists' reports. They usually have an independent political bias similar to that of the outlet for which they have been working. Thus, the media outlet can change its bias by changing its journalists' bias at a cost.[5] We assume that a high-quality outlet with many journalists incurs higher costs to change bias than a low-quality outlet does; the bias change costs are $c_1 = 0$ and $c_2 = c(b - b_0)^2$ where $c > 0$.[6]

In the digital world, the boundary between news information and non-news information is blurred. The price of news content is determined in the broader digital content market. So, the consumer price $p_c > 0$ and the post-paid ad price $p_a > 0$ are exogenously fixed.[7] Let $p = p_c + p_a$. There is one advertiser in the market.

The news consumer i's utility at x_i is $\bar{u} - p_c - q_j(x_j - x_i)^2$. ($\bar{u}$: reservation utility, $j = 1, 2$) The marginal consumer, x_m, satisfies the following equation.

$$(a - x_m)^2 = \theta^2(1 - b - x_m)^2$$
$$\text{where } \theta = \sqrt{q_2/q_1} \in (0, 1).$$

$$x_m \text{ are : } x_{21} = \frac{a - \theta(1 - b)}{1 - \theta}$$
and
$$x_{12} = \frac{a + \theta(1 - b)}{1 + \theta}, (x_{21} < x_{12}).$$

The demands of each media outlet depend on a and $(1 - b)$ relative to the given θ, as shown in Figure 1.

$$D_1 = \begin{cases} x_{12} - x_{21}, \text{if } x_{21} \geq 0 \\ x_{12}, \text{if } x_{21} < 0 \end{cases},$$
$$D_2 = 1 - D_1.$$

.

Then, there exists an equilibrium only if $a < 1 - b$ since M1 has no demand and should deviate when $a = 1 - b$.[8] The profits of media outlets, $\pi_1 = pD_1$ and $\pi_2 = pD_2 - c(b - b_0)^2$, are as follows.

$$\text{When} 0 < \theta \leq \frac{a}{1 - b}, \text{i.e.}, x_{21} \geq 0,$$

$$\pi_1 = p\frac{2\theta(1 - a - b)}{1 - \theta^2},$$
$$\pi_2 = p\left(1 - \frac{2\theta(1 - a - b)}{1 - \theta^2}\right) - c(b - b_0)^2.$$

$$\text{When } \frac{a}{1 - b} \leq \theta < 1, \text{i.e.}, x_{21} < 0,$$

[4]Yang (2020) studies the media bias with a digital intermediary, employing Launhardt's idea. Yang assumes the symmetric quality between media outlets and defines quality as all kinds of information transfer capabilities to increase consumers' utility.
[5]Examples of costs: persuasion; coercion; hiring journalists with the bias that the media outlet wants.
[6]When $c_1 < c_2$, $c_1 > 0$ does not change the key qualitative results of the model. Its formal analysis is beyond the scope of the paper.
[7]In the digital news markets, most (but not all) media outlets provide the news to consumers virtually free of charge.
[8]Brocas, Carrillo, and Wilkie (2011) argue that when one of two firms having the same viewpoint is marginally more informative than the other in duopolistic competition, it can capture whole market demand and there cannot be an equilibrium. This is due to what they refer to as 'Informational Bertrand Competition'. If 'more informative' can be interpreted as 'higher quality', it supports that the case where $a = 1 - b$ cannot be an equilibrium.

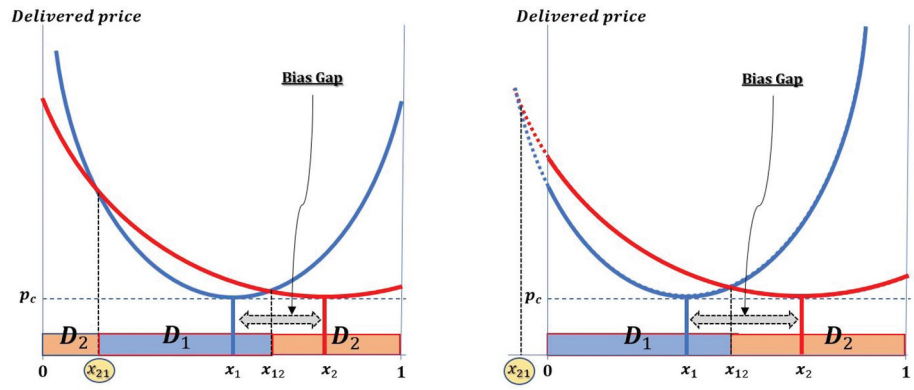

Figure 1. The demands of media outlets.

$$\pi_1 = p\frac{a+\theta(1-b)}{1+\theta},$$
$$\pi_2 = p\left(\frac{1-a+\theta b}{1+\theta}\right) - c(b-b_0)^2.$$

π_1 is maximized at $a=(1-b)\theta$ since $(d\pi_1/da)<0$ when $a \geq (1-b)\theta$ and $(d\pi_1/da)>0$ when $a \leq (1-b)\theta$. Thus, the optimal bias of M1, x_1^*, is $(1-b)\theta = x_2\theta$.

When $x_1^* = (1-b)\theta$, x_m, π_2, and $(d\pi_2/db)$ are:

$$x_m = \frac{2\theta(1-b)}{1+\theta},$$

$$\pi_2 = p\left(1-\frac{2\theta(1-b)}{1+\theta}\right) - c(b-b_0)^2,$$
$$\frac{d\pi_2}{db} = 2p\left(\frac{\theta}{1+\theta} - \frac{c}{p}(b-b_0)\right).$$

π_2 is maximized when $b = b_0 + p\theta/(1+\theta)c$. When $b_0 + p\theta/c(1+\theta) \geq 1$, $b=1$. However, it cannot be a solution since $a = 1-b$ when $b=1$. Therefore, we have an equilibrium bias pair when $b_0 + p\theta/c(1+\theta) < 1$, and as follows.

$$x_1^* = x_2^*\theta \text{ and } x_2^* = (1-b_0) - \frac{p\theta}{c(1+\theta)}.$$

Denotes G to be the equilibrium bias gap between outlets.

$$G = x_2^* - x_1^* = \left((1-b_0) - \frac{p\theta}{c(1+\theta)}\right)(1-\theta)\ .$$

Then, (dG/dc) and $(dG/d\theta)$ as follows.

$$\frac{dG}{dc} = \frac{p(1-\theta)\theta}{c^2(1+\theta)} > 0\ ,$$

$$\frac{dG}{d\theta} = \left(\begin{array}{l} <0 \text{ when} \begin{cases} 0<\theta\leq -1+\sqrt{2} \\ -1+\sqrt{2}<\theta(\text{ 1and } c/p)\bar{\bar{\theta}}/(1-b_0) \end{cases} \\ >0 \text{ when } -1+\sqrt{2}<\theta<1 \text{and} c/p<\bar{\bar{\theta}}/(1-b_0) \\ =0 \text{ when } -1+\sqrt{2}<\theta<1 \text{and} c/p=\bar{\bar{\theta}}/(1-b_0) \end{array}\right) \text{where } \bar{\bar{\theta}}$$
$$= \frac{\theta^2+2\theta-1}{(1+\theta)^2}$$

[PROPOSITION] *In the duopoly news market with a given p and $\theta = \sqrt{q_2/q_1} \in (0,1)$, an equilibrium media bias pair, $x_1^* = x_2^*\theta$ and $x_2^* = (1-b_0) - p\theta/(1+\theta)c$, exists when $(1-b_0) > p\theta/c(1+\theta)$. The size of the equilibrium bias gap, G, depends on θ, c/p, and b_0:*

(i) *the larger c, the larger G;*
(ii) *when $0<\theta\leq -1+\sqrt{2}$, the smaller θ, the larger G;*
(iii) *when $-1+\sqrt{2}<\theta<1$, the smaller θ, the larger G if $c/p>\bar{\bar{\theta}}/(1-b_0)$ and the smaller G if $c/p<\bar{\bar{\theta}}/(1-b_0)$, and does not affect G when $c/p=\bar{\bar{\theta}}/(1-b_0)$.*

The proposition implies that the quality difference influences the media bias and the size of the equilibrium bias gap between media outlets. A decrease in θ increases G. Conversely, no matter how extreme the bias is, it has nothing to do with the quality. The high-quality outlet reduces its bias to capture more demand; thus, there is no high-quality outlet with extreme bias, as in the real world. In contrast, the low-quality outlet may

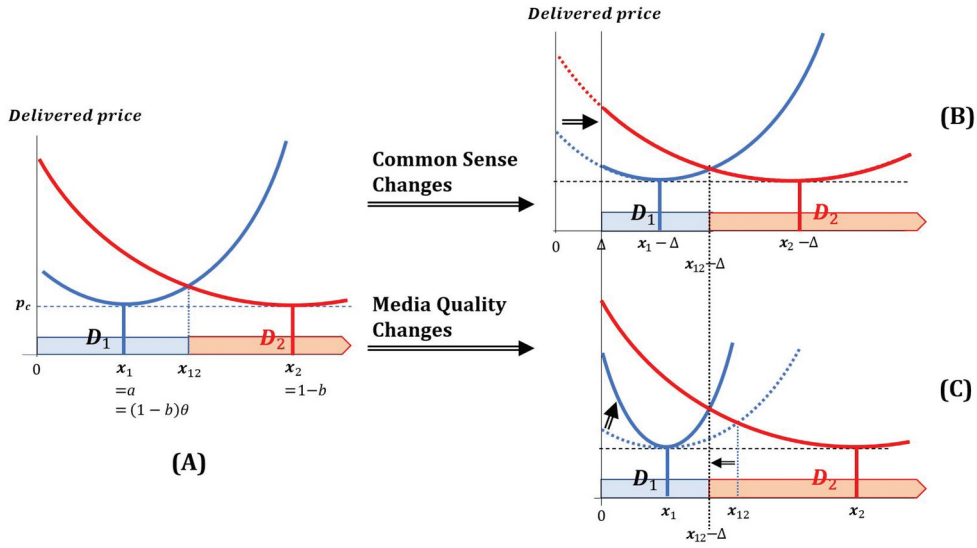

Figure 2. Common sense change and quality change.

increase bias to near extreme levels to avoid competing with high quality. These results explain why lower-quality fringe digital outlets, which cannot improve their quality to the traditional press level, exhibit greater partisan bias.[9]

Gentzkow and Shapiro (2006) argue that the low-quality outlet reduces the bias gap to avoid losing consumers in reputation competition. According to the proposition, their case is possible only when the quality difference and the high-quality outlet's location cost are small enough, but not in the general case.

The interpretations for the representative studies

Mullainathan and Shleifer (2005), a representative study on demand-side media bias, claim that competition increases bias, while Gentzkow and Shapiro (2006) argue that competition decreases bias. The model proposes a unified understanding of these two conflicting views.

The model's results are similar to those of Mullainathan and Shleifer (2005) in that it replaces their assumption of symmetric quality and price competition with one of asymmetric quality and a fixed price.

The model's results are also similar to those of Gentzkow and Shapiro (2006) as follows. Suppose that the widely perceived view (or 'common sense') for a particular issue is newly widespread in society. It means that the linear city moves entirely to the right or left. Based on this paper's definition of media quality, the change of common sense can be interpreted as a practical quality change following the change in the persuasive of the logical contexts in the news the media have provided to consumers.

Assuming that the linear city moves to the right by Δ, M1 loses demand by Δ, as shown in (B) of Figure 2. This change in demand is the same as when M1's quality drops relative to M2, as shown in (C). Then, M1, which makes up for the declining demand, adjusts its bias in line with the changed common sense or improves its quality to persuade consumers with original bias. The former action is analogous to the reputational competition of Gentzkow and Shapiro (2006). Therefore, the model of this paper can be interpreted as a generalization of the above two studies.

III. Conclusion

The main results of this paper are: there is equilibrium bias unless the bias change cost of the high-

[9]According to the Media Bias Chart 6.0 by Ad Fontes Media, the lower quality, the more extreme or partisan bias. https://www.adfontesmedia.com

quality media outlet is small enough; the location and size of the equilibrium bias gap between media outlets depend on the quality difference; the high-quality outlet decreases the bias gap as much as possible; the low-quality outlet's bias depends on both the quality difference and the high-quality outlet's bias; the larger the quality difference, the larger the media bias gap tends to be. These findings may embrace the two conflicting views that competition increases the media bias or decreases it.

Disclosure statement

No potential conflict of interest was reported by the author.

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