MEDIA BIAS, POLITICAL POLARIZATION, AND THE MERITS OF FAIRNESS°

RYAN Y. FANG◊

ABSTRACT. In this paper, we study the economic and social consequences of biased news coverage in the public media and evaluate the merits of content regulations designed to curtail such bias. We present a general model of the market for news and show that rational Bayesian consumers might prefer biased news to more balanced news, even when the latter is significantly more informative. Consequently, media outlets motivated only by higher profits might produce news with significant bias in equilibrium. Our model is able to fit documented empirical relationships between media bias and consumer ideology. It also provides an explanation for the historical variations of the average degree of bias in the U.S. news market based on changes in the cost of news to the consumers and the intensity of competition. Our policy analysis shows that content regulations can never lead to Pareto superior outcomes but can lead to Pareto dominated ones. Thus, they are poorly justified on the ground of protecting consumer welfare. However, we also find that media bias can lead to political polarization. While content regulations might help to mitigate such polarization, their effectiveness depends critically on market conditions.

JEL Classification: D03; D83; L12; L13; L51; L52

Key Words: Media Bias, Political Polarization, Content Regulation, Confirmation Bias, Bayesian Rationality, Endogenous Information Acquisition

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Date: February 15, 2014.

°This research was conducted under the direction of my advisers Roger Myerson, Philip Reny, and Hugo Sonnenschein and have benefited immensely from their insightful suggestions. I am also grateful for the valuable comments provided by Jesse Shapiro, Richard Van Weelden, and seminar participants at Brown University, the Pennsylvania State University, and the University of Chicago. All remaining errors are, of course, my own.

◊ Department of Economics, University of Chicago. Email: ryfang@uchicago.edu.

1. Introduction

> "*Where the press is free and every man able to read, all is safe.*" - Thomas Jefferson (to Colonel Charles Yancey 1816)

It is widely believed that a free, fair, and honest news media is one of the essential pillars of a modern democracy. Because of its importance, scholars, politicians, and various watchdog groups have closely monitored the state of the media and have never been shy to voice their criticism.

Thus, allegations of failure by the media to meet public expectations and, in particular, allegations of bias in its coverage of political news have been plentiful in public discourse. However, in the past two decades, such allegations appeared to be growing more prevalent and impassioned in the United States. Numerous best-sellers have been written to warn the public of the pervasiveness and severity of media bias.[1] Research scholars have identified and measured media bias in the U.S. news market (e.g., Groseclose and Milyo (2005) and Gentzkow and Shapiro (2010)) and its impact on the views of the general public and the outcomes of political processes (e.g., Gentzkow and Shapiro (2004), DellaVigna and Kaplan (2007), and Chiang and Knight (2011)).[2] Recent surveys by the Pew Research Center for the People and the Press (2011) show that consumers' perception of media bias has deteriorated drastically since the mid 1980s (see Figure 1.1).

Scholars, pundits, and politicians have expressed concerns over the apparent surge of media bias in the U.S. news market. It is the belief shared by many that media bias is the deliberate attempt by media outlets to misinform the public in pursuit of their own agendas. Moreover, biased news is less informative and thus inferior in value to consumers. Thus, in order to protect consumer welfare, the government must intervene and impose fairness standards in the industry to curtail media bias.

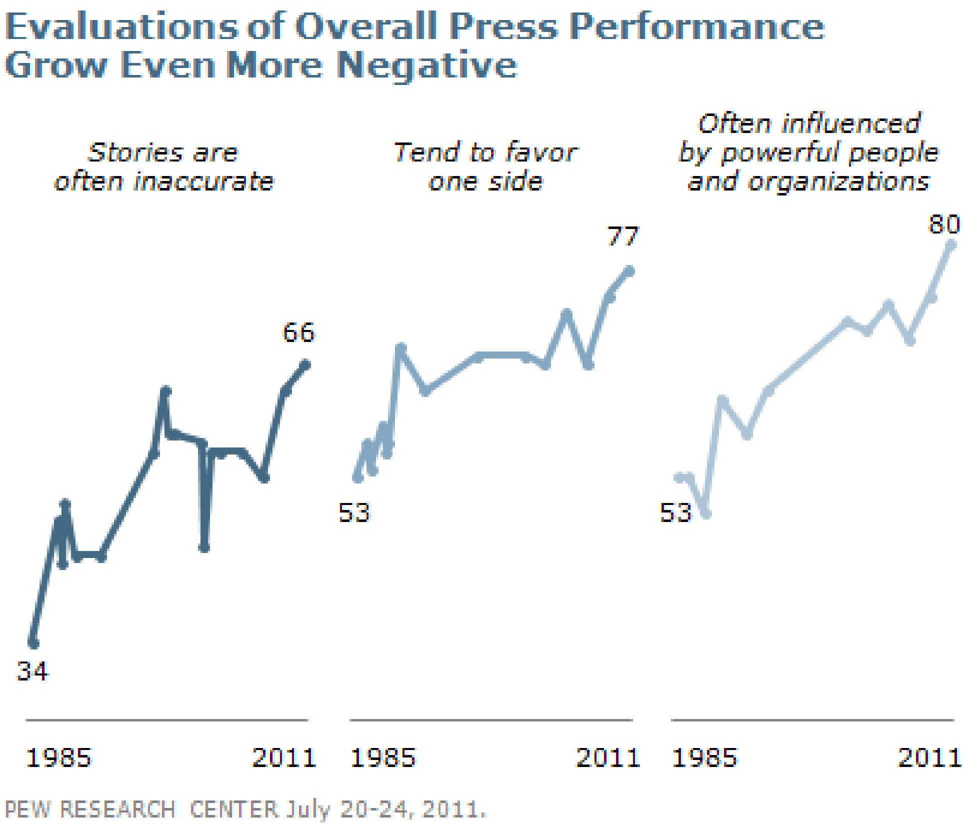
Content regulations that restrict the degree of bias in news coverage are popular tools for such purposes. In the United Kingdom, the Office of Communications's Broadcasting Codes require news to be reported with "due impartiality".[3] In the United States, the Federal Communications Commission (FCC) enforced the Fairness Doctrine, which required TV and radio stations to present contrasting viewpoints on controversial issues of public interest. The FCC dissolved the doctrine during the deregulation sweep

[1]For example, Coulter (2003) and Goldberg (2002) claim that there is a significant liberal bias in the American public media, while Alterman (2003) and Brock, Rabin-Havt, and Media Matters for America (2012) claim that the bias is to the right.

[2]Note that, while many studies find significant bias in the news media, Puglisi and Snyder (2012) find the press to be largely balanced.

[3]Section Five of the Ofcom Broadcasting Codes, available at: http://stakeholders.ofcom.org.uk/broadcasting/broadcast-codes/broadcast-code/?a=0.

FIGURE 1.1. Percentage of Respondents Expressing Concerns for Media Bias



of the Reagan Administration. But attempts to reintroduce the Fairness Doctrine and even to codify it have not stopped since.[4]

In this paper, we present a general model of the market for news and apply it to examining the economic and social consequences of media bias and evaluating the merits of these regulations on news content. Motivated by our goal to understand the impact of content regulations such as the Fairness Doctrine as well as the empirical measures of media bias in the literature, we define such bias in this paper as the unbalanced presentation of information (views, evidence, etc.) in favor of (i.e., inherently biased to) different sides of a controversial issue. The media outlets in our model can spend a limited amount of resources on acquiring information regarding the unknown state of the world and can allocate these resources to collecting information with different biases. They can produce balanced news reports by allocating resources evenly across the collection of information favoring each side. Otherwise, their news reports will be biased. Thus, media bias can be created in the process of collecting and synthesizing

[4]See Limburg (2013) for a brief account of the introduction and abolition of the Fairness Doctrine and suggestions for further reading.

information. The media outlets can also garble the information they have collected before reporting them to the consumers. However, we show that if the media outlets' goal is to maximize profits, garbling is suboptimal and is not part of their equilibrium strategies.

Our findings cast serious doubt on the common justification for content regulations that hinges on protecting consumers from misinformation. Although there is evidence suggesting that consumers exposed to unbalanced news sources appear to be relatively poorly informed (e.g., Gentzkow and Shapiro (2004)), this does not necessarily imply that consumer welfare is lower. Our results show that rational Bayesian consumers who consume news only to help themselves make informed individual decisions may strictly prefer biased news to more balanced news, *even if* the latter provides significantly more information. The reason is that, while more information always improves the accuracy of the consumers' beliefs and can never hurt a rational Bayesian consumer making non-strategic decisions (Blackwell (1951)), its value depends on the nature of the consumers' decision problem and the nature of other information the consumers have.[5]

In particular, acquiring information with opposite biases can be inefficient. Contrasting viewpoints or conflicting evidence prevents rational consumers from becoming certain of the underlying state and making resolute decisions that bring higher expected utilities. Thus, when information are costly to gather and there is tradeoff between information with different biases, learning only one-sided information can be more efficient to the consumers. This may be the case even when there is significant decreasing return to scale associated with producing information biased to one side, and allocating all resources to collecting one-sided information results in less information gathered in total.

We show that media outlets may choose to produce news with significant bias in equilibrium even when they are only motivated by higher profits. Moreover, content regulations not only cannot lead to Pareto improvements from market outcomes, they can in fact result in Pareto dominated outcomes. Thus, these regulations are poorly justified on the ground of protecting consumer welfare. On the other hand, we also find that media bias can lead to political polarization, which is behaviorally defined by consumers taking more extreme actions in opposite directions. We show that content

[5]Note that, in this paper, a news report providing "more information" is one that presents a larger number of facts (pieces of evidence) and does not necessarily dominate a news report providing less information according to the Blackwell order, which already takes into account of the nature of the decision problem. In fact, pairs of news reports often cannot be ordered by the Blackwell order, which, of course, is not complete.

regulations can help mitigate such polarization under some market conditions, but can also exacerbate polarization under other circumstances.

A fast growing literature on media economics has produced many insightful explanations for the perceived biases in the news media.[6] Baron (2006), Besley and Prat (2006), Duggan and Martinelli (2011), and Anderson and McLaren (2012) show that media bias may originate from the supply side, when media outlets or their employees have incentives to deliberately distort the consumers' beliefs with biased news. On the other hand, other papers have modeled media bias as originating from the demand side. The consumers may demand bias in their news because they appreciate the entertainment value in such news (e.g. Mullainathan and Shleifer (2005), Bernhardt, Krasa, and Polborn (2008)) or find such news more useful in helping them determining their optimal course of action (e.g. Chan and Suen (2008), Oliveros and Vardy (2012), and Sobbrio (2013)). Gentzkow and Shapiro (2006) and Stone (2011) show that media bias can arise if media outlets have the incentive to mislead consumers unsure of the media outlets' capabilities into believing that they are of the superior type or if consumers and reporters misinterpret their information (i.e., they are affected by confirmation biases in the spirit of Rabin and Schrag (1999)).

In this paper, our consumers only care about making optimal individual choices and consume news only to assist their decision making as in Chan and Suen (2008) and Oliveros and Vardy (2012). The media outlets in our model only aim to maximize profits as in Mullainathan and Shleifer (2005) and Sobbrio (2013). This is not to say that we do not think that the entertainment value in news and the media outlets' incentives to influence their consumers are not important aspects of the problem. But we believe that, to better understand these other aspects, it is important to learn how far a more basic model can take us to understand the phenomenon of media bias.

In contrast to the fruitful research on the cause of media bias and its impact on democratic processes, little has been done to develop a theoretical understanding of the industrial organization of the market for news, which is essential for the evaluation of media industry regulations. Earlier models that study the commercial aspects of media bias (e.g., Mullainathan and Shleifer (2005), Anderson and McLaren (2012), and Sobbrio (2013)) are too restrictive to match the rich body of empirical evidence accumulated by recent studies (e.g. Hamilton (2006), Gentzkow, Glaeser, and Goldin (2006), Gentzkow and Shapiro (2010), and Gentzkow, Shapiro, and Sinkinson (2012)). For example, consumers are generally restricted to consuming only one news report, and most of the models have difficulties analyzing oligopolistic competition involving more

[6] See Prat and Stromberg (2011) for a survey of the literature on the political economy of public media.

than two media outlets. Consequently, these models cannot match known consumption patterns, according to which consumers often consume multiple number of news reports with distinct biases, and media outlets attract consumers from distinct ideological groups (the Pew Research Center for the People and the Press (2012) and Mitchell, Jurkowitz, Enda, and Olmstead (2013)).

In this paper, media outlets have more freedom in deciding the amount of information to report and the manner in which they report, while consumers are able to consume multiple news reports. At the same time, our model remains tractable and is able to accommodate any finite number of media outlets. The generality of our model leads to new predictions. In addition to matching the above mentioned consumption patterns, the flexibility to handle large number of competitors allows us to examine the joint effect of the cost incurred by consumers from consuming news and the intensity of competition on the average degree of bias in the news supplied in equilibrium. We are thus able to explain the historical variations of the degree of media bias in the US market based on the changes in those factors.

Last, this paper presents a new model of rational demand for biased information. As in Calvert (1985) and Suen (2004), the preference for biased information by our consumers is attributable to the non-concavity in the value of information (Radner and Stiglitz (1984)). However, the ways bias is conceptualized differ across these models, which lead to different behavioral predictions.[7] The type of preference for biased information in our model is an example of the concept generally termed "confirmation bias" in the Psychology literature (See Klayman (1995) and Nickerson (1998)), which has been introduced to the economics literature by Rabin and Schrag (1999).

The rest of the paper is organized as follows: the next section introduces the formal model. In Section 3, we characterize the optimal news report from an individual consumer's perspective and show that it often is biased. Section 4 studies the industrial organization of the market for news and analyzes the relationship between average equilibrium media bias and other market conditions. Towards the end of the section, we lay out the empirical implications of our model and evaluate the effect of imposing content regulations on consumers' well-being. In Section 5, we show that media bias can lead to political polarization. We demonstrate that content regulations can mitigate such polarization and discuss their limits. Section 6 concludes with a discussion on possible extensions. All proofs are relegated to the appendix.

[7] For example, in Chan and Suen (2008), which shares the same basic model as Suen (2004), the consumers are never willing to pay for more than one news reports.

2. The Model

Consider a market for news with a continuum of consumers and a finite number of producers. The producers will be referred to as media outlets. The mass of the consumers is normalized to unity and $N \in \mathbb{N}$ denotes the number of media outlets. The consumers each, independently, face a choice under uncertainty and the media outlets provide information that can potentially assist the consumers in making better decisions.

2.1. **The Consumers' Decision.**

Let i denote a typical consumer who faces a choice between three actions: the left action, denoted by l, the right action, denoted by r, and abstention, denoted by a. As summarized in Table 2.1, i's utilities associated with actions l and r depend on the unknown state of the world, which can be either left, denoted by L, or right, denoted by R, while her utility associated with action a is certain and is normalized to 0. The parameters $\alpha_i, \beta_i, \delta_i, \gamma_i$ are positive real numbers. We assume that $\frac{\alpha_i}{\alpha_i+\beta_i} < \frac{\delta_i}{\delta_i+\gamma_i}$, so that action a is not dominated.

Table 2.1. Consumer $i's$ Decision Problem

	L	R
l	α_i	$-\beta_i$
r	$-\delta_i$	γ_i
a	0	0

Consumer i is assumed to be a subjective expected utility (SEU) maximizer. Let her subjective prior belief over the possible states, $\{L, R\}$, be given by the vector $(1-\pi_i, \pi_i)$, that is, she believes that state R obtains with probability π_i.[8] Let $u_i^p(d)$ denote her expected utility when her belief over $\{L, R\}$ is given by the vector of probabilities $(1-p, p)$ and she decides to take action $d \in \{l, r, a\}$. Define $\widehat{d}_i(p)$ as her optimal decision given her belief p, i.e., $\widehat{d}_i(p) \equiv \arg\max_{d \in \{l,r,a\}} u_i^p(d)$. Ex ante, her optimal decision depends on her utility function and prior belief as follows:

$$\widehat{d}_i(\pi_i) = \begin{cases} \{l\}, & \pi_i \in [0, \frac{\alpha_i}{\alpha_i+\beta_i}) \\ \{l, a\}, & \pi_i = \frac{\alpha_i}{\alpha_i+\beta_i} \\ \{a\}, & \pi_i \in \left(\frac{\alpha_i}{\alpha_i+\beta_i}, \frac{\delta_i}{\delta_i+\gamma_i}\right) \\ \{a, r\}, & \pi_i = \frac{\delta_i}{\delta_i+\gamma_i} \\ \{r\}, & \pi_i \in (\frac{\delta_i}{\delta_i+\gamma_i}, 1] \end{cases}.$$

[8]Note that the consumers are not forced to have heterogeneous priors. The subjective prior beliefs of all of the consumers may very well agree.

In the rest of the paper, members of $\widehat{d}_i(\pi_i)$ are referred to as consumer i's "*default actions*".

Different consumers can have different utility functions and beliefs, hence the dependence of $(\alpha_i, \beta_i, \delta_i, \gamma_i, \pi_i)$ on i. Consequently, they might have different default actions.

For example, imagine that two candidates are vying for a political office. The consumers at a positive utility cost can either vote for the left candidate (action l) or vote for the right candidate (action r). Otherwise, she can choose to abstain (a). One of the two candidates has higher valence than the other. The better candidate could be the left one (state L) or the right one (state R). Consumer i always wants to vote for the candidate with the higher valence.

Alternatively, imagine that there is contention over the optimal strategy to prevent a hostile foreign country from developing nuclear weapons. All consumers agree that if the foreign country's nuclear program is still in its early stage (state L), sanctions are the most appropriate policy. However, if the nuclear program has passed a certain point (state R), preemptive military actions are necessary. Consumer i can, again at a cost, choose to advocate for either choice (actions l or r) or she can refrain from choosing sides at all (action a).

In either case, if i is sufficiently certain that the true state is L (R), or, more precisely, if $\pi_i < \frac{\alpha_i}{\alpha_i+\beta_i}$ (respectively, if $\pi_i > \frac{\delta_i}{\delta_i+\gamma_i}$), her optimal choice is l (r). Otherwise, she is better off choosing a, which is both less costly and less risky than the other choices.

Note that how certain consumer i needs to be to choose l or r depends on her utility function. Two consumers with the same belief might choose different actions because of their different preferences. For example, given the same belief about the candidates' valence, one consumer might choose to vote for the left candidate and the other for the right candidate because they each find their chosen candidates' personal traits more likable. Alternatively, given the same belief about the success of the foreign country's nuclear program, one consumer might support sanctions while the other supports military action, because the former disapproves of the use of violence in general and the latter is more lax about it.

For expositional convenience, the consumers with default action l, i.e. all i with $\widehat{d}_i(\pi_i) = \{l\}$, are referred to as "*liberals*", and those with default actions r and a are referred to as "*conservatives*" and "*moderates*", respectively.[9]

2.2. **The News Reports.**

[9]Those consumers who are indifferent between two actions can be categorized into either group. In the following analysis, they will generally form a subset of measure zero. Consequently, their behavior does not affect our analysis.

2.2.1. *Investigations and Signals.* To produce a news report, the media outlets need to investigate into various matters pertaining to the unknown state. Conceptually, we can think of this as the media outlets asking a number of questions, each with an "yes" or "no" answer, on behalf of their readers / viewers. Formally, these investigations can be modeled as binary signals that send a message of "left" or "right" in each state.

We recognize that investigations conducted by media outlets to ascertain the truth of an uncertain issue can in fact favor one side or the other. For example, when investigating the valence of a political candidate, the media outlets can elicit opinions from a supporter of the candidate or a member of the same political party. These people are more likely to endorse the candidate, and might even endorse him or her knowing that he or she in fact has lower valence. Thus, opinions elicited from supporters or party members are inherently biased towards their favored candidate.

To capture this idea, we assume that there are two types of binary signals the media outlets can acquire: signals that are biased to the left (in short, "*left signals*") and signals that are biased to the right ("*right signals*"). As illustrated in Table 2.2, when the true state is L, a left signal always identifies the state, correctly, as left. On the other hand, if the true state is R, a left signal only correctly identifies the state as right with probability $\sigma_L \in (0,1)$ and, with the remaining probability, the signal makes a mistake (or "lies") and identify the state as left. A right signal is defined symmetrically, and is characterized by some $\sigma_R \in (0,1)$ (see Table 2.3).

Given her prior belief $(1-\pi_i, \pi_i)$, consumer i expects a left signal to report "left" with a probability strictly higher than $1-\pi_i$, and, upon receiving a "left" report from the signal, the consumer updates her belief to $(1-\pi', \pi')$, where $\pi' < \pi$. The opposite is true for a right signal. This is the sense in which the signals are biased: ex ante, a left (right) signal is more likely to cause the consumer to have a stronger belief in state L (respectively, R).[10] In the previous example, the opinion from a supporter of the left candidate amounts to a left signal, while the opinion from a supporter of the right candidate is a right signal.

TABLE 2.2. A Left Signal

	L	R
"*left*"	1	$1-\sigma_L$
"*right*"	0	σ_L

[10] In precise terms, "more likely" here means "with higher probability than actuarially fair according to the consumer's prior belief".

TABLE 2.3. A Right Signal

	L	R
"$left$"	σ_R	0
"$right$"	$1 - \sigma_R$	1

However, bias does not have to result from misrepresentation of facts. It can equally be due to the uneven type I and type II errors associated with the particular investigation. For example, when investigating the foreign nuclear program, the media outlets can attempt to find out whether or not the foreign country has developed the capacity to enrich uranium, which must occur before the milestone of development, or they can attempt to find out if that country has already conducted nuclear tests, which occurs after the critical stage. The former amounts to a right signal, since it will fail to recognize that the milestone has not been reached, if the foreign country has acquired the capacity to enrich uranium. The latter, on the other hand, is equivalent to a left signal.

Realistically, even a left (right) signal may not be perfectly accurate in identifying the left (right) state. There may very well be small chances that the signals can err in their favored states. Such small chances are ignored here in order to gain tractability. However, one needs not to be too concerned by this simplification. As it will become clearer below, the consumers' expected utilities are continuous in the conditional probabilities characterizing our signals. Thus, so long as the probability that left and right signals misidentify their favored states is small, the predictions of consumers' behavior in our model remain good approximations.

2.2.2. *News Reports and News Consumption Bundles.* Each media outlet can produce one news report, which is based on the findings of the various investigations conducted. Tracking all the possible combinations of findings from those investigations and compute the probabilities they each obtain is potentially a very tedious task. However, note that a collection of left signals can be identified with a single (composite) left signal.

For example, consider a collection of two left signals characterized by conditional probabilities σ_L and σ'_L, respectively. In state L, both signals are going to identify the state as L. In state R, there are four distinct possible outcomes in which zero, one, or two of the signals identifies the state correctly as R. However, if any of the two left signals identifies the state as R, we can conclude that the state must indeed be R. Thus, for all intents and purposes, we can simply identify the two left signals with a single left signal characterized by conditional probability σ''_L, which is the probability that any of the two original left signals correctly identifies the state in R. Note that $\sigma''_L > \max\{\sigma_L, \sigma'_L\}$ as long as the two original signals are not perfectly correlated. Similarly, any collection of left (right) signals can be identified with a single (composite) left (right) signal.

On the other hand, a collection of signals of both types can be identified to a composite signal that sends a message m_L (respectively, m_R) when any of the right (left) signals reports "left" ("right"), and sends a message m_N when all of the left signals report "left" and all of the right signals report "right". Thus, a news report that reports *truthfully* the findings from all the investigations conducted can be identified as a composite signal characterized by a pair of conditional probabilities $(\sigma_L, \sigma_R) \in [0,1]^2$, where σ_L (respectively, σ_R) is the probability that any left (right) signal correctly identifies the state as R (L) (see Table 2.4).

If such a news report sends a message m_L (m_R), consumer i knows that the true state must be L (R). Thus, m_L (m_R) can be interpreted as "*conclusive evidence*" presented by the media outlet in support of state L (R). By contrast, message m_N represents "*inconclusive evidence*" presented by the media outlet. There may be two types of inconclusive evidence: if either σ_L or σ_R equals to zero, the evidence is *"one-sided*", while, if both σ_L and σ_R are positive, the evidence is "*conflict*ing".

TABLE 2.4. A News Report

	L	R
s_L	σ_R	0
s_N	$1-\sigma_R$	$1-\sigma_L$
s_R	0	σ_L

Note that the media outlet is assumed to be reporting its findings truthfully here. If, instead, the media outlet chooses to garble its signals, its news report is no longer equivalent to the composite signal presented in Table 2.4. However, as we shall see in our analysis below, we do not expect this to happen in equilibrium if the media outlets maximize their profits. This is because that, in equilibrium, where consumers have rational expectations of the media outlets' strategies, garbling its signals can only reduce a media outlet's profit and is therefore dominated by truthful reporting.

Finally, as alluded to earlier, the consumers in our model have the freedom to consume news reports produced by multiple media outlets. For any set of media outlets $J \subseteq \{1, 2, \ldots, N\}$, a "*news consumption bundle*" consisting of the news reports produced (faithfully) by members of J is equivalent to the collection of all the left signals and all the right signals acquired by those media outlets and can be identified again with a (richer) composite signal characterized by conditional probabilities $\left(\sigma_L^J, \sigma_R^J\right) \in [0,1]^2$, where $\left(\sigma_L^J, \sigma_R^J\right)$ depend on the conditional probabilities characterizing each of the media outlet's reports, which, in turn, depend on the amount of resources devoted by the media outlets to acquire their signals.

2.2.3. *News Production Technology.* Each media outlet is endowed with q units of resources that can be spent on conducting investigations (i.e., acquiring signals). q is normalized so that it falls in $(0,1)$. A media outlet can allocate these resources between acquiring left signals and right signals. Specifically, media outlet j chooses a *"reporting strategy"*, characterized by a pair of non-negative real numbers $\left(q_L^j, q_R^j\right)$ such that $q_L^j + q_R^j \leq q$, where q_L^j (respectively, q_R^j) is the amount of resources allocated to acquiring left (right) signals.[11]

Spending q_L^j and q_R^j on acquiring left and right signals gives media outlet j a composite signal characterized by $\left(\sigma_L^j, \sigma_R^j\right) = \left(\sigma\left(q_L^j\right), \sigma\left(q_R^j\right)\right)$. The function $\sigma : [0,1] \to [0,1]$ specifies the news production technology available to the media outlet. We assume that σ is strictly increasing and that $\sigma(0) = 0$. The strict monotonicity of σ reflects the idea that, as a media outlet spends more resources on collecting information, its information becomes better.[12]

For any subset of media outlets J, a news consumption bundle consisting reports from these outlets is characterized by $\left(\sigma_L^J, \sigma_R^J\right)$, where σ_b^J, $b = L, R$, should depend on the statistical interdependence between all of the b-biased signals contained in all of the news reports. We assume that $\sigma_b^J = \tau_J\left(\left(\sigma_b^j\right)_{j\in J}\right)$, where $\tau_J : [0,1]^{|J|} \to [0,1]$ is defined by $\tau_J\left(\left(\sigma_b^j\right)_{j\in J}\right) \equiv 1 - \prod_{j\in J}\left(1 - \sigma_b^j\right)$. That is, the composite signals generated by the news reports are, in effect, statistically independent conditional on the state.[13]

In what follows, we refer to $(q,0)$ and $(0,q)$ as "*extreme reporting strategies*" and any other feasible (q_L, q_R) as an "*interior reporting strategy*". We shall from time to

[11] The fact that media outlets only choose the allocation of resources to acquiring signals reflects our restriction of attention to the undominated truthful reporting strategies.

[12] For example, if the media outlet acquires more left signals, the probability that at least one of these signals will correctly identify the state R increases as long as those signals are not perfectly correlated. No additional restrictions on σ (e.g., on its curvature) is imposed. While it is reasonable to expect that σ_L and σ_R should be concave in the number of signals the media outlet acquires, they need not to be concave in the amount of resources the media outlet spends. There may very well be significant scale economies in acquiring signals of the same type and the resulting σ may be linear or even convex.

[13] This assumption is in fact more restrictive than what is needed for our results and is made for expositional brevity only. However, we do need τ_J to be strictly monotone and concave. As discussed earlier, the curvature of σ is not restricted. In particular, it can be convex. Thus, the fact that τ_J is strictly concave reflects the assumption that by pooling their resources, two media outlets can produce a single news report that is more accurate than the news consumption bundle containing news reports produced independently by these outlets. This could be due to repetitions in investigations conducted by the outlets.

time abuse notation and write $\boldsymbol{\sigma}(\mathbf{q}^j)$ for $\left(\sigma\left(q_L^j\right), \sigma\left(q_R^j\right)\right)$ and $\boldsymbol{\tau}\left(\boldsymbol{\sigma}(\mathbf{q}^j), \boldsymbol{\sigma}\left(\mathbf{q}^k\right)\right)$ for $\left(\tau\left(\sigma\left(q_L^j\right), \sigma\left(q_L^k\right)\right), \tau\left(\sigma\left(q_R^j\right), \sigma\left(q_R^k\right)\right)\right)$.

2.2.4. *Defining Bias.* A media outlet is considered "*biased to the left (right)*" if it allocates more resources to acquiring left (right) signals. Formally, a news report (q_L, q_R) is biased to the left (right) if $\rho \equiv \frac{q_R}{q_L+q_R} < \frac{1}{2}$ $(> \frac{1}{2})$, where $|\ \rho - \frac{1}{2}\ |$ measures the degree of bias in the report.

Thus, media bias is created in the process of acquiring and synthesizing information. By choosing different experts or institutions to consult, questions to ask, or matters to investigate, the media outlets can make their reports favor one state over the other. In our previous example, a media outlet that only elicits opinions from a candidate's supporters is considered to be biased towards that candidate. On the other hand, a media outlet that elicits opinions from supporters of both candidates is considered balanced.

Our definition of media bias is tailored to representing the kind of bias policies like the Fairness Doctrine are intended to curtail. Moreover, it corresponds directly to the measures of media bias in the empirical literature adopted by scholars like Groseclose and Milyo (2005), who measure the bias of a media outlet by the relative frequencies the latter quotes "liberal think tanks" versus "conservative ones", and Gentzkow and Shapiro (2010), who measure bias by the relative frequencies media outlets use phrases that are more commonly used by Democrats versus those used by Republicans.[14]

Similarly, a news consumption bundle is said to be "*biased to the left*" or "*biased to the right*" if $\omega \equiv \frac{\sigma_R}{\sigma_L+\sigma_R} < \frac{1}{2}$ or $\omega > \frac{1}{2}$ respectively. $|\ \omega - \frac{1}{2}\ |$ measures the degree of bias in the news consumption bundle.

2.3. **The Value of Information to Consumers.** The consumers are assumed to have rational expectations about the media outlets' reporting strategies and update their beliefs according to Bayes' rule. Given consumer i's prior belief, π_i, and her news consumption, $\boldsymbol{\sigma} \equiv (\sigma_L, \sigma_R)$, we can calculate i's posterior belief upon receiving messages m_L, m_R, and m_N, respectively, as well as her prior belief for the likelihood

[14]The correspondence to the Gentzkow and Shapiro (2010) measure might appear less obvious at first. However, if we recognize that phrases used by politicians are likely related to the issues they raise, the questions they ask, and the arguments they make, all of which are presumably in favor of their own causes; then more frequent usage of the same phrases as a politician may well indicate that the media outlet takes the same stance as that politician on the underlying issues.

of receiving them. Abusing notation a little, these can be written as:

$$\begin{aligned} p\left(m_L\right) &= \left(1-\pi_i\right)\sigma_R \\ p\left(m_R\right) &= \pi_i\sigma_L \\ p\left(m_N\right) &= 1-\pi_i\sigma_L-\left(1-\pi_i\right)\sigma_R \\ p\left(R\mid m_L\right) &= 0 \\ p\left(R\mid m_R\right) &= 1 \\ p\left(R\mid m_N\right) &= \frac{\pi_i\left[1-\sigma_L\right]}{1-\pi_i\sigma_L-\left(1-\pi_i\right)\sigma_R}. \end{aligned}$$

Note that the bias in consumer i's news consumption bundle determines how the report affects her posterior belief. After receiving conclusive evidence m_L (m_R), the consumer knows that the state is L (R). However, her posterior belief, and hence optimal choice, upon receiving inconclusive evidence m_N depends on ω. For any $\pi_i \in (0,1)$, holding $\sigma_L+\sigma_R$ constant, $p\left(R\mid s_N\right)$ is strictly increasing in ω, and $p\left(R\mid s_N\right)<\pi_i$ ($>\pi_i$) if and only if $\omega<\frac{1}{2}$ ($>\frac{1}{2}$).

Define $u_i^*\left(p\right)\equiv\max\{u_i^p\left(l\right),u_i^p\left(r\right),u_i^p\left(a\right)\}$. Thus, $u_i^*\left(p\right)$ is the maximum expected utility consumer i can achieve without additional information given her belief $(1-p,p)$. Consumer i's "*default utility*" is $u_i^*\left(\pi_i\right)$. Having access to a bundle of news reports allows the consumer to make her decision contingent on the message she receives. Thus, with consumption bundle (σ_L,σ_R), the maximum expected utility consumer i can achieve, ex ante, becomes:

$$\begin{aligned} & U_i^*\left(\sigma_L,\sigma_R,\pi_i\right) \\ \equiv\ & p\left(m_R\right)u_i^*\left(p\left(R\mid m_R\right)\right)+p\left(m_L\right)u_i^*\left(p\left(R\mid m_L\right)\right)+p\left(m_N\right)u_i^*\left(p\left(R\mid m_N\right)\right) \\ =\ & \pi_i\sigma_L\gamma_i+\left(1-\pi_i\right)\sigma_R\alpha_i+\left[1-\pi_i\sigma_L-\left(1-\pi_i\right)\sigma_R\right]u_i^*\left(p\left(R\mid s_N\right)\right). \end{aligned} \tag{2.1}$$

The difference between $U_i^*\left(\sigma_L,\sigma_R,\pi_i\right)$ and $u_i^*\left(\pi_i\right)$ is the net gain in expected utility brought by the news consumption bundle $\boldsymbol{\sigma}$ and, hence, is how much the news consumption bundle is valued to the consumer.

Since $[1-\pi_i\sigma_L-(1-\pi_i)\,\sigma_R]$ is non-negative for all $(\sigma_L,\sigma_R)\in[0,1]^2$, we can rewrite (2.1) as:

$$\begin{aligned}U_i^*(\sigma_L,\sigma_R,\pi_i) &= \max\{\pi_i\sigma_L\gamma_i+(1-\pi_i)\,\sigma_R\alpha_i \\ &\quad +\pi_i(1-\sigma_L)\,\alpha_i+(1-\pi_i)(1-\sigma_R)(-\beta_i)\,, \\ &\quad \pi_i\sigma_L\gamma_i+(1-\pi_i)\,\sigma_R\alpha_i \\ &\quad +\pi_i(1-\sigma_L)(-\delta_i)+(1-\pi_i)(1-\sigma_R)\,\gamma_i, \\ &\quad \pi_i\sigma_L\gamma_i+(1-\pi_i)\,\sigma_R\alpha_i\}.\end{aligned}$$

The expressions in the brackets are the consumer's expected utility if she commits to choosing l, r, and a, respectively, after receiving inconclusive evidence. Viewed as functions of (σ_L,σ_R) or functions of π_i, all of these expressions are linear. Thus, U_i^* is the maximum of linear functions and is therefore convex in (σ_L,σ_R) and in π_i.

3. Utility Maximizing News Reports

We are interested in the consumers' welfare in various market outcomes with or without government intervention. This comes down to understanding the consumers' preference over news consumption bundles. In this section, we ask the following question: fixing a media outlet's resources and production technology, what is the most valuable news report it can produce for an individual consumer, given the consumer's preference and prior belief? Formally, let $(\alpha,\beta,\delta,\gamma)$ be any member of $\mathbb{R}^4_{++}$ that satisfy $\frac{\alpha}{\alpha+\beta}<\frac{\delta}{\delta+\gamma}$, we want to solve, for each $q\in(0,1)$ and each $\pi\in(0,1)$, the following problem:

$$\begin{aligned}\max_{(q_L,q_R)} \quad & U^*(\sigma(q_L),\sigma(q_R),\pi) \\ s.t. \quad & q_L,q_R\geq 0 \\ & q_L+q_R\leq q,\end{aligned} \tag{3.1}$$

where the dependence of U^* on the utility vector $(\alpha,\beta,\delta,\gamma)$ is suppressed in the notation.

As it turns out, if the consumer is a liberal or a conservative, i.e., if $\pi<\frac{\alpha}{\alpha+\beta}$ or $\pi>\frac{\delta}{\delta+\gamma}$, the solution to this problem is remarkably simple.

Proposition 1. *The unique solution to problem (3.1) is* $\mathbf{q}^*=(q,0)$, *if the consumer is a liberal, and is* $\mathbf{q}^*=(0,q)$, *if she is a conservative.*

Thus, a liberal prefers her news report to be extremely biased towards the left, while a conservative prefers her news report to be extremely biased to the right. These consumers' preference for biased news is rational and consistent with SEU maximization.

Note that, when σ is concave, acquiring more left (right) signals or producing such signals with higher accuracy may lead to larger reductions in the number or accuracy of of right (left) signals that can be produced. That is, the extremely biased news report may be significantly less informative than a more balanced one. Nevertheless, the partisan consumers always prefer the former.

To understand the intuition behind Proposition 1, let us explore some properties of the function U^*. The following lemma establishes that U^* is monotone in (σ_L, σ_R).

Lemma 1. *For any* $\pi \in (0,1)$ *and any* $\sigma_L, \sigma'_L, \sigma_R, \sigma'_R \in [0,1]$*, such that* $\sigma_L < \sigma'_L$ *and* $\sigma_R < \sigma'_R$*:*

a) $U^*(\sigma_L, \sigma_R, \pi) \leq U^*(\sigma'_L, \sigma_R, \pi)$ *and* $U^*(\sigma_L, \sigma_R, \pi) \leq U^*(\sigma_L, \sigma'_R, \pi)$*;*

b) $U^*(\sigma_L, \sigma_R, \pi) < U^*(\sigma'_L, \sigma'_R, \pi) \leq U^*(1, \sigma'_R, \pi) = U^*(\sigma'_L, 1, \pi)$*.*

A short algebraic proof of Lemma 1 is given in the appendix. However, note that, for $b = L, R$, reducing σ_b can be viewed as randomly misreporting the realization of b-biased signals. Thus, Lemma 1 a) is essentially a special case of Blackwell's (1951) well-known theorem on comparing experiments. It re-iterates the well-known fact that, to an individual facing a non-strategic decision problem, more information is never a bad thing.

Lemma 1 b) implies that the marginal utility value of resources spent on collecting one of the two types of information must always be strictly positive. Thus, it is never optimal for the consumers if a media outlet underutilizes its resources, hence the solution to (3.1), (q_L^*, q_R^*), must satisfy $q_L^* + q_R^* = q$.

The next lemma identifies the conditions in which additional information of a particular kind is not valuable. If the consumer's news consumption bundle is $\boldsymbol{\sigma}$, let $p_\pi^{\boldsymbol{\sigma}}(L \mid m_N)$ denote her posterior belief after she is presented with inconclusive evidence. Recall that $\widehat{d}(p)$ is the consumer's optimal choice(s) of action when her belief is given by p.

Lemma 2. *For any* $\pi \in (0,1)$ *and any* $\sigma_L, \sigma'_L, \sigma_R, \sigma'_R \in [0,1]$*:*

a) *If* $\widehat{d}\left(p_\pi^{(\sigma_L,\sigma_R)}(L \mid m_N)\right) = \widehat{d}\left(p_\pi^{(\sigma'_L,\sigma_R)}(L \mid m_N)\right) = \{r\}$*, then* $U^*(\sigma_L, \sigma_R, \pi) = U^*(\sigma'_L, \sigma_R, \pi)$*; and,*

b) *If* $\widehat{d}\left(p_\pi^{(\sigma_L,\sigma_R)}(L \mid m_N)\right) = \widehat{d}\left(p_\pi^{(\sigma_L,\sigma'_R)}(L \mid m_N)\right) = \{l\}$*, then* $U^*(\sigma_L, \sigma_R, \pi) = U^*(\sigma_L, \sigma'_R, \pi)$*.*

Lemma 2 says that if, upon receiving inconclusive evidence (m_N), the consumer's optimal choice is l (r), then additional information (signals) biased to the right (left) adds no value to her unless it can persuade her to change action.

Because the consumer is a Bayesian, a news report that directly sends her a message from the set $\{m_L, m_R, m_N\}$ is equivalent to two reports that inform her, in turn, about which message she can rule out. For example, telling the consumer m_L is equivalent to first telling her not m_R and then not m_N. However, if her choice after receiving m_N is l, then, after receiving the report "not m_R", the consumer can just go ahead and choose l. This is simply Savage's (1972) "Sure-thing Principle", which our SEU maximizing consumer respects. Consequently, the second report is useless to her. Moreover, even if the second report is made more informative (i.e., σ_R increases), it still does not help the consumer as long as it is not informative enough to persuade her to change her choice after receiving m_N.

Recall that $p_\pi^{(\sigma_L,\sigma_R)}(L \mid m_N) \leq \pi$, if and only if $\sigma_L \geq \sigma_R$. Therefore, for a liberal, there exists $\varepsilon > 0$, such that any news report $(\sigma_L, \sigma_R + \varepsilon)$ with $\sigma_L \geq \sigma_R$ is as valuable to her as the extremely biased news report $(\sigma_L, 0)$. The opposite is true for a conservative.

On the other hand, Lemma 1 and the strict monotonicity of σ imply that

$$U^*(\sigma(q_L), \sigma(q_R), \pi) \leq U^*(\sigma(q), \sigma(q), \pi)$$

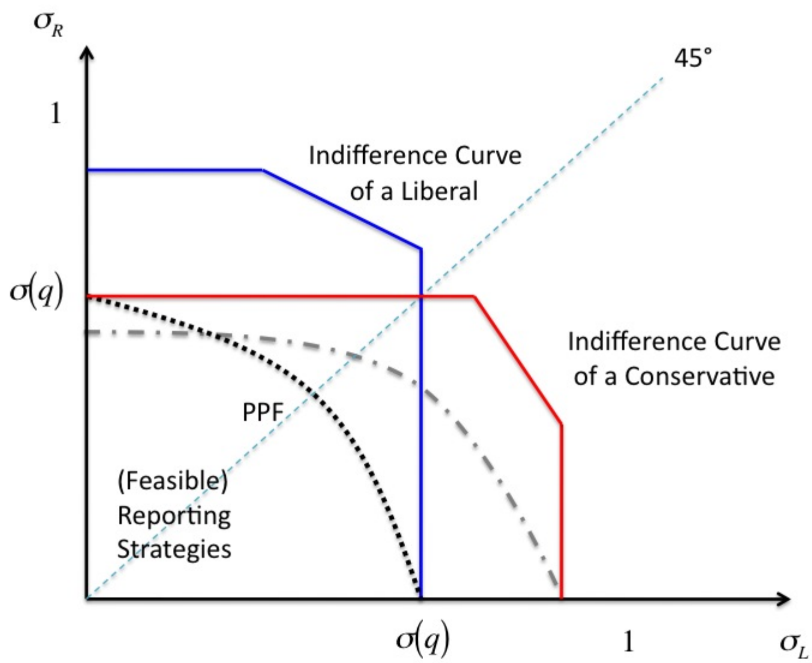
for all interior reporting strategies (q_L, q_R). Proposition 1 follows immediately.

We can also visualize Proposition 1 in Figure 3.1, which depicts the consumers' indifference curves. The set of feasible reporting strategies is the area bounded by the black dotted curve that represents the production possibility frontier (PPF) of the media outlet. The PPF is determined by σ and q and can be concave, linear or convex, if σ is concave, linear or convex respectively.

Lemma 1 implies that there can be no "thick" indifference curves and that indifference curves lying to the North-East represent higher values to the consumer. Lemma 2 implies that, when the difference between σ_L and σ_R is sufficiently large, the indifference curves are either horizontal ($\sigma_L < \sigma_R$) or vertical ($\sigma_L > \sigma_R$). Moreover, the vertical part of a liberal's indifference curves must cross the 45-degree line. So does the horizontal part of a conservative's indifference curves. Therefore, a liberal's utility must be maximized at the corner $(\sigma(q), 0)$, while a conservative's utility is maximized at $(0, \sigma(q))$.

However, note that Proposition 1 relies on our implicit assumption that the media outlet is equally efficient in acquiring information biased to the left and right, which implies that the PPF is symmetrical about the 45-degree line. If, instead, we assume that the media outlet is more efficient in acquiring information biased to the left, then the PPF looks like the grey dotted curve in Figure 3.1. In that case, while a conservative still prefers an extremely biased news report, her utility maximizing news report may very well be $(q, 0)$.

FIGURE 3.1. Indifference Curves of Liberals and Conservatives



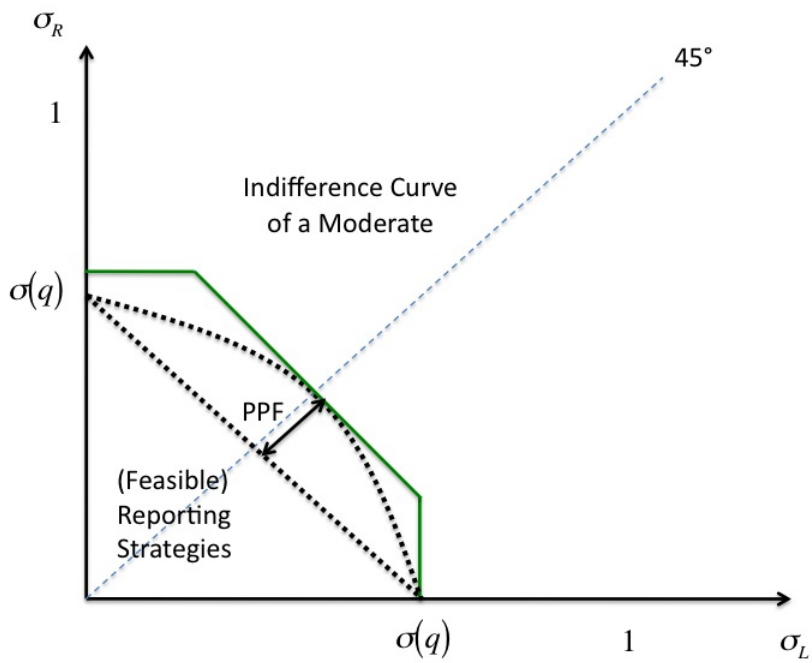
The argument for Proposition 1 given above does not apply to the moderates. Unlike the case with liberals and conservatives, the horizontal and vertical parts of a moderate's indifference curves do not cross the 45-degree line (See Figure 3.2). Therefore, a moderate consumer's utility may very well be maximized by an interior reporting strategy. However, the next proposition shows that, if σ is convex, the solution to (3.1) is still at a corner. Thus, when increasing the accuracy of the left (right) signals does not cost strictly more in terms of the accuracy of the right (left) signals, a moderate also prefers her news report to be extremely biased.

Proposition 2. *If $\sigma : [0,1] \to [0,1]$ is convex, the solution to problem (3.1) is either $(q,0)$ or $(0,q)$ for all consumers.*

Proposition 2 follows from the fact that U^* is convex in (σ_L, σ_R) and that σ is strictly increasing. If σ is also convex, U^* is convex in (q_L, q_R) and the solution to (3.1) must be an extreme point of the set of feasible reporting strategies. Lemma 1 rules out the extreme point $(0,0)$. Proposition 2 can also be visualized in Figure 3.2.

3.1. **Discussion.**

FIGURE 3.2. Indifference Curves of Moderates



3.1.1. *Contrasting Viewpoints.* The conventional wisdom professes that, to make an informed decision, one should consider arguments both for and against any particular course of action; and that truth will emerge from competition in the marketplace of ideas. Such beliefs are behind industry regulations that obligate media outlets to present diversified viewpoints on controversial affairs of public interest. However, our analysis above suggests that the conventional wisdom may have been misapplied in this case.

While learning additional information that might challenge one's current belief can never hurt if such information is readily available, this is not necessarily true when such information can only be acquired at a cost and one has to trade off information from different sources. In order to present contrasting viewpoints, a media outlet has to acquire both information biased to the left and to the right. However, Lemma 2 identifies circumstances under which acquiring information biased in a particular direction adds no value to the consumer. By contrast, Lemma 1 guarantees that resources can be better spent on acquiring information biased in the other direction. This is true regardless of the efficiency with which the media outlet can acquire information.

Thus, the consumer prefers her evidence to be more one-sided, even if that evidence is less accurate in identifying the true state. Regulations restricting the degree of bias in news reporting can therefore hurt the consumers.

However, this is not to say that such regulations cannot be justified at all. As we show in Section 5, content regulations like the Fairness Doctrine may serve the society as a whole by preventing political polarization and correcting distortions created by misalignment between individual and societal interests.

3.1.2. *More Choices Available to Consumers.* We can extend the model to include any finite number of choices by the consumers. In this case, Proposition 2 goes through without any modification. That is, so long as σ is convex, the utility maximizing news report for a consumer is always extremely biased, regardless of how many actions she can choose from.

In the general model, the consumers can still be divided into groups according to their default actions. In particular, we can identify the "*most liberal consumers*", whose default action is the "*most liberal action*", that is, $\widehat{d}(0)$. Similarly, the "*most conservative consumers*" are those with default action $\widehat{d}(1)$. Lemma 2 and Proposition 1 still hold in the general model for the most liberal action and the most liberal consumers as well as the most conservative ones.

4. The Industrial Organization of the Market for News

In this section, we analyze the industrial organization of the market for news and examine how equilibrium demand and supply respond to changes in market conditions. We then relate our results to empirical observations made by other researchers.

4.1. **The Consumers.** Recall that there is a continuum of consumers with unit mass. Each consumer is described by a five-dimensional vector, $(\alpha, \beta, \delta, \gamma, \pi)$ that specifies her utility function and prior belief. In the rest of the paper, we consider the aggregate demand by these consumers for news reports offered by an array of media outlets. In order to keep track of the demand of all the consumers, we restrict attention to the case in which all of the consumers share the same utility function as summarized in Table 4.1. Here, $c \in (0, 1)$ represents the cost associated with taking action l or r. For expositional brevity, we shall identify a consumer with her prior belief.

The consumers may still differ in their prior beliefs and, hence, default optimal actions. A liberal now has prior belief in $[0, \frac{1-c}{2})$, a conservative has prior belief in $(\frac{1+c}{2}, 1]$, and a moderate's prior belief falls in the interval $\left(\frac{1-c}{2}, \frac{1+c}{2}\right)$. Let the distribution

Table 4.1. Consumers' Utility Function

	L	R
l	$1-c$	$-1-c$
r	$-1-c$	$1-c$
a	0	0

of the consumers' prior beliefs be summarized by the distribution function F, which has a continuous density f and support $[0,1]$.[15]

4.2. **The Producers.** The producers in the market for news are $N \in \mathbb{N}$ profit-maximizing media outlets. The media outlets' profits, denoted Π_j, for $j = 1, 2, \ldots N$, are assumed to be an increasing affine function of the measure of consumers they attract. Thus, maximizing expected profits is the same as maximizing expected readership / viewership. This assumption is common in the literature and is appropriate when the majority of the media outlets' profits come from advertising.

Realistically, a media outlet's advertising income should also depend on the demographic characteristics of its readers / viewers. In particular, advertisers might pay different rates for consumers who only consume news from one media outlet from those who consume news from multiple sources **(Gentzkow, Shapiro, and Sinkinson (2012), Ambrus, Calvano, and Reisinger (2013))**. As we show below, this can be easily accommodated in our model by adjusting the weight on the measures of different groups of consumers.

4.3. **The Market Demand for News.** Recall that, the value of news consumption bundle $\boldsymbol{\sigma} \equiv (\sigma_L, \sigma_R)$ to the consumer is the difference between $U^* (\sigma_L, \sigma_R, \pi)$ and $u^* (\pi)$. We denote this value by $V (\sigma_L, \sigma_R, \pi)$. Define $\pi_* (\sigma_L, \sigma_R)$ implicitly by $p^{\boldsymbol{\sigma}}_{\pi_*} (R \mid s_N) = \frac{1-c}{2}$ and $\pi^* (\sigma_L, \sigma_R)$ by $p^{\boldsymbol{\sigma}}_{\pi^*} (R \mid s_N) = \frac{1+c}{2}$.[16] $U^* (\sigma_L, \sigma_R, \pi)$ and $u^* (\pi)$ are given by:

$$U^* (\sigma_L, \sigma_R, \pi) = \begin{cases} 1 - 2\pi - c + 2\sigma_L \pi & \pi \in [0, \pi_* (\sigma_L, \sigma_R)] \\ [\sigma_L \pi + \sigma_R (1-\pi)] (1-c) & \pi \in (\pi_* (\sigma_L, \sigma_R), \pi^* (\sigma_L, \sigma_R)) \\ 2\pi - 1 - c + 2\sigma_R (1-\pi) & \pi \in [\pi^* (\sigma_L, \sigma_R), 1] \end{cases},$$

[15]Some readers may be concerned by the assumed combination of homogeneous utility functions and heterogeneous priors. However, as demonstrated by the analysis so far, the behavior characteristics of the consumers and, in particular, their preferences for biased news reports, are not driven by any restrictions on their utilities or beliefs. Moreover, this is also only a choice of representation: the consumers described above behave identically as a set of consumers with a common prior and heterogeneous utility functions. Detailed discussion is given in Appendix 7.3.

[16]Thus, fixing a news consumption bundle $\boldsymbol{\sigma}$, $\pi_* (\sigma_L, \sigma_R)$ is the prior belief of a consumer who is indifferent between actions l and a after learning inconclusive evidence s_N. Similarly, consumer $\pi^* (\sigma_L, \sigma_R)$ is indifferent between actions a and r after learning s_N.

and

$$u^*(\pi) = \begin{cases} 1-2\pi-c & \pi \in \left[0, \frac{1-c}{2}\right] \\ 0 & \pi \in \left(\frac{1-c}{2}, \frac{1+c}{2}\right) \\ 2\pi-1-c & \pi \in \left[\frac{1+c}{2}, 1\right] \end{cases}.$$

Recall that, $\pi_* < \frac{1-c}{2}$ and $\pi^* < \frac{1+c}{2}$, if $\sigma_L < \sigma_R$, while the opposite is true, if $\sigma_L > \sigma_R$.

The consumers can acquire any number of news reports offered in the market at a constant cost (in terms of money, time, effort and other resources) of $\kappa > 0$ per news report.[17] To avoid triviality, κ needs to satisfy $\kappa < V\left(\sigma(q), 0, \frac{1-c}{2}\right) \equiv \overline{\kappa}$, where $V\left(\sigma(q), 0, \frac{1-c}{2}\right) = V\left(0, \sigma(q), \frac{1+c}{2}\right)$ is the highest possible value of a single news report to any consumer.

The consumers each choose a set of news reports that maximizes their expected utilities. We assume that when a consumer is indifferent between consuming a news report or not, she always chooses to consume it.[18] Moreover, when a consumer is indifferent between a number of news consumption bundles, she randomly chooses one of them and all news consumption bundles are chosen with equal probabilities.

To illustrate how market demand is determined, suppose there are two media outlets operating in the market, namely, media outlets j and k. They each offer a news report, characterized by $\mathbf{q}^j = \left(q_L^j, q_R^j\right)$ and $\mathbf{q}^k = \left(q_L^k, q_R^k\right)$ respectively. A consumer with prior belief π values these reports at $V\left(\boldsymbol{\sigma}\left(\mathbf{q}^j\right), \pi\right)$ and $V\left(\boldsymbol{\sigma}\left(\mathbf{q}^k\right), \pi\right)$, and values the bundle of these two reports at $V\left(\boldsymbol{\tau}\left(\boldsymbol{\sigma}\left(\mathbf{q}^j\right), \boldsymbol{\sigma}\left(\mathbf{q}^k\right)\right), \pi\right)$. Without loss of generality, let $V\left(\boldsymbol{\sigma}\left(\mathbf{q}^j\right), \pi\right) \geq V\left(\boldsymbol{\sigma}\left(\mathbf{q}^k\right), \pi\right)$. Thus the consumer will consume $\mathbf{q}^j$, if $V\left(\boldsymbol{\sigma}\left(\mathbf{q}^j\right), \pi\right) \geq \kappa$. She will choose to consume both $\mathbf{q}^j$ and $\mathbf{q}^k$ if $V\left(\boldsymbol{\tau}\left(\boldsymbol{\sigma}\left(\mathbf{q}^j\right), \boldsymbol{\sigma}\left(\mathbf{q}^k\right)\right), \pi\right) \geq 2\kappa$ *and* $V\left(\boldsymbol{\tau}\left(\boldsymbol{\sigma}\left(\mathbf{q}^j\right), \boldsymbol{\sigma}\left(\mathbf{q}^k\right)\right), \pi\right) - V\left(\boldsymbol{\sigma}\left(\mathbf{q}^j\right), \pi\right) \geq \kappa$.

4.4. **Model Specialization.** We have defined all of the necessary components of our formal model. However, this setup is quite general. While all of the qualitative results in the following sections are stated and proved within this general setting, sharper characterizations can be given if the model is further specialized. Thus, in addition to the general model, we consider a specialized model with the following additional assumptions.

Assumption 1. *c, q, and σ satisfy: $\sigma(q) > \frac{2c}{1+c}$.*

[17]The assumption of a constant marginal consumption cost is made for convenience only. Letting the marginal consumption cost depend on the number of news reports received does not qualitatively change our results.

[18]This implies that the sum of the media outlets' readership / viewership is upper semi-continuous in their reporting strategies.

Assumption 1 ensures that any moderate consumer can potentially be persuaded to take a partisan action even when the evidence is not conclusive.

Assumption 2. $\sigma(x) \equiv x$

The following analyses focus on market forces that drive media bias, and not on the media outlets' considerations for production efficiency. Therefore, in the specialized model, σ is assumed to be linear. Since $\sigma(0) = 0$, letting the slope of σ be unity, i.e., $\sigma(x) \equiv x$, is without loss of generality.

Assumption 3. *F is given by the truncated normal distribution with mean $\mu \in \left[\frac{1-c}{2}, \frac{1+c}{2}\right]$ and variance σ^2, i.e.,*

$$f(x) = \left[\frac{1}{\int_0^1 \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(y-\mu)^2}{2\sigma^2}} dy}\right] \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

for all $x \in [0,1]$ and is equal to 0 otherwise.[19]

While most of the results stated in the following sections only require the distribution F to be uni-modal, some of them do depend on its shape. Instead of imposing a number of conditions on F, we simply assume that it takes the form of a truncated normal distribution.

4.5. **Monopoly.** When there is only one media outlet in the market, the consumers can consume at most one news report. Therefore, given the monopolist j's reporting strategy $\mathbf{q}^j$, consumer π chooses to consume j's news report if and only if $V(\boldsymbol{\sigma}(\mathbf{q}^j), \pi) \geq \kappa$. Thus, j faces the following problem:

$$\begin{aligned} \max_{q_L^j, q_R^j} \Pi_j\left(q_L^j, q_R^j; \kappa\right) &= \max_{q_L^j, q_R^j} \int_{\{\pi\in[0,1]|V\left(\sigma\left(q_L^j\right),\sigma\left(q_R^j\right),\pi\right)\geq\kappa\}} f d\pi \\ s.t.\ & \ q_L^j, q_R^j \geq 0 \\ & \ q_L^j + q_R^j \leq q. \end{aligned} \tag{4.1}$$

Lemma 1 implies that, for any $\kappa > 0$ and any $\left(\tilde{q}_L^j, \tilde{q}_R^j\right) >> \left(q_L^j, q_R^j\right)$, $\{\pi \in [0,1] \mid V\left(q_L^j, q_R^j, \pi\right) \geq \kappa\} \subsetneq \{\pi \in [0,1] \mid V\left(\tilde{q}_L^j, \tilde{q}_R^j, \pi\right) \geq \kappa\}$. Since F has full support on $[0,1]$, this implies that j can strictly increase its profit by increasing both q_L^j and q_R^j. Therefore, any solution to (4.1), $\mathbf{q}^{j*} \equiv \left(q_L^{j*}, q_R^{j*}\right)$, must satisfy: $q_L^{j*} + q_R^{j*} = q$.

The same holds for a duopolist, a triopolist, or, in general, any producer in the market. Since f is supported on $[0,1]$, there are always marginal consumers that are indifferent between distinct news reports or indifferent between consuming a news

[19] π in this expression is the familiar mathematical constant.

report or not. Therefore, it is always suboptimal for a profit maximizing media outlet to underutilize its resources.[20] Moreover, a media outlet has no incentive to garble its signals, that is, mis-reporting the findings from its investigation. Blackwell's (1951) theorem implies that any garbling by the media outlet can only reduce the value of its news report to all of the consumers and, consequently, leads to lower profits.

Fixing $q_L^j + q_R^j$, changing the bias $\rho^j = \frac{q_L^j}{q_L^j + q_R^j}$, makes a news report more valuable to some consumers and less valuable to others. Thus, in general, the monopolist's choice of bias in its report involves a tradeoff between one group of consumers and another. However, there are exceptions, as illustrated by the next lemma.

Lemma 3. *There exists $\kappa^* \in (0, \overline{\kappa})$ such that, if $\kappa \in (\kappa^*, \overline{\kappa})$, then the monopolist's problem (4.1) has only extreme solutions (i.e., either $(q, 0)$ or $(0, q)$).*

That is, when the news consumption costs borne by the consumers are sufficiently high, the only profit maximizing reporting strategies of the monopolist are extremely biased.

When the monopolist increases the bias of its news report in a particular direction, the consumers whose initial position lies opposite to that direction are alienated. However, when the cost of consuming news is high, these consumers would not consume the monopolist's news report even without the increase in bias. Therefore, the monopolist faces no real tradeoff and is better off choosing an extreme position. However, the next observation shows that, when the cost of consuming news is low, the opposite is true.

Lemma 4. *For any interior $\left(q_L^j, q_R^j\right)$, there exists $\widehat{\kappa}\left(q_L^j, q_R^j\right) > 0$ such that, if $\kappa \in \left(0, \widehat{\kappa}\left(q_L^j, q_R^j\right)\right)$, $\Pi_j\left(q_L^j, q_R^j\right)$ is strictly higher than both $\Pi_j(q, 0)$ and $\Pi_j(0, q)$.*

Thus, if the news consumption costs are sufficiently low, the extremely biased reporting strategies are suboptimal, and Problem (4.1) has only interior solutions.

Lemmas 3 and 4 lead to the following Proposition.

Proposition 3. *The solution to the monopolist's problem (4.1) exists for all κ. Moreover, there exist κ_1^* and $\widehat{\kappa}_1$ in $(0, \overline{\kappa})$, such that, when $\kappa \in (\kappa_1^*, \overline{\kappa})$, the monopolist's profit maximizing reporting strategies must be extreme (i.e. $(q, 0)$ or $(0, q)$), and, when $\kappa \in (0, \widehat{\kappa}_1)$, the monopolist's profit maximizing reporting strategies must be interior.*

Compared with a more balanced news report, an extremely biased news report provides strictly higher value to some consumers. On the other hand, Lemma 2 implies

[20] Note that τ is a strictly increasing function, so the consumers' valuation of their second (third, etc) news report is also increasing in the resources devoted by the media out.

that an extremely biased news report provides no value to consumers with strong positions contrary to the direction of its bias, while a more balanced news report provides positive value to all consumers. When the consumption costs are high, only high value news reports are consumed. Consequently, the monopolist is better off focusing on a segment of the market and attracting as many consumers in that segment as possible. This is achieved by producing an extremely biased news report. On the other hand, when the consumption costs are low, a monopolist can capture the whole market by offering a more balanced news report.

We can further characterize the monopolist's optimal reporting strategy, by focusing on the specialized model.

Proposition 4. *Under Assumptions 1 to 3, the monopolist's profit maximizing reporting strategies are biased to the left (right) if and only if* $\mu < \frac{1}{2}$ $(\mu > \frac{1}{2})$*. Moreover, when* $\kappa < \widehat{\kappa}_1$*, the monopolist's profit maximization strategy is unique and it becomes less biased (i.e.* $\mid \rho^{j*} - \frac{1}{2} \mid$ *decreases) as* κ *falls.*

In the specialized model, when consumption costs are low, the monopolist's problem essentially becomes a tradeoff between marginal liberal consumers and conservative ones. This comes down to comparing the population density of the marginal consumers, and hence the dependence of $\rho^* = \frac{q_L^{j*}}{q_L^{j*}+q_R^{j*}}$ on μ.

4.6. **Duopoly.** Now suppose there are two media outlets, j and k. The oligopolistic competition amongst media outlets is modeled as a strategic game, in which the media outlets independently and simultaneously choose their reporting strategies. The payoff to a player is the profits it makes. In the following sections, we study the Nash Equilibria of this game.

The duopolists each offer a news report. Thus, the consumers can consume up to two news reports at a cost of κ per report. Fixing the reporting strategy of its competitor, k, and that of itself, the consumers attracted to media outlet j can be broken down to two groups. One group of the consumers have a unique optimal consumption bundle that includes j's news report. The other group of consumers have multiple optimal consumption bundles, and j's news report is included in some of them. The first group of consumers, denoted by $A_j \subseteq [0, 1]$, choose to consume j's report with probability one. On the other hand, the second group of consumers randomly choose from their optimal consumption bundles, and thus may only choose to consume j's report with positive probability. Let $A_j^{\frac{m}{M}}$ denote the set of consumers who have M optimal consumption bundles, m of which include j's report.

In a duopoly, j's profit can be written as:

$$\Pi_j\left(\mathbf{q}^j;\mathbf{q}^k,\kappa\right) = \int_{A_j} f d\pi + \frac{1}{2}\int_{A_j^{\frac{1}{2}}} f d\pi.$$

The duopolists' game and, more generally, any oligopolists' game are not continuous, that is, the media outlets' payoffs are not continuous in their strategies, and pure strategy Nash equilibria do not exist in general. However, as the next proposition shows, there always exists at least one Nash equilibrium in mixed strategies. In fact, there exists at least one symmetric equilibrium. Moreover, the mixed strategy equilibria have to satisfy certain properties:

Proposition 5. *The duopolists' game has at least one symmetric Nash equilibrium (in mixed strategies) for any $\kappa \in (0,\overline{\kappa})$. Moreover, there exist κ_2^* and $\widehat{\kappa}_2$ in $(0,\overline{\kappa})$, such that, if $\kappa \in (\kappa_2^*,\overline{\kappa})$, only $(q,0)$ and $(0,q)$ can be in the support of any equilibrium strategy, while, if $\kappa \in (0,\widehat{\kappa}_2)$, then, in any equilibrium, the probability that some interior reporting strategy is chosen must be strictly positive.*

That is, when the news consumption costs are sufficiently high, only extremely biased news reports are produced with positive probability. However, when the news consumption costs are sufficiently low, more balanced news reports are produced with positive probability. Thus, similar to the monopolist's case, as the costs of consuming news fall, the news reports offered in equilibrium become more balanced, albeit in a probabilistic sense.[21] Note that, when news consumption costs are low, *all* media outlets choose interior reporting strategies with positive probability in the symmetric equilibrium.

The logic behind Proposition 5 is also similar to the logic behind the monopolist's problem. Even though the consumers have the freedom to choose two news reports, when consumption costs are high, doing so is not economical. Thus, an oligopolist's problem is similar to that of a monopolist when consumption costs are high. Thus, its optimal strategy is to focus on a segment of the market.

On the other hand, when the consumption costs are low, then it is possible for some consumers to consume two news reports. However, just like before, an extremely biased news report is not valuable to consumers with strong positions opposite to the direction of the report's bias even as a second choice. On the other hand, like in the monopolist's case, any media outlet can serve the whole market with a more balanced news report. Consequently, the media outlets have incentives to reduce biases in their news reports.

With the specialized model, we can further characterize the equilibria of this game.

[21]Note that, in general, $\widetilde{\kappa}_1 \neq \widetilde{\kappa}_2$ and $\widehat{\kappa}_1 \neq \widehat{\kappa}_2$.

Proposition 6. *Under Assumptions 1 to 3, there exists* $\check{\kappa}_2 \in (0, \kappa_2^*]$*, such that, when* $\mu = \frac{1}{2}$ *and* $\kappa \in (0, \check{\kappa}_2)$*, the game has a symmetric Pure Strategy Nash Equilibrium (PSNE) at* $\left(\left(\frac{q}{2}, \frac{q}{2}\right), \left(\frac{q}{2}, \frac{q}{2}\right)\right)$*. Moreover, if* $\mid \mu - \frac{1}{2} \mid$ *is sufficiently small, then there is a PSNE* $((x^* q, (1 - x^*) q), (x^* q, (1 - x^*) q))$*, where* $x^* \in [0, 1]$ *and* $x^* \approx \frac{1}{2}$*.*

Thus, in the specialized model with enough symmetry and low consumption costs, the duopolists each choose a (almost) perfectly balanced news report with probability one in equilibrium.

Note that, the consumers' ability to choose any number of news reports is essential for these results. The reason a media outlet offers a less biased news report, when news consumption costs are low, is to attract consumers initially located at the other end of the ideological spectrum, who might consume the less biased report as a second news source. For that reason, Propositions 5 and 6 may not hold if the consumers are restricted to consuming only one news report, as illustrated by the next example.

Example 1. In addition to Assumptions 1 and 3, assume that the consumers are restricted to consuming no more than one news report. Then, for any $\kappa > 0$, only $(q, 0)$ and $(0, q)$ can be chosen with positive probability in any equilibrium.

4.7. **Multiple Competitors.** When there are $N > 2$ media outlets competing in the market, results analogous to Propositions 5 and 6 still hold. That is, fixing the number of media outlets operating in the market, when news consumption costs are sufficiently high, we can only expect to see extremely biased news reports in equilibrium. As the consumption costs fall, extreme reporting strategies become less profitable to media outlets compared to more balanced ones. Indeed, in some cases, all media outlets end up offering perfectly balanced news reports with probability one.

The next result shows that, for any level of consumption costs, increase in competition eventually makes the extreme reporting strategies profitable. Thus, the trend of decreasing biases brought about by falling consumption costs can be reversed by intensifying competition.

Proposition 7. *For each* $\kappa \in (0, \overline{\kappa})$*, there exists a positive integer* $\widetilde{N}(\kappa)$*, such that, in any equilibrium of the game with* $N > \widetilde{N}(\kappa)$ *media outlets and news consumption cost* κ*,* $(q, 0)$ *must be chosen with positive probability, and so is* $(0, q)$*.*

With low consumption costs, the reason that a media outlet produces a less biased news report in equilibrium is so that it can attract more consumers from the other end of the ideological spectrum. However, this becomes difficult when there are more media outlets producing news with biases that are preferred by those consumers. On the other hand, by reducing the bias in its news report, a media outlet risks losing consumers who favor such biases, when there are other media outlets targeting those consumers and are willing to produce news with more bias. Consequently, increasing biases eventually becomes more profitable to the media outlets.

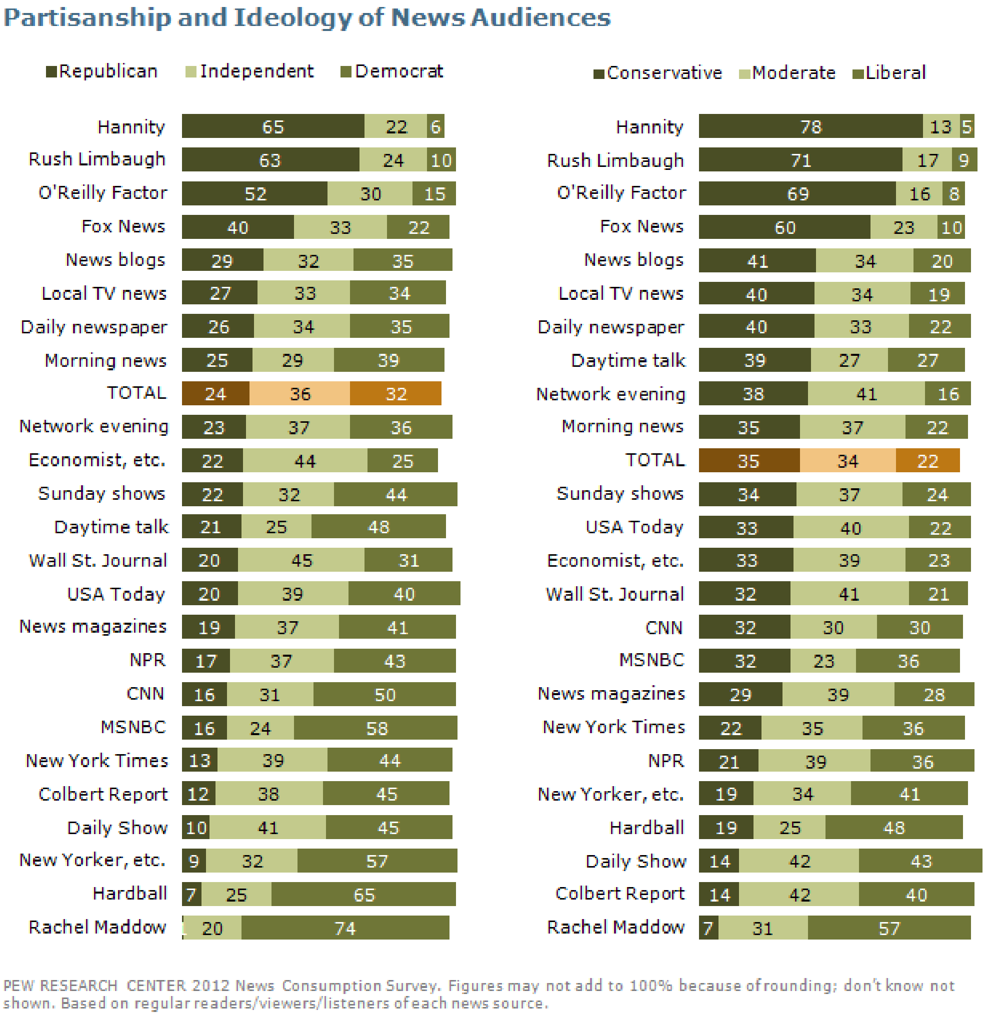
4.8. **Empirical Implications.** As argued above, when news consumption costs are low, there must be (symmetric) Nash equilibria in which all media outlets choose interior reporting strategies with positive probability. In particular, we may observe outcomes in which news reports are produced with biases across the ideological spectrum. The next example illustrates such a scenario.

Example 2. Let $\sigma(x) \equiv x$ and let F be uniform over $[0,1]$. Consider a market with three media outlets. Suppose that κ is sufficiently low and the following strategy profile is in the support of the equilibrium strategies: $((xq,(1-x)q),(yq,(1-y)q),((1-x)q,xq))$, where $0<x<y<1-x$. When κ is sufficiently low, all three media outlets can attract consumers from all three ideological groups. Specifically, all consumers whose prior belief falls in $\left[\frac{\kappa}{2xq}, 1-\frac{\kappa}{2(1-xq)[1-(1-y)q](1-x)q}\right]$ consume the news report $(xq,(1-x)q)$, all consumers $\left[\frac{\kappa}{2(1-xq)yq}, 1-\frac{\kappa}{2(1-xq)(1-y)q}\right]$ consume the news report $(yq,(1-y)q)$, and all consumers $\left[\frac{\kappa}{2(1-xq)(1-yq)(1-x)q}, 1-\frac{\kappa}{2xq}\right]$ consume the report $((1-x)q,xq)$.

In this example, the media outlet most biased to the left attracts $\left(\frac{1-c}{2}-\frac{\kappa}{2xq}\right)$ liberals and $\left(\frac{1-c}{2}-\frac{\kappa}{2(1-xq)[1-(1-y)q](1-x)q}\right)$ conservatives. Similarly, the most right-biased media outlet attracts $\left(\frac{1-c}{2}-\frac{\kappa}{2(1-xq)(1-yq)(1-x)q}\right)$ liberals and $\left(\frac{1-c}{2}-\frac{\kappa}{2xq}\right)$ conservatives. The most balanced news report attracts $\left(\frac{1-c}{2}-\frac{\kappa}{2(1-xq)yq}\right)$ liberals and $\left(\frac{1-c}{2}-\frac{\kappa}{2(1-xq)(1-y)q}\right)$ conservatives. Thus, the ratio of liberals to conservative consumers decreases as the media outlet's bias $\rho=\frac{q_R}{q_L+q_R}$ increases. The average ideological position of a media outlet's consumers is correlated with the bias in its news report. This matches the findings by the Pew Research Center for the People and the Press (2012) in a recent survey of news consumption patterns (see Figure 4.1).

Moreover, there are overlaps between the readership / viewership of the media outlets. The consumers with prior beliefs in $\left[\frac{\kappa}{2(1-xq)yq}, 1-\frac{\kappa}{2(1-xq)[1-(1-y)q](1-x)q}\right]$ consume both the most left biased news report and the most balanced news report. The consumers in $\left[\frac{\kappa}{2(1-xq)(1-yq)(1-x)q}, 1-\frac{\kappa}{2(1-xq)(1-y)q}\right]$ consume both the balanced report and the most right biased report. The two media outlets with strong opposite biases share the consumers in $\left[\frac{\kappa}{2(1-xq)(1-yq)(1-x)q}, 1-\frac{\kappa}{2(1-xq)[1-(1-y)q](1-x)q}\right]$. Thus, the media outlets with similar biases share larger overlapping readership / viewership. This pattern of overlapping readership / viewership is consistent with the findings by a Nielson survey

FIGURE 4.1. Pew Research Center Survey on Audience Ideology

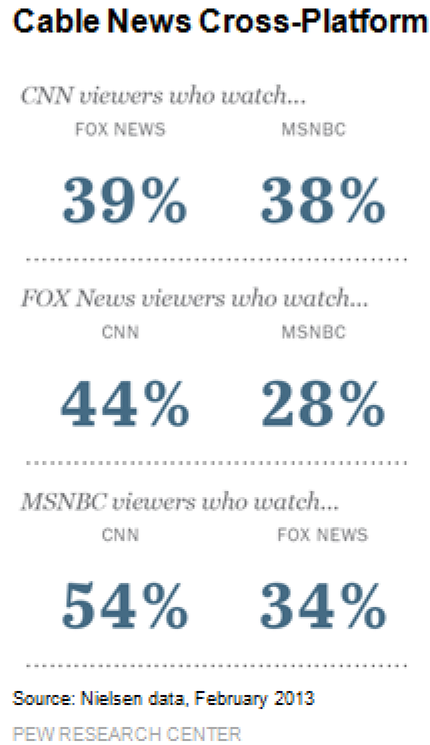


conducted on behalf of Pew Research Center (Mitchell, Jurkowitz, Enda, and Olmstead (2013)), which shows a similar pattern of cross viewership between cable news programs in the U.S. market (See Figure 4.2).

Hamilton (2006) documents historical changes of media bias in the U.S. market for news. There was first a trend of decreasing media bias occurred in the late 19th century. Before then, most U.S. newspapers are openly affiliated with political parties. However, since the 1870s, "nonpartisan reporting emerged as a commercial product."[22] Gentzkow, Glaeser, and Goldin (2006) provided a similar account for this change. According to them, in 1870, only 11 percent of all political newspapers claimed to be independent.

[22]Hamilton (2006) P. 3

Figure 4.2. Nielson Survey on Cross-Viewership



By 1920, this number had risen to 62 percent. An opposite trend occurred since the 1990s, when "elements of partisanship reemerged in television."[23]

Both of these historical trends can be explained by the present model. As noted by Hamilton (2006), the first trend of decreasing media bias corresponded with the invention of rotary printing press. Mass printing and other technological innovation drastically reduced the cost of newspapers to the consumers. Thus, as predicted by Proposition 5 and 6, the papers had the incentive to reduce bias in their reporting in order to capture a larger share of the market.

While news consumption costs did not rise in the 1990s, new technologies such as cable and satellite provided consumers with easy access to a wider range of programs. Thus, as predicted by Proposition 7, increase in competition among media outlets gave them incentives to bias their news reports. The late 1990s saw the establishment of the Fox News Channel and MSNBC, which over the years have established strong branding as conservative and progressive news stations. Moreover, it has been argued that "the rise of the conservative Fox News Channel caused CNN to shift to the left. "[24] Chiang

[23]Hamilton (2006) P.3
[24]Posner (2005)

(2010) provides further evidence that competition induces media outlets to increase their bias.

4.9. **The Merits of Fairness.** Content regulations such as the FCC's Fairness Doctrine and the Ofcom's Due Impartiality rules can be modeled in our framework as constraints on the degree of bias with which the media outlets can produce their news reports. Formally, such regulations can be represented by a number $\bar{b} \in \left[0, \frac{1}{2}\right]$ such that all media outlets can only choose reporting strategies (q_L, q_R) that satisfy $\mid \frac{q_L}{q_L+q_R} - \frac{1}{2} \mid \leq \bar{b}$. Such regulations are said to be binding, if, without these constraints, the media outlets' equilibrium strategies assign positive probabilities to reporting strategies that violate these constraints. The next proposition shows that such regulations, if binding, will always make some consumers worse off. Moreover, there are conditions under which they can make all consumers worse off.

Proposition 8. *Content regulations, if binding, can never result in Pareto improvements but can result in Pareto dominated outcomes.*

Thus, contrary to widely held beliefs, content regulations like the Fairness Doctrine are poorly justified on the ground of protecting consumer welfare. However, as we show in the next section, they may help to mitigate other potentially harmful social consequences of media bias, such as political polarization.

5. Political Polarization

The consumers' preferences for the biases in their news consumption are not continuous, that is, two consumers with very similar utility functions and prior beliefs may prefer their news consumption to contain very different biases. On the other hand, having received news reports containing different biases, the posterior beliefs of two almost identical consumers may end up being quite far apart. Thus, as we show in the following example, media bias can cause political polarization, which is defined behaviorally as consumers choosing more extreme actions in opposite directions.

Suppose there are two media outlets operating in the market, and the market conditions are such that in equilibrium, all consumers consume at most one news report and the two media outlets offer news reports that are extremely biased in opposite directions, i.e., $(q, 0)$ and $(0, q)$.[25] Moreover, suppose that Assumptions 1 and 2 hold. Thus, all consumers with prior beliefs smaller than $\frac{1}{2}$ strictly prefer the news report $(q, 0)$, while the report $(0, q)$ is strictly preferred by consumers with prior beliefs greater than $\frac{1}{2}$.[26]

[25] By virtue of Proposition 5, such an equilibrium exists when κ is sufficiently high.

[26] These assumptions are not essential for this analysis but are made for expositional brevity.

Consider two moderates with prior beliefs π' and π'' respectively, where $\pi' < \frac{1}{2} < \pi''$. Further, let π' and π'' be such that the two moderates each consume one news report.[27] The two media outlets are expected to both report message σ_N with probability $1 - \sigma(q)$. In that event, consumers π' and π'' learn the inconclusive evidence presented by their news reports of choice and update their beliefs to $p_{\pi'}^{(\sigma(q),0)}(R \mid s_N)$ and $p_{\pi''}^{(0,\sigma(q))}(R \mid s_N)$ respectively. By virtue of Assumption 1, both moderates abandon their default action after seeing the evidence. However, while consumer π' chooses action l, consumer π'' goes in the other direction and chooses action r.

Thus, media bias leads to political polarization. Given the choice, both moderate consumers consume a biased news report. However, due to the difference in the consumers' prior beliefs, the biases in their chosen news reports are in the opposite directions. This difference in their beliefs is not significant enough for the consumers to choose different actions without additional information. However, in some event, the consumers learn inconclusive evidence that point to opposite directions. As a result, the two moderates end up choosing opposite partisan actions.

The two consumers in this example each represent a positive measure of other moderates whose choices agree with theirs. Thus, in the absence of conclusive evidence, there can be a significant reduction in the population of moderate consumers, while the populations of both partisan groups increase.

The extent of political polarization depends on the level of news consumption costs and the degree of competition. In the previous example, when κ is high, the news reports produced are extremely biased. However, polarization is not severe, since very few consumers consume any news. As κ falls, the news reports remain extremely biased, and more moderates choose to consume one of the two news reports. Consequently, polarization becomes more severe, that is, in the event that no conclusive evidence is found, more moderates become partisans. However, as κ continues to fall, some moderates find it worthwhile to consume both news reports, which gives them a perfectly balanced news consumption bundle. When presented with inconclusive evidence, these consumers do not change their action, since the evidence in the news reports balance out. Thus, polarization is mitigated. It is further mitigated if κ falls even more, as the media outlets produce more balanced news in response.

On the other hand, when news consumption costs are low such that political polarization is not severe to begin with, it can be exacerbated by increase in competition. As more media outlets enter the market, the news reported in equilibrium becomes more biased again. Moreover, the moderates that used to consume two news reports with

[27]Such π' and π'' exist for any $\kappa < \overline{\kappa}$.

opposite biases end up consuming news reports biased in the same direction. Thus, polarization becomes more severe again. However, with more media outlets acquiring information, the probability that conclusive evidence is produced increases. So does consumer surplus.

5.1. **Political Polarization and Social Inefficiency.** The reason why a consumer prefers her news to be biased is because that, in the absence of any conclusive evidence, evidence that is more one-sided can make her more certain of what the true state is. Indeed, such evidence can be strong enough to convince her to take a more extreme action. However, her decision to change action may not be justifiable if all the social costs associated with her action are taken into account. Higher social costs means that stronger evidence is needed to justify the consumer's new action. In other words, the consumer's choice in light of the evidence presented by her choice of news consumption may be premature from the society's perspective.

Let us consider a simple scenario where, in addition to costing c to the consumers, the partisan actions l and r also impose an externality on the society, which makes the social cost of these actions equal to $c' > c$. As illustrated in the previous example, media bias can lead to political polarization. The two moderates in the earlier example end up choosing partisan actions after learning inconclusive evidence presented by their news reports.

Consider consumer π'. Suppose that the externalities are significant so that $\frac{1-c'}{2} < p_{\pi'}^{(\sigma(q),0)}(R \mid s_N) < \frac{1-c}{2}$. Thus, if consumer π' takes into account the costs her action imposes on the society, she would not change her action after learning s_N. In the absence of any means to ensure that the consumer internalize all the social costs, she ends up choosing l, and expected social welfare is brought down.

5.2. **Mitigating Political Polarization.** Now suppose a content regulation, $\bar{b}$, is imposed. For expositional convenience, let $\bar{b} = 0$. Then, the only reporting strategies the media outlets can choose is $\left(\frac{q}{2}, \frac{q}{2}\right)$. The inconclusive evidence reported by $\left(\frac{q}{2}, \frac{q}{2}\right)$ is not strong enough to persuade the consumer to change her action, so political polarization is mitigated. Moreover, it is easy to verify that, the ex ante expected social welfare is higher when consumer π' chooses news report $\left(\frac{q}{2}, \frac{q}{2}\right)$ instead of $(q, 0)$, as long as $\frac{1-c'}{2} < p_{\pi'}^{(\sigma(q),0)}(R \mid s_N) < \frac{1-c}{2}$. Therefore, the content regulation helps to correct the distortions caused by the externalities.

However, the effectiveness of such regulations in mitigating political polarization depends crucially on market conditions. In fact, there are circumstances under which content regulations can exacerbate political polarization, rather than mitigate it. Suppose that, in the previous example, the consumption costs are lower so that some moderates choose to consume both news reports. However, suppose that the media outlets still produce extremely biased news.[28] Now suppose that a content regulation, characterized by $0 < \bar{b} < \frac{1}{2}$, is introduced and is binding in equilibrium.[29]

After the media outlets reduce their bias to satisfy the regulations, the moderate consumers who were close to being indifferent between consuming one and two news reports before the regulation is introduced end up consuming only one news report. Comparing with their initial consumption bundle, which was completely balanced, the news report they consume now is more biased. Consequently, in addition to reducing consumer surplus, the content regulation can also aggravate polarization, because some of those moderates that end up consuming more biased news might end up choosing a partisan action in the absence of conclusive evidence.[30]

6. Conclusion

We present a theory of media bias where preference for biased news is consistent with Bayesian rationality. To an individual consumer, consuming biased news may be a more efficient means to acquire information than consuming more balanced news. Consequently, profit maximizing media outlets have the incentive to bias their news reports in order to attract more consumers.

Our model offers theoretical explanations for a number of empirical findings pertaining to consumer and supplier behaviors in the news market uncovered in recent studies. We find that falling costs of consuming news encourages the media outlets to offer more balanced news in equilibrium, while the opposite happens when competition heightens. The biases in the news reports are correlated with the prior positions of the consumers they attract. The consumer bases of different media outlets may overlap, and the overlap is larger if the biases in their news reports are closer.

Moreover, this new formal framework sheds some light on the social impact of media bias and the regulations designed to curtail it. We show that media bias may lead to political polarization, which can be socially inefficient when there are externalities. Content regulations such as the FCC's Fairness Doctrine can help to mitigate polarization and correct distortions. However, the severity of political polarization and the

[28]In general, without strong efficiency gains, to make the media outlets choose an interior strategy, the consumption costs need to be sufficiently low so that balanced reports can potentially attract sizable populations of partisan consumers.

[29]Otherwise, it would be unnecessary to introduce this regulation.

[30]Because the consumers' posterior beliefs $p_{\pi}^{(\sigma_L,\sigma_R)}(s_N)$ and their valuation of information $V(\sigma_L,\sigma_R,\pi)$ are both continuous, the set of parameters $\left(\sigma(q),\kappa,\bar{b}\right)$ that can give rise to such scenarios is non-empty.

effectiveness of content regulations both depend critically on market conditions. Under some circumstances, content regulations might exacerbate polarization rather than mitigate it.

Our model can be extended in a number of directions. As discussed in Section 3, an implicit assumption we make is that the media outlets are equally efficient in acquiring information biased to both directions. If, instead, the media outlets are more efficient in producing news reports biased to the left, then even a conservative might prefer left biased news reports to right biased ones.

Many scholars as well as political commentators have argued that the American public media is biased to the left (e.g., Goldberg (2002), Groseclose and Milyo (2005), and Groseclose (2011)). One explanation they give for why a liberal bias exists is that the members of the media elite themselves have liberal views that, in turn, make them more open to liberal arguments. As a consequence, they are more efficient in acquiring information biased to the left.

For example, Groseclose and Milyo (2005) quote the following from Sutter (2001):

> If the majority of journalists have left-of-center views, liberal news might cost less to supply than unbiased news.[31]

Arguments like these are supported by our model. If the media outlets' production technology is sufficiently asymmetrical, both liberals and conservatives prefer news reports biased to the left. Consequently, the media outlets produce mostly left biased news in the equilibrium.

However, if the liberal bias results from taking advantage of more efficient production technology, then such biases are beneficial to all consumers, including the conservatives. The conservatives would be better off if the media outlets could produce right biased news more efficiently. However, when this is not feasible, consuming left biased news is optimal for them.

We can also let consumers' well-being depend on each other's actions (as in an election). Then a consumer's choice of news consumption imposes an externality on others through her expected choice of action. Consequently, an individual consumer might prefer regulations that affect the variety of news reports other consumers can consume. Given the heterogeneity among the consumers, their preferred policy interventions are also going to differ.

[31]Sutter (2001) P. 444. Quoted by Groseclose and Milyo (2005) P. 1227

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7. Appendix

7.1. Proofs of Lemmas 1 and 2.

Proof. Let $\Sigma = \sigma_L + \sigma_R$ and recall that $\omega = \frac{\sigma_R}{\Sigma}$ and $u^p(d)$ is the consumers expected utility when her belief is given by p and she chooses $d \in \{l, r, a\}$. It is easy to verify that, when $\Sigma \leq 1$:

$$U^*(\Sigma, 0, \pi) = \max\{u^\pi(l) + (\gamma + \beta)\pi\Sigma, u^\pi(r), \gamma\pi\Sigma\}, \tag{7.1}$$

$$U^*(0, \Sigma, \pi) = \max\{u^\pi(l), u^\pi(r) + (\alpha + \delta)(1 - \pi)\Sigma, \alpha(1 - \pi)\Sigma\}, \tag{7.2}$$

and,

$$\begin{aligned} U^*(\sigma_L, \sigma_R, \pi) = \max\{&(1 - \omega)[u^\pi(l) + (\gamma + \beta)\pi\Sigma] + \omega u^\pi(l), \\ &(1 - \omega)u^\pi(r) + \omega[u^\pi(r) + (\alpha + \delta)(1 - \pi)\Sigma], \\ &(1 - \omega)[\gamma\pi\Sigma] + \omega[\alpha(1 - \pi)\Sigma]\}. \end{aligned} \tag{7.3}$$

When $\Sigma > 1$, (7.1) and (7.2) no longer hold, but (7.3) still holds so long as $(\sigma_L, \sigma_R) \in [0, 1]^2$.

The monotonicity of U^* stated in Lemma 1 follows from the fact that each of the linear functions supporting $U^*(\sigma_L, \sigma_R, \pi)$ is non-decreasing in $\sigma_L = (1-\omega)\Sigma$ or $\sigma_R = \omega\Sigma$ and strictly increasing in Σ. Now if either σ_L or σ_R is 1, the news reports are perfectly informative and the consumer can achieve the highest expected utility possible.

Lemma 2 follows from the fact that for any (σ_L, σ_R) such that $\widehat{d}\left(p_\pi^{(\sigma_L,\sigma_R)}(R \mid s_N)\right) = r$, $U^*(\sigma_L, \sigma_R, \pi) = u^\pi(r) + (\alpha+\delta)\pi\sigma_R$, which clearly does not depend on σ_L. Similarly, when $\widehat{d}\left(p_\pi^{(\sigma_L,\sigma_R)}(R \mid s_N)\right) = l$, $U^*(\sigma_L, \sigma_R, \pi) = u^\pi(l) + (\gamma+\beta)\pi\sigma_L$, which does not depend on σ_R. □

7.2. **Proofs of Proposition 2.**

Proof. Recall that $U^*(\sigma_L, \sigma_R, \pi)$ is convex in (σ_L, σ_R). Therefore, given the monotonicity of U^* and σ, if σ is convex, then $U^*(\sigma(q_L), \sigma(q_R), \pi)$ is also convex in (q_L, q_R). The set of feasible (q_L, q_R) is a polyhedron, thus U^* is maximized at an extreme point. Clearly, $(0,0)$ cannot be a solution. Therefore, we must have:

$$U^*(\sigma(q_L), \sigma(q_R), \pi) \leq \max\{U^*(\sigma(q), 0, \pi), U^*(0, \sigma(q), \pi)\}.$$

□

7.3. **Isomorphic Representation.** In Section 4, we suggested that our restriction of the consumer's utility function to that defined in Table 4.1 is only a matter of representation. The consumers in our simplified model behave identically as a set of consumers with a common prior and heterogeneous utility functions.

Formally, for any $\pi, \pi' \in (0,1)$, there exists a vector $(\alpha, \beta, \delta, \gamma)$ such that, $\alpha, \beta, \delta, \gamma > 0$ and $\frac{\gamma}{\delta+\gamma} < \frac{\beta}{\alpha+\beta}$, and, if consumer i's utility function is that given in Table 4.1 and her prior belief is π, and if consumer j's utility function and prior belief is given by the vector $(\alpha, \beta, \delta, \gamma, \pi')$, the following statements hold:

(1) $\widehat{d}_i(\pi) = \widehat{d}_j(\pi')$;
(2) for any $\boldsymbol{\sigma} \equiv (\sigma_L, \sigma_R) \in [0,1]^2$, $V_i(\sigma_L, \sigma_R) = V_j(\sigma_L, \sigma_R)$; and,
(3) $\widehat{d}_i\left(p_\pi^{(\sigma_L,\sigma_R)}(L \mid s_N)\right) = \widehat{d}_j\left(p_{\pi'}^{(\sigma_L,\sigma_R)}(L \mid s_N)\right)$.

Proof. It suffices to show that, we can find $(\alpha, \beta, \delta, \gamma)$, such that, for any $\boldsymbol{\sigma} \equiv (\sigma_L, \sigma_R) \in [0,1]^2$: i) $u_i^\pi(d) = u_j^{\pi'}(d)$, for $d \in \{l, r, a\}$; ii) $V_i(\sigma_L, \sigma_R) = V_j(\sigma_L, \sigma_R)$; and, iii) for all $d, d' \in \{l, r, a\}$, $u_i^{p_\pi^{(\sigma_L,\sigma_R)}(R|s_N)}(d) \geq u_i^{p_\pi^{(\sigma_L,\sigma_R)}(R|s_N)}(d')$ if and only if $u_j^{p_{\pi'}^{(\sigma_L,\sigma_R)}(R|s_N)}(d) \geq u_j^{p_{\pi'}^{(\sigma_L,\sigma_R)}(R|s_N)}(d')$.

By definition, ii) holds if i) holds and $U_i^*(\sigma_L, \sigma_R, \pi) = U_j^*(\sigma_L, \sigma_R, \pi')$. (7.1) to (7.3) guarantee that both i) and $U_i^*(\sigma_L, \sigma_R, \pi) = U_j^*(\sigma_L, \sigma_R, \pi')$ hold if:

$$\begin{cases} [(1-\pi')\alpha - \pi'\beta + (\gamma+\beta)\pi'\Sigma] = [1 - 2\pi - c + 2\pi\Sigma] \\ [(1-\pi')\alpha - \pi'\beta] = [1 - 2\pi - c] \\ [-(1-\pi')\delta + \pi'\gamma] = [2\pi - 1 - c] \\ [-(1-\pi')\delta + \pi'\gamma + (\alpha+\delta)(1-\pi')\Sigma] = [2\pi - 1 - c + 2(1-\pi)\Sigma] \\ [\gamma\pi'\Sigma] = [(1-c)\pi\Sigma] \\ [\alpha(1-\pi')\Sigma] = [(1-c)(1-\pi)\Sigma] \end{cases}.$$

Thus, there exists $(\alpha, \beta, \delta, \gamma)$ such that both i) and ii) hold if the system of linear equations above has a solution.

It is easy to verify that $(\alpha, \beta, \delta, \gamma) = \left((1-c)\frac{1-\pi}{1-\pi'}, (1+c)\frac{\pi}{\pi'}, (1+c)\frac{1-\pi}{1-\pi'}, (1-c)\frac{\pi}{\pi'}\right)$ is a solution to the system. It is, in fact, the unique solution.

Note that, when the system of equations hold, we also have:

$$\begin{aligned} & u_i^{p_\pi^{(\sigma_L,\sigma_R)}(R|s_N)}(d) - u_i^{p_\pi^{(\sigma_L,\sigma_R)}(R|s_N)}(d') \\ = \; & u_j^{p_{\pi'}^{(\sigma_L,\sigma_R)}(R|s_N)}(d) - u_j^{p_{\pi'}^{(\sigma_L,\sigma_R)}(R|s_N)}(d') \end{aligned}$$

for all $d, d' \in \{l, r, a\}$. Thus, iii) also holds. □

7.4. **Proof of Lemma 3.**

Proof. For any $q_L' \in (\frac{q}{2}, q]$, we have $\sigma(q_L') > \sigma(q - q_L')$ and hence $\frac{1-c}{2} < \pi_*(\sigma(q_L'), \sigma(q - q_L'))$. Suppose $\pi_*(\sigma(q_L'), \sigma(q - q_L')) < \frac{1+c}{2}$, then $V(\sigma(q_L'), \sigma(q - q_L'), \pi)$ is strictly increasing in π over $\left[\pi_*(\sigma(q_L'), \sigma(q - q_L')), \frac{1+c}{2}\right]$ and strictly decreasing over $\left[\frac{1+c}{2}, 1\right]$. That is to say

$$\{\frac{1+c}{2}\} \;=\; \arg \max_{\pi \in [\pi_*(\sigma(q_L), \sigma(q_R)), 1]} V(\sigma(q_L'), \sigma(q - q_L'), \pi).$$

Now let $\kappa^* = \max_{q_L \in \left[\frac{q}{2}, q\right]} V\left(\sigma(q_L), \sigma(q_R), \frac{1+c}{2}\right)$. The maximum is attained given the continuity of V in (q_L, q_R). By Lemma 1, $\kappa^* < V\left(\sigma(q), \sigma(q), \frac{1+c}{2}\right) = \overline{\kappa}$. It follows that, for any $\kappa > \kappa^*$ and $q_L' \in (\frac{q}{2}, q]$, $V(\sigma(q_L'), \sigma(q - q_L'), \pi) > \kappa$ implies $\pi \in [0, \pi_*(\sigma(q_L'), \sigma(q - q_L'))]$, which, in turn, implies that $V(\sigma(q_L'), \sigma(q - q_L'), \pi)$ is strictly increasing in q_L'. The same clearly holds when $\pi_*(\sigma(q_L'), \sigma(q - q_L')) \geq \frac{1+c}{2}$. Therefore, when $\kappa \in (\kappa^*, \overline{\kappa})$, $\{(q, 0)\} = \arg\max_{q_L \in \left[\frac{q}{2}, q\right]} \Pi(q_L, q_R)$.

A symmetrical argument establishes that $\{(0, q)\} = \arg\max_{q_R \in \left[\frac{q}{2}, q\right]} \Pi(q_L, q_R)$. We have thus proved Lemma 3. □

7.5. **Proof of Lemma 4 and Proposition 3.**

Proof. Lemma 4 follows from the fact that $\Pi(q_L, q_R; \kappa)$ is continuous in κ over

$$\left[0, \max\{V\left(\sigma(q_L), \sigma(q_R), \frac{1-c}{2}\right), V\left(\sigma(q_L), \sigma(q_R), \frac{1+c}{2}\right)\}\right] \quad ,$$

and hence for any interior (q_L, q_R), $\lim_{\kappa\to 0} \Pi(q_L, q_R; \kappa) = 1$ and $\lim_{\kappa\to 0} \Pi(q, 0; \kappa), \lim_{\kappa\to 0} \Pi(0, q; \kappa) < 1$.

Continuity of $\Pi(q_L, q_R; \kappa)$ in (q_L, q_R) over $\{(q_L, q_R) \mid q_L, q_R \geq 0, q_L + q_R \leq q\}$ guarantees that the solution set is non-empty. The rest of Proposition 3 follows from Lemmas 3 and 4. □

7.6. **Proof of Proposition 4.**

Proof. Under Assumption 2, $V(\sigma(q_L), \sigma(q_R), \pi) = V(q_L, q_R, \pi)$. Suppose, $q_L > q_R > 0$, we have: $\frac{1-c}{2} < \pi_*(q_L, q_R) < \pi_*(q, 0)$. Moreover, Assumption 1 implies that $\pi_*(q, 0) > \frac{1}{2}$.

It is obvious that for all $\pi \in [0, \pi_*(q_L, q_R)]$, $U^*(q, 0, \pi) > U^*(q_L, q_R, \pi)$ and hence $V(q, 0, \pi) > V(q_L, q_R, \pi)$. Now, for all $\pi \in (\max\{\frac{1}{2}, \pi_*(q_L, q_R)\}, \pi_*(q, 0)]$, we have:

$$\begin{aligned} U^*(q, 0, \pi) &= 1 - 2\pi - c + 2q\pi \\ &\geq \pi q(1-c) \\ &> [\sigma(q_L)\pi + \sigma(q_R)(1-\pi)](1-c) \\ &= U^*(q_L, q_R, \pi), \end{aligned}$$

and for all $\pi \in \left[\min\{\frac{1}{2}, \pi_*(q_L, q_R)\}, \frac{1}{2}\right]$, we have:

$$\begin{aligned} U^*(q, 0, \pi) &> U^*(q, 0, \pi_*(q, 0)) \\ &= \pi_*(q, 0)\, q(1-c) \\ &> \frac{q}{2}(1-c) \\ &\geq [\sigma(q_L)\pi + \sigma(q_R)(1-\pi)](1-c) \\ &= U^*(q_L, q_R, \pi). \end{aligned}$$

Finally, if $\pi_*(q, 0) < \pi^*(q_L, q_R)$, it is obvious that $U^*(q, 0, \pi) > U^*(q_L, q_R, \pi)$ for all $[\pi_*(q, 0), \pi^*(q_L, q_R)]$.

Therefore, for all interior $\mathbf{q} = (q_L, q_R)$ such that $q_L > q_R$ and all $\pi \in [0, \pi^*(q_L, q_R)]$, we have $V(q, 0, \pi) > V(q_L, q_R, \pi)$. Similarly, one can show that, for all interior $\mathbf{q} = (q_L, q_R)$ such that $q_L < q_R$ and all $\pi \in [\pi_*(q_L, q_R), 1]$, we have $V(0, q, \pi) > V(q_L, q_R, \pi)$.

Define $\underline{\pi}(\sigma_L, \sigma_R, \kappa) \equiv \inf\{\pi \mid V(\sigma_L, \sigma_R, \pi) \geq \kappa\}$ and $\overline{\pi}(\sigma_L, \sigma_R, \kappa) \equiv \sup\{\pi \mid V(\sigma_L, \sigma_R, \pi) \geq \kappa\}$.

Consider $q_L > q_R > 0$. If $\kappa \geq V(q_L, q_R, \pi^*(q_L, q_R))$, then $\overline{\pi}(q_L, q_R, \kappa) \geq \pi^*(q_L, q_R)$. Thus, $V(q, 0, \pi) > V(q_L, q_R, \pi)$ implies that $\Pi(q, 0; \kappa) > \Pi(q_L, q_R; \kappa)$. Similarly, if $0 < q_L < q_R$ and $\kappa \geq V(q_L, q_R, \pi_*(q_L, q_R))$, then $\Pi(0, q; \kappa) > \Pi(q_L, q_R; \kappa)$.

Suppose there is an interior solution to (4.1), denoted (q_L^*, q_R^*). Then if $q_L^* > q_R^*$, it must be that $\kappa < V(q_L^*, q_R^*, \pi^*(q_L^*, q_R^*))$ (or, equivalently, $q_R^* > \frac{\kappa}{2\pi^*\left(q_L^*, q_R^*\right)}$), while $q_L^* < q_R^*$ implies $\kappa < V(q_L^*, q_R^*, \pi_*(q_L^*, q_R^*))$ (or, equivalently, $q_L^* > \frac{\kappa}{2\pi_*\left(q_L^*, q_R^*\right)}$). In either case, the monopolist's profit is given by:

$$\Pi(q_L^*, q_R^*; \kappa) = \int_{\underline{\pi}\left(q_L^*, q_R^*, \kappa\right)}^{\overline{\pi}\left(q_L^*, q_R^*, \kappa\right)} f d\pi,$$

where $\underline{\pi}(q_L^*, q_R^*, \kappa) = \frac{\kappa}{2q_L^*}$ and $\overline{\pi}(q_L^*, q_R^*, \kappa) = \frac{\kappa}{2q_R^*}$. Hence, the FOC is given by:

$$\frac{f\left(1 - \frac{\kappa}{2\sigma\left(q_L^*\right)}\right)}{f\left(\frac{\kappa}{2\sigma\left(q_R^j\right)}\right)} = \left(\frac{q_L^*}{q_R^*}\right)^2. \tag{7.4}$$

Under Assumption 3, (7.4) can only be satisfied by one interior reporting strategy and $q_L^* > q_R^*$ (respectively, $q_L^* < q_R^*$) if and only if $\mu < \frac{1}{2}$ (respectively, $\mu > \frac{1}{2}$). It is obvious that $\Pi(q, 0; \kappa) > \Pi(0, q; \kappa)$ if and only if $\mu < \frac{1}{2}$. Finally, it is easy to verify that when $\mu < \frac{1}{2}$ and $q_L^* > q_R^*$, $f\left(1 - \frac{\kappa}{2\sigma\left(q_L^*\right)}\right) / f\left(\frac{\kappa}{2\sigma\left(q_R^j\right)}\right)$ is increasing in κ, while the opposite is true when $\mu > \frac{1}{2}$ and $q_L^* < q_R^*$. □

7.7. **Proof of Proposition 5.**

Proof. We apply Corollary 5.2 of Reny (1999) to prove the existence of mixed strategy Nash equilibria for the dupololists' game. To apply the corollary, we want to show that the mixed extension of the duopolists' game is both "reciprocally upper semicontinuous" and "payoff secure"[32].

The sum of the duopolists' payoffs always equals the total news consumption by all the consumers, and is hence upper semicontinuous in $\mathbf{q}^j$ and $\mathbf{q}^k$ for all κ. Proposition 5.1 of Reny (1999) then ensures that the mixed extension of the duopolists' game is always "reciprocally upper semicontinuous".

Let $\mathbf{E}\Pi_j\left(\vartheta^j, \vartheta^k; \kappa\right)$ denote player j's expected payoff when j and k play mixed strategies ϑ^j and ϑ^k, respectively. Since $\Pi_j\left(\mathbf{q}^j, \mathbf{q}^k; \kappa\right)$ is only discontinuous at points where $\mathbf{q}^j = \mathbf{q}^k$, $\mathbf{E}\Pi_j\left(\vartheta^j, \vartheta^k; \kappa\right)$ can only be discontinuous at points where ϑ^j and ϑ^k have mass points at $\mathbf{q}^j$ and $\mathbf{q}^k$, respectively, for some $\mathbf{q}^j = \mathbf{q}^k$. Moreover, for any $\mathbf{q} = (q_L, q_R)$ and $\Delta \in \mathbb{R}$, let $\mathbf{q} + \Delta$ denote $(q_L + \Delta, q_R - \Delta)$, then $\Pi_j\left(\mathbf{q}^j, \mathbf{q}^k; \kappa\right)$ is only discontinuous

[32]See Reny (1999) for the relevant definitions

at $(\mathbf{q},\mathbf{q})$ if $\Pi_j(\mathbf{q}+\varepsilon\Delta,\mathbf{q};\kappa) > \Pi_j(\mathbf{q}+(-\varepsilon\Delta),\mathbf{q};\kappa)$ for all $\varepsilon > 0$ sufficiently small. Therefore at those points where $\mathbf{E}\Pi_j\left(\vartheta^j,\vartheta^k;\kappa\right)$ is discontinuous, player j can "secure" a payoff $\mathbf{E}\Pi_j\left(\vartheta^j,\vartheta^k;\kappa\right)$ by moving the mass point at $\mathbf{q}^j$ to $\mathbf{q}^j+\varepsilon\Delta$ for some ε arbitrarily small. Thus the mixed extension of the duopolists' game is "payoff secure".

Therefore the duopolists' game has at least one Nash equilibrium in mixed strategies. Moreover, the duopolist's game is clearly symmetrical. Therefore, Corollary 5.3 of Reny (1999) implies that there exists at least one symmetric Nash equilibrium in mixed strategies of this game. The same argument can be applied to proving the existence of symmetric mixed strategy Nash equilibria for the media outlets' game with any number of players.

Recall from the proof of Lemma 3 that if $\kappa > \max_{q_L\in\left[\frac{q}{2},q\right]} V\left(\sigma(q_L),\sigma(q_R),\frac{1+c}{2}\right)$ and if $V(\sigma(q_L),\sigma(q-q_L),\pi)\geq\kappa$, then $V(\sigma(q_L),\sigma(q-q_L),\pi)$ is either strictly increasing in q_L or strictly decreasing in q_L. On the other hand, the bundle of news reports consisting one from each media outlet can be valued at most at $V\left(\tau(\sigma(q),\sigma(q)),0,\frac{1-c}{2}\right)$. Thus, if $\kappa > \frac{1}{2}V\left(\tau(\sigma(q),\sigma(q)),0,\frac{1-c}{2}\right)$, no consumer would purchase more than one news report. Moreover, $V\left(\tau(\sigma(q),\sigma(q)),0,\frac{1-c}{2}\right) < 2\sigma(q)(1-c) = 2\overline{\kappa}$.

Now let κ_2^* be defined by:

$$\kappa_2^* = \max\{\max_{q_L\in\left[\frac{q}{2},q\right]} V\left(\sigma(q_L),\sigma(q_R),\frac{1+c}{2}\right),\frac{1}{2}V\left(\tau(\sigma(q),\sigma(q)),0,\frac{1-c}{2}\right)\}.$$

It follows that, when $\kappa > \kappa_2^*$, at least one extreme reporting strategy (i.e. $(q,0)$ or $(0,q)$ or both) strictly dominates all interior strategies for either media outlet.

Finally, let $\mathbf{q}^k = (q,0)$. For κ sufficiently small, j's payoff when choosing strategy $(q,0)$ is:

$$\begin{aligned}\Pi_j\left((q,0),\mathbf{q}^k;\kappa\right) &= \frac{1}{2}\int_{A_j^{\frac{1}{2}}} f d\pi + \int_{A_j} f d\pi \\ &= \frac{1}{2}\int_{\frac{\kappa}{2\tau(\sigma(q),\sigma(q))}}^{\frac{\kappa}{2[\tau(\sigma(q),\sigma(q))-\sigma(q)]}} f d\pi + \int_{\frac{\kappa}{2[\tau(\sigma(q),\sigma(q))-\sigma(q)]}}^{\frac{1+c-2\kappa}{2-(1-c)\tau(\sigma(q),\sigma(q))}} f d\pi,\end{aligned}$$

while its payoff when choosing strategy $(0,q)$ is:

$$\begin{aligned}\Pi_j\left((0,q),\mathbf{q}^k;\kappa\right) &= \int_{A_j} f d\pi \\ &= \int_{\frac{\kappa+(1-c)[1-\sigma(q)]}{2[1-\sigma(q)]}}^{1-\frac{\kappa}{2\sigma(q)}} f d\pi.\end{aligned}$$

Now pick any interior strategy (q_L, q_R), j's payoff when choosing (q_L, q_R) is:

$$\begin{aligned}\Pi_j\left((q_L,q_R),\mathbf{q}^k;\kappa\right) &= \int_{A_j} f d\pi \\ &= \int_{\frac{\kappa}{2[\tau(\sigma(q),\sigma(q_L))-\sigma(q)]}}^{1-\frac{\kappa}{2\sigma(q_R)}} f d\pi.\end{aligned}$$

All of these payoffs are continuous in κ when κ is sufficiently small. Thus, we have $\lim_{\kappa\to 0}\Pi_j\left((q_L,q_R),\mathbf{q}^k;\kappa\right)=1$ while $\lim_{\kappa\to 0}\Pi_j\left((q,0),\mathbf{q}^k;\kappa\right), \lim_{\kappa\to 0}\Pi_j\left((0,q),\mathbf{q}^k;\kappa\right)<1$. Therefore, there exists a $\kappa'>0$ such that $\Pi_j\left((q_L,q_R),\mathbf{q}^k;\kappa\right)$ is strictly higher than both $\Pi_j\left((q,0),\mathbf{q}^k;\kappa\right)$ and $\Pi_j\left((0,q),\mathbf{q}^k;\kappa\right)$ for all $\kappa<\kappa'$.

Similarly, we can prove that, when $\mathbf{q}^k=(0,q)$, there exists a $\kappa''>0$ such that $\Pi_j\left((q_L,q_R),\mathbf{q}^k;\kappa\right)$ is strictly higher than both $\Pi_j\left((q,0),\mathbf{q}^k;\kappa\right)$ and $\Pi_j\left((0,q),\mathbf{q}^k;\kappa\right)$ for all $\kappa<\kappa''$. In fact, the analogous statement can be proved by the same argument for any reporting strategy $\mathbf{q}^k$.

Now let $\widehat{\kappa}_2=\min\{\kappa',\kappa''\}$. Then, when $\kappa<\widehat{\kappa}_2$, an interior strategy (q_L,q_R) strictly dominates both $(q,0)$ and $(0,q)$ for media outlet j when k is restricted to randomizing over only $\{(q,0),(0,q)\}$. Therefore, there cannot be any Nash equilibria where both players only randomize over $\{(q,0),(0,q)\}$.

We have thus proved Proposition 5. □

7.8. **Proof of Proposition 6.**

Proof. When both media outlets choose $\mathbf{q}=\left(\frac{q}{2},\frac{q}{2}\right)$ and $\kappa<\left(1-\frac{q}{2}\right)q\frac{1-c}{2}$, each receives a payoff equal to:

$$\Pi(\mathbf{q},\mathbf{q};\kappa) = \frac{1}{2}\int_{\frac{\kappa}{q}}^{1-\frac{\kappa}{q}} f d\pi+\frac{1}{2}\int_{\frac{\kappa}{(1-\frac{q}{2})q}}^{1-\frac{\kappa}{(1-\frac{q}{2})q}} f d\pi.$$

On the other hand, if media outlet j deviate to some other interior reporting strategy (q_L,q_R) with $q_L>q_R$ its payoff is equal to:

$$\Pi\left((q_L,q_R),\mathbf{q};\kappa\right) = \int_{\frac{\kappa}{2q_L}}^{\widetilde{\pi}} f d\pi,$$

where $\widetilde{\pi}$ is the prior belief of the most conservative consumer who is willing to choose j's news report as her second choice, which, depending on κ, has to satisfy one of the following equations:

$$\begin{cases}\frac{1}{2}V\left(\sigma_L,\sigma_R,\widetilde{\pi}\right)=\kappa & \text{if } V\left(\sigma_L,\sigma_R,\widetilde{\pi}\right)\geq 2V\left(\frac{q}{2},\frac{q}{2},\widetilde{\pi}\right)\\ V\left(\sigma_L,\sigma_R,\widetilde{\pi}\right)-V\left(\frac{q}{2},\frac{q}{2},\widetilde{\pi}\right)=\kappa & \text{Otherwise}\end{cases},$$

where $\sigma_L = \tau\left(\frac{q}{2}, q_L\right)$ and $\sigma_R = \tau\left(\frac{q}{2}, q_R\right)$. Note that, $\frac{\partial \sigma_L}{\partial q_L} = \frac{\partial \sigma_R}{\partial q_R} = \left(1 - \frac{q}{2}\right)$, which implies that $V\left(\sigma_L, \sigma_R, \widetilde{\pi}\right)$ is strictly increasing in q_L over $\left[\frac{1}{2}, \pi^*\left(\sigma_L, \sigma_R\right)\right]$. It follows that, if $\widetilde{\pi} < \pi^*\left(\sigma_L, \sigma_R\right)$, then it is strictly increasing in q_L, and $\Pi\left(\left(q_L, q_R\right), \mathbf{q}; \kappa\right) < \Pi\left(\left(q, 0\right), \mathbf{q}; \kappa\right)$. When $\widetilde{\pi} \geq \pi^*\left(\sigma_L, \sigma_R\right)$, which implies that $\kappa \leq 2\pi^*\left(\sigma_L, \sigma_R\right)\left(\sigma_R - \frac{q}{2}\right)$, we have $\widetilde{\pi} = 1 - \frac{\kappa}{2\left(\sigma_R - \frac{q}{2}\right)} = 1 - \frac{\kappa}{2\left(1-\frac{q}{2}\right)q_R}$, which is strictly increasing in q_R. $\frac{\kappa}{2q_L}$, on the other hand, is strictly decreasing in q_L. Thus any $\left(q_L, q_R\right)$ with $q_L + q_R < q$ cannot be profit maximizing for j. Therefore, we can, without loss generality, focus on reporting strategies satisfying $q_L + q_R = q$, and can identify j's strategy with $x = \frac{q_L}{q}$. j's payoff then becomes:

$$\Pi\left(x, \mathbf{q}; \kappa\right) = \int_{\frac{\kappa}{2xq}}^{1-\frac{\kappa}{2\left(1-\frac{q}{2}\right)(1-x)q}} f d\pi.$$

Differentiating with respect to x yields:

$$f\left(\frac{\kappa}{2xq}\right)\frac{\kappa}{2qx^2} - f\left(1 - \frac{\kappa}{2\left(1-\frac{q}{2}\right)\left(1-x\right)q}\right)\frac{\kappa}{2\left(1-\frac{q}{2}\right)q\left(1-x\right)^2}, \quad (7.5)$$

which, when $\mu = \frac{1}{2}$, is negative for $x > \frac{1}{2}$. The case when $q_L < q_R$ is symmetrical and, when $\mu = \frac{1}{2}$, $\frac{\partial \Pi(x,\mathbf{q};\kappa)}{\partial x}$ is positive for $x < \frac{1}{2}$. Finally, it is easy to verify that, when $\mu = \frac{1}{2}$, $\lim_{x \to \frac{1}{2}} \Pi\left(x, \mathbf{q}; \kappa\right) = \Pi\left(\frac{1}{2}, \mathbf{q}; \kappa\right)$. Therefore, at $\left(\left(\frac{q}{2}, \frac{q}{2}\right), \left(\frac{q}{2}, \frac{q}{2}\right)\right)$, if a media outlet has a profitable deviation, then its payoff must be maximized by either $(q, 0)$ or $(0, q)$. However, an argument similar to that applied towards the end of the previous proof shows that we can find a $\check{\kappa}_2 \leq \min\{\left(1-\frac{q}{2}\right)q\frac{1-c}{2}, \kappa_2^*\}$, such that for all $\kappa \in (0, \check{\kappa}_2)$, $\Pi\left(x = \frac{1}{2}, \mathbf{q}; \kappa\right)$ is strictly higher than both $\Pi\left(0, \mathbf{q}; \kappa\right)$ and $\Pi\left(1, \mathbf{q}; \kappa\right)$.

Therefore, when $\mu = \frac{1}{2}$ and $\kappa \in (0, \check{\kappa}_2)$, $\left(\left(\frac{q}{2}, \frac{q}{2}\right), \left(\frac{q}{2}, \frac{q}{2}\right)\right)$ is a Nash equilibrium.

Moreover, it is easy to show that, for all $\varepsilon > 0$, if μ is sufficiently close to $\frac{1}{2}$, there exists an x^* in $\left(\frac{1}{2} - \varepsilon, \frac{1}{2} + \varepsilon\right)$, such that $\lim_{x \to x^*} \Pi\left(x, x^*; \kappa\right) = \Pi\left(x^*, x^*; \kappa\right)$.

On the other hand, when $\kappa < \left(1 - \frac{q}{2}\right)q\frac{1-c}{2}$, $\Pi\left(x, \mathbf{q}; \kappa\right)$ is continuous in $\left(x, \mathbf{q}, \mu\right)$ at $\left(\frac{1}{2}, \left(\frac{q}{2}, \frac{q}{2}\right), \frac{1}{2}\right)$, so is its derivative with respect to x. Therefore, for x^* and μ sufficiently close to $\frac{1}{2}$, we can simply replace $\frac{1}{2}$ by x^* in the above argument, and continuity ensures that all the strict inequalities still hold. Then, $\left(x^*, x^*\right)$ is a Nash equilibrium if we also have $\lim_{x \to x^*} \Pi\left(x, x^*; \kappa\right) = \Pi\left(x^*, x^*; \kappa\right)$.

Therefore, for the same κ, if μ is sufficiently close to $\frac{1}{2}$, the game has a Nash equilibrium at some $\left(\left(x^*q, \left(1 - x^*\right)q\right), \left(x^*q, \left(1 - x^*\right)q\right)\right)$ close to $\left(\left(\frac{q}{2}, \frac{q}{2}\right), \left(\frac{q}{2}, \frac{q}{2}\right)\right)$. □

7.9. **Proof of Proposition 7.**

Proof. If no media outlet chooses $(q,0)$ (respectively, $(0,q)$) with positive probability, then a player can secure a payoff of at least $\int_0^{\frac{1-c}{2}} f d\pi$ (respectively, $\int_{\frac{1+c}{2}}^1 f d\pi$) by choosing $(q,0)$ (respectively, $(0,q)$) with probability one. On the other hand, fixing κ, the number of news report a consumer will consume is bounded above by $V\left(1,0,\frac{1}{2}\right)/\kappa$. Thus, when there are N media outlets, the average payoff of a media outlet is bounded by $V\left(1,0,\frac{1}{2}\right)/(\kappa N)$. Therefore, for N sufficiently large, some player must find it more profitable to play $(q,0)$ (respectively, $(0,q)$) than any other interior reporting strategy if none of the other media outlets chooses $(q,0)$ (respectively, $(0,q)$) with positive probability. □

7.10. **Proof of Proposition 8.**

Proof. First, by inspecting V, the difference between functions U^* and u^*, we see that for any news consumption bundle (σ_L, σ_R) and any $\pi \in [0,1]$, we must have $V(\sigma_L,\sigma_R,\pi) \leq \max\{V\left(\sigma_L,\sigma_R,\frac{1-c}{2}\right), V\left(\sigma_L,\sigma_R,\frac{1+c}{2}\right)\}$. That is, either the consumers with prior belief given by $\pi = \frac{1-c}{2}$ or those with prior $\pi = \frac{1+c}{2}$ must value (σ_L,σ_R) higher than any other consumers. It follows that if any news report is consumed at all, it must be consumed by some consumers with prior beliefs $\frac{1-c}{2}$ or $\frac{1+c}{2}$. Since V is continuous in π, this implies that the news report is also consumed by either some liberals or some conservatives.

Now let $b \in \left[0,\frac{1}{2}\right]$ be a set of binding content regulations. Let Σ_0^j and Σ_1^j denote the supports of media outlet j's pre-regulation equilibrium strategy and its post-regulation equilibrium strategy, respectively. Then, there must be some media outlet j, for whom the set $\Sigma^{j*} \equiv \{\left(q_L^j,q_R^j\right) \in \Sigma_0^j \setminus \Sigma_1^j \mid |\frac{q_L^j}{q_L^j+q_R^j} - \frac{1}{2}| > b\}$ is non-empty. Moreover, either the set $\{\left(q_L^j,q_R^j\right) \in \Sigma^{j*} \mid q_L^j < q_R^j\}$ or the set $\{\left(q_L^j,q_R^j\right) \in \Sigma^{j*} \mid q_L^j < q_R^j\}$ is non-empty. Without loss of generality, let $\{\left(q_L^j,q_R^j\right) \in \Sigma^{j*} \mid q_L^j < q_R^j\}$ be non-empty. Note that, by definition, the reporting strategies in $\{\left(q_L^j,q_R^j\right) \in \Sigma^{j*} \mid q_L^j < q_R^j\}$ are played with positive probability before the regulations were imposed.

Now let (q_L', q_R') denote the news report in the set $\cup_j \Sigma_1^j$ that is most biased to the left. By the above argument, there must be some liberal consumer who are willing to consume (q_L', q_R'). Moreover, concavity of τ implies that a liberal who is willing to consume (q_L', q_R') in a bundle must be willing to consume it on its own. On the other hand, we know that a liberal with prior belief given by $\pi = 0$ is not willing to consume (q_L', q_R') at any positive κ. Thus, by continuity of V, there exists $\pi' \in (0,1)$ such that consumers with prior belief π' are indifferent between consuming (q_L', q_R') on its own and not consuming any news. Fixing κ, consumers with prior belief $\pi < \pi'$ are not willing to consume (q_L', q_R') and are therefore not willing to consume any news with positive probability. On the other hand, continuity of V implies that some of these consumers are willing to consume news reports in $\{(q_L^j, q_R^j) \in \Sigma^{j*} \mid q_L^j < q_R^j\}$ at κ. Thus, these consumers enjoy positive expected surplus in the equilibrium before the content regulations are imposed and are made strictly worse-off by the introduction of such regulations. We have thus proved the first half of the proposition.

Consider a game with two media outlets. Let σ be convex and suppose that, in the equilibrium before content regulations are introduced, one of the two media outlet produces news report $(q, 0)$ with probability one and the other produce $(0, q)$ with probability one. Then Proposition 2 and the concavity of τ implies that the introduction of binding content regulations must make all consumers worse-off. This proves the second half of the proposition. $\square$