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Mass Media and Special Interest Groups

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Abstract

Media revenues are an important determinant of media behavior. News coverage depends not only on the preferences of media consumers but also on the preferences of advertisers or subsidizing groups. We present a theoretical model of the interaction between special interest groups and media outlets in which the media face a trade-off between a larger audience and lower payments from special interest groups versus a smaller audience and more biased content. We focus on the relationship between the costs of production of media product and the level of distortion in news coverage that can be introduced by interest groups. Specifically, we look at the effect of falling marginal costs or the growing reliance on advertising revenues. We show that if people do not want to tolerate bias, or if special interest groups have budget constraint, then this effect is negative. If people do not pay attention to bias, or if the size of the audience is very important for the interest group, then this effect becomes positive. If markets are fully covered, and all consumers buy one unit of media product, then the effect disappears.

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1 Introduction

Despite the journalistic ideal of "just reporting the truth", media outlets as a rule operate as profit maximizing firms. News coverage depends on the preferences of those who pay for it. Most of the literature suggests that economic growth will decrease media dependence on subsidies from various interest groups by increasing the value of the media audience for media outlets (Gentzkow et al. (2006), Baldasty (1992), Hamilton (2004), Starr (2004)). However, we do not observe that media around the world are becoming free and independent everywhere, even though advertising revenues have gone up and the marginal costs of production have fallen over the past 100 years.

Most existing theoretical models cannot explain why this fails to happen in a market economy.[1] In this paper, we aim to fill the gap by examining the conditions under which economic development indeed should have a positive effect on media independence. We develop a theoretical model of the interaction between media outlets and interest groups in a two-sided market. The model shows how the structure of media revenues affects distortions in news coverage. The sign of the effect of either falling marginal costs of production or increasing reliance on advertising revenues depends on the model's assumptions. There will be a positive relationship between the costs of production and the distortions in media coverage if: people *do* care about objective coverage; special interest groups are budget constrained; and for a special interest group, the size of the audience is not very important. There will be a negative relationship if: media consumers are ready to tolerate biased coverage, and for a special interest group, the extent of distortion in news coverage and the size of the audience are complements. Finally, if the markets are fully covered, that is every consumer buys one unit of media product, and there is competition between media outlets, there is no relationship.

In our model, different special interest groups offer menus of subsidies to media outlets, in order to

[1] One exception is Gehlbach and Sonin (2008) who analyze non-market strategies used by governments, such as explicit censorship or nationalization of media outlets.

induce editors or media owners to distort the news in a particular way.[2] A media outlet's profit depends on three sources of revenues: sales revenues; advertising revenues; and payments by special interest groups. Our model assumes that each interest group wants media outlets to be more extreme than they would choose to be without external influence. Therefore, one of the following cases is realized: in the first case, as the marginal revenues of a media outlet go up, it becomes costlier for an interest group to subsidize the media outlet, because it does not want to pay all of these costs in full. If marginal costs go down, then bias should go down, as in Gentzkow et al. (2006) and Besley and Prat (2006).

In the second case, as the marginal revenues of a media outlet go up, the media outlet can lower the price for media consumers, thus increasing the audience. As a result, an interest group which is interested in the size of the audience will be willing to pay even more for its preferred news coverage, and the bias will increase.

Finally, in the case of fully covered markets, and with any increase in marginal revenues perfectly offset by a corresponding change in price, any marginal change in an outlet's profit is competed away. Thus, for special interest groups, payments to induce a particular type of news coverage are as costly as before.

The interest groups in the model are interested in media content and include special interest groups, advertisers, politicians, or governments. The special interest groups might be interested in influencing media because it affects public opinion and, in turn, the preferences of politicians regarding the policy chosen, or the salience of certain policy issues (Sobbrio (2010), Alston et al. (2010)).

As to the advertisers, we assume that in addition to explicit advertising contracts in the spot market, there are also implicit advertising contracts that govern discounted streams of future media revenues

[2]Theoretically, we use the menu-auction approach of Bernheim and Whinston (1986). Formally, we modify and extend the model of Grossman and Helpman (1994) and Grossman and Helpman (2001), except that in our presentation media outlets play the role of policymakers. Our model also is related to Ujhelyi (2009) who considers the budget constraint of a special interest group and its effect on the policy choice.

and are conditional on media's behavior. As General Motors spokesman Brian Arke said (when GM terminated its advertising contract with the *Los Angeles Times* after a negative article by Dan Neil): "We recognize and support the news media's freedom to report and editorialize as they see fit. Likewise, GM and its retailers are free to spend our advertising dollars where we see fit."[3] The empirical results of Gambaro and Puglisi (2009) imply that in the Italian press the news coverage of advertisers is more positive than coverage of other companies, and this results in higher stock market returns for advertisers.

Governments also can exert the influence over media outlets: by using bribes, as in Peru (McMillan and Zoido (2004); by persecutions of journalists, as in some former Soviet Union countries (Reporters without Borders, 2005); or by state ownership and censorship, as in many countries around the world (Djankov et al. (2003)).[4] In such circumstances, governments trade off the benefits of distortion in news coverage against the aggregate costs of influencing media firms, including any non-monetary costs.

Finally, particular politicians or political parties might subsidize media outlets. In the 19th century United States, for example, the majority of newspapers were affiliated with political parties which had some control over their news coverage. The parties generated rents for affiliated media outlets through the distribution of official printing contracts which paid for printing local laws and ordinances. They also advertised that subscribing to partisan newspapers was a duty of every devoted party member, thus fostering newspapers' circulations.[5]

Our paper is closely related to Ellman and Germano (2009) who analyze the interaction between a particular type of special interest group, advertisers, and media outlets in a two-sided market. In their model, if competing media outlets rely more on revenues from advertisers, will lead to less media bias because of increased competition for the audience. Advertisers can counter this by committing to punish

[3]Source: BBC News 04/08/2005.

[4]This does not always means that the censorship is explicit. For example, according to a survey of journalists conducted in 2004 by Center "Public Expertise", 40% of Russian journalists do not feel "external censorship or pressure", but are subject to "self-censorship".

[5]See Kaplan (2002), Petrova (2010) for more details.

media outlets that publish negative stories. Our model differs in several respects, though. First, we consider a more general specification for the utility of an interest group, and for the consumer demand for news coverage. Thus we are able to identify three distinct effects of the growth of advertising. The Paradox result of Ellman and Germano (2009) could be explained in the context of our model, because in their paper the bias and the size of the audience are complements for advertisers. Second, because we have different types of interest groups, we can potentially differentiate between the effects of advertising on *political* distortions in news coverage (special interest groups include politicians or governments) and the effects of advertising on *commercial* distortions in coverage (for example, by omitting negative news about a particular company, since special interest groups are advertisers). Finally, we derive different implications for the effect of competition on commercial media bias. In the model of Ellman and Germano (2009), the competition is beneficial as long as punishment strategies are not used. In our model, this is not always true. In our paper the competition does not lead to the outcome optimal from the social point of view in the case of fully covered markets and if there is low elasticity of consumer demand with respect to bias.[6]

There is a growing body of literature about relationships between media outlets and various interest groups with their own preferences for media content. Herman and Chomsky (1988) , Baker (1994), and Hamilton (2004) argue that news media are biased in favor of advertisers. Surely, media bias also can arise as a result of capture by governments or incumbent politicians (Besley and Prat (2006), Egorov et al. (ming), Gehlbach and Sonin (2008), Puglisi (2004)), interest groups (Herman and Chomsky (1988), Grossman and Helpman (2001), Sobbrio (2010), Alston et al. (2010)), journalists (Baron (2006), Puglisi (2006)), or the set of actors involved in news production (Bovitz et al. (2002)). Other studies focus on the demand side of the problem,analyzing how consumer demand for a certain type of content affects the choices made by the media (Dyck et al. (2008), Gasper (2009), Gentzkow et al. (2006), Mullainathan and Shleifer (2005)). Our paper uses both supply-side and demand-side approaches, and shows how media

[6] This finding parallels the results of Mullainathan and Shleifer (2005) and Gabszewicz et al. (2001).

outlets frame content in response to both subsidies and advertising payments by special interest groups and the preferences of the media audience.

In the paper, a media outlet simultaneously sells the product to media consumers, advertisers, and special interest groups. To a special interest group, the profitability of the transaction depends on the price of a media product for consumers. In contrast, consumer demand depends on the type of media coverage distorted by the special interest groups. So, in a definition of Rochet and Tirole (2006), the model involves a two-sided market, with each side introducing an externality for the other.[7] In this respect, our model differs from Besley and Prat (2006), Gentzkow et al. (2006), or Gehlbach and Sonin (2008), which focus only on the effect of the interest group on the profit function of a media outlet, and from Mullainathan and Shleifer (2005) and Dyck et al. (2008), which incorporate only the consumer demand effect. Anderson and Gabszewicz (2006) discuss different models of media outlets as platforms in a two-sided market between advertisers and media consumers, and they derive the revenue-neutrality result.[8] Gabszewicz et al. (2001) analyze how the political bias of newspapers may change as the importance of advertising increases. However, our paper is different from theirs because we consider more general specifications for the utilities of interest groups and for the consumer demand for news coverage. Thus we are able to identify three different effects of the relative importance of advertising.

The rest of the paper is organized as follows. Section 2 introduces the model, section 3 analyzes equilibria in the game, and section 4 discusses the results and offers conclusions.

[7] The general discussion of two-sided markets can be found in Armstrong (2006), Rochet and Tirole (2003), and Rochet and Tirole (2006).

[8] Other papers analyze the effects of competition in media markets. Anderson and Coate (2005) provide welfare analysis of advertising and competition in media industry. Anderson and McLaren (2007) present a model of competition and mergers with politically motivated media owners.

2 Model

In the model there are media outlets and special interest groups. We start from the basic case of one media outlet and then extend the model for the case of duopoly.

A media outlet chooses a type of news coverage and a price for its media product. An outlet's coverage is characterized by the extent and the direction of media bias. A media outlet acts as a profit maximizing agent; its profit is a sum of the sales revenues, the advertising revenues, and the subsidies from special interest groups. Each special interest group cares about the outlet's coverage and the size of its audience.

To model the subsidies from the special interest groups, we use the menu auctions theoretical approach.[9] Each group offers a menu of subsidies which is conditional on a media outlet's news coverage. These subsidies are similar to the contribution schedules in the framework of Grossman and Helpman (1994) and Grossman and Helpman (2001). Each media outlet observes the menus of subsidies offered by all special interest groups and then chooses news content and the product price which maximizes the outlet's profit.[10]

In the model a media outlet changes its news coverage in order to get subsidies from special interest groups, which leads to a decrease in the size of the outlet's audience. This trade-off between the size of audience and the extent of bias is a fundamental problem which the media outlet solves.

2.1 Framework

The media outlet chooses the type of news coverage z. In the simple version of the model presented here, z is unidimensional.[11] This setup assumes that there is some unbiased coverage which corresponds to

[9] Bernheim and Whinston (1986)

[10] Note that a media owner can be considered as a special interest group; if the media outlet deviates from a profit maximizing media policy in order to please its owner, this shift corresponds to forgone profit. In such a framework, the loss of profit is equivalent to spending money on the subsidies.

[11] An older version of this paper analyzed the case of multidimensional z. We choose to drop this extension as the interpretation becomes more difficult and proofs become more complicated.

the absence of media bias.

The concept of the type of news coverage which we use reflects the discretion which media outlets have in framing and choosing the content of their news product. They can choose which topics to cover (Iyengar and Kinder (1987), McCombs (2004)), which expert to quote (Groseclose and Milyo (2005)), or which candidates to endorse (Ansolabehere and Snyder (2006)).[12]

Assume that the preferences of media consumers are described by the demand function $q(p, z)$ which depends on both the media coverage z chosen by the media outlet and the price of the media product p.[13] We also assume that this demand function is additively separable with respect to p and z:

$$q(p, z) = h(z) - g(p) \geq 0 \tag{1}$$

Both functions $g(p)$ and $h(z)$ are continuously differentiable, $g(p)$ is linear with $g\prime(p) > 0$, and $h(z)$ is concave with $h'(|z|) < 0$.[14]

Media outlet

A media outlet maximizes the profit which depends on sales revenues, advertising revenues, and the

[12] Numerically, media bias can be measured as the deviation from the political orientation of the median member of Congress (Groseclose and Milyo (2005)), mutual fund recommendations in the absence of advertising (Reuter and Zitzewitz (2006)), or independent wine rating (Reuter (2002)). It may also describe if the state of the world is misreported (as in models of Besley and Prat (2006), Gentzkow et al. (2006), Mullainathan and Shleifer (2005), Petrova (2008), and Puglisi (2004)).

[13] Utility-maximizing consumers can tolerate media bias and have non-zero demand for biased coverage because of behavioral assumptions (i.e. people have non-rational preferences for particular kinds of media bias, e.g. Mullainathan and Shleifer (2005)), or because some consumers do not pay a lot of attention to bias (e.g. consume media product mainly for entertainement, as in Prior (2007)). Consumers can evaluate the extent of media bias as they have prior beliefs about what is unbiased coverage (stereotypes for Lippmann (1922), or the initial impressions of Rabin and Schrag (1999)).

[14] Assumption (1) implies that without special interest groups the optimal price does not depend on bias. This specification of demand includes standard linear demand in the form $D(p) = A - bp$ where the intercept A does not depend on z, and $g(p) = bp$.

payments by special interest groups. Formally, the media outlet maximizes

$$\max_{p,z} \pi(p, z, C(\cdot)) = (p-d)q(p,z) + aq(p,z) + \sum_{i=1}^{N} C_i(z) \tag{2}$$

where p is the unit price of a media product, d is the marginal cost of production, a is advertising revenue per media consumer, and $C_i(z)$ is the menu of subsidies offered by special interest group i. Advertising revenue per reader is taken as given, for the purpose of simplification, similar to Besley and Prat (2006) and Gentzkow et al. (2006). It is important to distinguish between the advertisers interested only in the size of the audience and the special interest groups interested in the size of the audience and in the type of media coverage z. $C_i(z)$ might take the form of direct subsidies (e.g. from the government or from the business group which owns the outlet), discounted future payments in the case of implicit advertising contracts,[15] printing contracts (e.g. 19th century U.S., as discussed in Baldasty (1992), Kaplan (2002), Petrova (2010)), bribes (in countries with imperfect institutions, e.g. in Peru, as described by McMillan and Zoido (2004)), or even credible threats of physical punishments (as described in annual reports by the *Reporters without Borders*).

Subsidy $C_i(z)$ from special interest group i is conditional only on the type of news coverage z, and the price is chosen optimally by the media outlet from problem (2).[16] The profit of the media outlet

[15] The story about the General Motors and the Los Angeles Times, briefly described in the introduction, is an illustrative one. It exemplifies the existence of implicit advertising contracts, in which a media outlet not only sells its advertising space, but also commits not to cover its advertisers negatively. A threat point here is cancelling the contract, precisely as the story shows. When in 1979 Mother Jones published a critical article written by G. Blair "Why Dick Can't Stop Smoking?" which described the addictive effects of tobacco smoking, tobacco companies (Phillip Morris, Brown and Williamson, and others) responded by cancelling their long-term advertising contracts with the magazine. In addition, "in a show of corporate solidarity," many liquor companies follow their example.(Bates, E. "Smoked Out", *Mother Jones*, March/April 1996 issue.)

Herman and Chomsky (1988) provide a plenty of evidences of these implicit advertising contracts. They highlight the importance of advertising as one of the “filters" which information passes before becoming the news, inducing a bias toward special interest groups. Both Parenti (1986) and Bagdican (1997) offer examples of stories or programs killed because of the fear of offending advertisers.

[16] Theoretical results of the paper also hold if subsidies C_i depend on both z and p. Proofs, however, require additional

without the contributions from special interest groups is given by $\pi(p, z, 0) = \pi(p, z) = (p + a - d)q(p, z)$.

News coverage and media bias

In the space of potential types of news coverage the point which maximizes the demand for a media product is normalized to 0.

$$\arg\max_{z} q(p, z) = 0 \tag{3}$$

Note that the optimal z which solves this problem does not vary with p, by assumption (1). So, $|z|$ characterizes the extent of media bias, i.e. the amount of distortion in equilibrium news coverage introduced by the subsidizing interest group.

The maximum profit which can be earned without contributions from special interest groups is denoted as π^*. The price that yields maximum to the profit without subsidies is given by

$$p^* = \arg\max_{p,z}(p + a - d)q(p, z) = \arg\max_{p,z}\pi(p, z) = \arg\max_{p}\pi(p, 0).$$

Special interest groups

Special interest group i receives utility from media coverage z, audience size q, and income. Its payoff is

$$U_i(z, q, C(\cdot)) = W_i(z, q) - C_i(z) \tag{4}$$

where $C_i(z)$ is a payment to the media outlet. Function W is such that $W(z, q(\overline{p}(z), z))$ is a concave function of news coverage z with a unique maximum, where $\overline{p}(z) = \arg\max_{p}(p+a-d)q(p, z)$ is the optimal price. A special interest group i has one most preferred news coverage $\widehat{z}_i$ given by

$$\widehat{z}_i = \arg\max_{z,C(\cdot)} U_i(z, q, C_i(\cdot)) = \arg\max_{z} W_i(z, q(\overline{p}(z), z)) \tag{5}$$

assumptions on the sum of derivatives of the demand function which are difficult to interpret. Empirically, it seems plausible that the subsidizing group clearly specifies what kind of coverage it would like to have or avoid, but does not intervene into pricing decisions.

The timing of the game is as follows: first, special interest groups simultaneously offers menus of subsidies $C_i(\cdot)$ to the media outlet, second, the media outlet observes these menus of subsidies and chooses p and z, and, finally, media consumption takes place, and all agents receive their payoffs.

3 Analysis

3.1 One media outlet and one special interest group

Consider first the case of one media outlet and one special interest group. Assume without loss of generality that the special interest group prefers right-wing ideology, i.e. $\widehat{z} > 0$, and for any $z \in (0, \widehat{z})$ the utility $W(z, q)$ is increasing in q. In other words, the special interest group prefers the largest possible audience to be exposed to the news with a “positive" bias.

This section shows that the relationship between the economic parameters (e.g. a, d) and the extent of distortion introduced by the presence of the special interest group depends on the assumptions. The first set of assumptions used below is that

$$\frac{\partial^2 W}{\partial z \partial q} \leq 0 \text{ and } \frac{\partial^2 W}{\partial q^2} = 0 \tag{6}$$

This assumption means that for the special interest group, the optimal z is a non-increasing function of the size of the media audience q, taken as a parameter,[17] and the marginal utility $\dfrac{\partial W(z,q)}{\partial q}$ from an additional person in the audience is constant, i.e. W is linear in q.

[17] Consider the following problem for the special interest group: $\max_z W(z, q)$ where q is the parameter. Then the condition that $\dfrac{\partial^2 W}{\partial z \partial q} \leq 0$ means that the optimal news coverage $\arg\max_z W(z, q)$ is non-increasing in q. It is the case when the special interest group's ideal point does not depend on q, or when the special interest group wants more extreme media coverage if the audience size q (taken as a parameter!) is smaller. The latter assumption implies that bias and audience are substitutes: if the audience size is small, then the extent of bias should be large, while if the audience size is large, then the bias should be moderate.

We also consider the case of a budget constraint of the interest group (i.e. SIG's constraint has the form $C(z, q) \leq B$, where B is the budget of the interest group)

The proposition below shows the comparative statics of equilibrium news coverage with respect to characteristics of media production, of consumer demand, and of the preferences of special interest groups.

Proposition 1 *If there is one interest group and one media outlet and the most preferred news coverage for the special interest group is* $\widehat{z} > 0$

1. *Equilibrium media bias* $\widetilde{z}$ *satisfies* $0 < \widetilde{z} < \widehat{z}$;

2. *If assumption (6) is satisfied, then:*

   - *Bias* $\widetilde{z}$ *is an increasing function of the marginal costs (d),* $\dfrac{\partial \widetilde{z}}{\partial d} > 0$*;*
   - *Bias* $\widetilde{z}$ *is an decreasing function of the advertising revenue per reader (a),* $\dfrac{\partial \widetilde{z}}{\partial a} < 0$*;*
   - *Bias* $\widetilde{z}$ *is lower if the elasticity of consumer demand for particular type of coverage is higher (i.e. if* $\left|\dfrac{\partial \log q}{\partial \log z}\right|$ *is higher for any z);*
   - *Bias* $\widetilde{z}$ *is lower if the marginal valuation of media bias by the special interest group is higher (i.e. if* $\left|\dfrac{\partial W}{\partial z}\right|$ *is higher for any* $0 < z < \widehat{z}$*);*

3. *If the special interest group is budget constrained then*

   - *Bias* $\widetilde{z}$ *is an increasing function of the marginal costs (d),* $\dfrac{\partial \widetilde{z}}{\partial d} > 0$*;*
   - *Bias* $\widetilde{z}$ *is an decreasing function of the advertising revenue per reader (a),* $\dfrac{\partial \widetilde{z}}{\partial a} < 0$*;*
   - *Bias* $\widetilde{z}$ *does not depend on the marginal valuation of media bias by the special interest group;*

Proof. In Appendix A. ■

The intuition behind this set of results is as follows. A media outlet considers choosing a bias z, and weighs the costs of bias in terms of forgone advertising and sales revenues against the benefits of bias in the form of a subsidy from the special interest group. If marginal costs of media production d decrease, or the profitability of advertising a increases, or elasticity of consumer demand with respect to media bias increase, this implies that the marginal costs $\left|(p(z)+a-d)\frac{\partial q}{\partial z}\right|$ of bias z increase, but the marginal subsidy, given by $\frac{\partial W}{\partial q}\frac{dq}{dz}+\frac{\partial W}{\partial z}$, increases by a lesser amount. As a result, the optimal bias of the media outlet goes down. Similarly, if the marginal valuation of media bias by the special interest group go up, marginal costs of bias remain the same, and benefits go up. As a result, the optimal bias of the media outlet goes up.

The findings of Hamilton (2004), Gentzkow et al. (2006), and Petrova (2010) are consistent with these theoretical predictions. In all of these studies, the authors argue that the decrease in the marginal costs of printing newspapers or the increase in the profitability of advertising at the end of the 19^{th} century led to more objective media coverage and made the U.S. press more independent from the influence of political parties, which could be viewed as special interest groups in the context of this model.

A more scrupulous analysis of Proposition 1 show that it does not cover all potential cases. If people do not pay too much attention to media bias when making their purchasing decision, and the special interest group is very interested in the size of the audience, the comparative statics is different There is a set of assumptions under which some of results of Proposition 1 are actually reversed. Assume, for example, that

$$\frac{\partial^2 W}{\partial z \partial q} \geq 0 \text{ and } \frac{\partial^2 W}{\partial q^2} \leq 0 \tag{7}$$

Note that this assumption may seem more intuitive than (6), as it implies that the bias and the audience are complements, and the marginal utility of an additional person is non-decreasing. In particular, such a simple function as $W = zq$[18] satisfies conditions (7).

Also, assume that consumers do not pay too much attention to bias, as compared with the interest group. In particular, we assume that the relative marginal change in audience due to bias as compared

[18] Ellman and Germano (2009) obtain this functional form with a microfounded model of an advertiser's preferences.

with a corresponding change due to increase in a price is smaller than the corresponding change in the marginal valuation of an additional consumer by the interest group:[19]

$$\frac{\partial^2 W}{\partial z \partial q} \geq \frac{\left|\dfrac{\partial q(\overline{p}(z,d),z)}{\partial z}\right|}{2\left|\dfrac{\partial q(\overline{p}(z,d),z)}{\partial p}\right|} \tag{8}$$

Then, the following proposition could be shown:

Proposition 2 *If there is one interest group and one media outlet and the most preferred news coverage for the special interest group is* $\widehat{z} > 0$*, then*

1. *Equilibrium media bias* $\widetilde{z}$ *satisfies* $0 < \widetilde{z} < \widehat{z}$;

2. *If (7) and (8) are satisfied then:*

   - *Bias* $\widetilde{z}$ *is an increasing function of the marginal costs (d),* $\dfrac{\partial \widetilde{z}}{\partial d} > 0$*;*
   - *Bias* $\widetilde{z}$ *is an decreasing function of the advertising revenue per reader (a),* $\dfrac{\partial \widetilde{z}}{\partial a} < 0$.

Proof. In Appendix A. ■

The comparison of Proposition 1 and Proposition 2 allows us to make predictions about environments in which we should expect the positive effect of economic development on the amount of media outlet's news distortion. If people in the economy do not care too much about bias and are sensitive to price, then media should move further from the ideal point of consumers as marginal costs decrease and advertising revenue per reader go up. We expect a similar effect if the special interest group in the economy has a higher marginal valuation of bias and does not have budget constraint, e.g. if it is the government of a country with a low level of political competition. If, in contrast, the special interest group has a budget constraint or the elasticity of consumer demand with respect to bias is high, media should move closer to

[19] Here 2 emerges as in a simple case $\frac{\partial \overline{p}}{\partial d} = -\frac{\partial \overline{p}}{\partial a} = \frac{1}{2}$.

the ideal point of consumers as marginal costs decrease and advertising revenue per reader go up. The section below shows that the latter effect is even more likely to take place if we consider several special interest groups with diverse preferences instead of one.

3.2 One media outlet and several special interest groups

In this section, we analyze what happens if more than one special interest group can subsidize a single media outlet. For the sake of brevity, we focus on the case of two special interest groups.[20] These groups can have either aligned or misaligned preferences. In the model, the preferences of special interest groups are aligned if they have the same desired direction of bias. We consider the case of two interest groups whose ideal points $\widehat{z}_1$ and $\widehat{z}_2$ are both positive (aligned preferences), and the case where $\widehat{z}_1$ and $\widehat{z}_2$ are positive and negative (misaligned preferences). The equilibrium news coverage for the case in which *only* group i is allowed to offer a contribution to the media outlet is denoted as $\widetilde{z}_i$. If two special interest groups can offer contributions to a media outlet, then the following proposition holds:

Proposition 3 *If the preferences of different special interest groups are aligned ($\widehat{z}_i > 0$, $i = 1, 2$), then the type of news coverage $\widetilde{z}$ of a media outlet lies strictly between $\widetilde{z}_1$ and $\widetilde{z}_2$, so that the media bias is higher than $min\{\widetilde{z}_1, \widetilde{z}_2\}$. If the preferences of different special interest groups are misaligned ($\widehat{z}_1 > 0$, $\widehat{z}_2 < 0$), then the equilibrium news ideology lies strictly between $\widetilde{z}_1$ and $\widetilde{z}_2$, and the resulting bias is less than $max\{|\widetilde{z}_1|, |\widetilde{z}_2|\}$.*

Proof. In Appendix A. ■

If the preferences of different special interest groups are aligned, then the resulting coverage is, on average, further from the ideal point of consumers than the coverage in the case in which the preferences of different special interest groups are misaligned.[21] This proposition formalizes the argument made by

[20] The proposition below can be easily extended to the case of N special interest groups. The same stylized results hold.

[21] Here "on average" is interpreted as "in expectation", if ideal points of special interest groups are, for example, uniformly distributed on the same interval.

Herman and Chomsky (1988) in that there is a significant aggregate bias in the news about those issues for which preferences of various interests in the economy are similar (e.g. foreign policy), and there is a smaller aggregate bias, if any, in the news about issues for which these preferences differ significantly (e.g. the support of a candidate from a particular party in presidential elections).

This proposition shows that the structure of the market in which media sell their content to the special interesting groups matters. If there are more than one special interest group with opposing preferences, media should be less biased as compared with the case of one special interest group. This effect may be reinforced by the information processing features of the demand side. As empirically shown in Zaller (1992), a single media message is much more likely to affect public opinion than multiple potentially conflicting messages.

3.3 Two media outlets

The model above describes the basic intuition for the trade-off faced by a single media outlet which sells its product to both media consumers and special interest groups. We now present the model for the case of two media outlets. The utility of special interest group i in this case is given by $\max_{\mathbf{z}} \sum_{j=1,2} W_i(z_j, q_j(\overline{\mathbf{p}}(\mathbf{z}), \mathbf{z})) - c_{ij}$ where j denotes a media outlet.

We analyze the case of general demand function $q_j(\mathbf{z}, \mathbf{p})$, so that some of the micro-founded models of consumer demand are special cases.[22] We separately consider the cases of fully covered market (i.e. all consumers consume one unit of media product) and not fully covered market (i.e. aggregate demand for a media product may change). We also look at the case of a budget constrained interest groups.

The timing is the following: (1) special interest groups, simultaneously and independently, offer

[22] E.g. Anderson and Coate (2005), Gabszewicz et al. (2001), Gabszewicz et al. (2002), Ellman and Germano (2009) use different IO models to model the interaction between media outlets, their audience, and advertisers. Depending on the chosen model, there are different demand functions faced by media outlets. We do not present a microfounded model to keep the results as general as possible.

subsidies to media outlets, (2) media outlets choose their news coverage, and (3) media outlets choose price for their product. Note that at the last stage of the game, optimal prices are given by $\arg\max_{p_j}(p_j + a - d)q_j(\mathbf{z}, \mathbf{p})$.

Revenue neutrality

We start from the case of fully covered markets, i.e. the case in which all consumers buy exactly one copy of a newspaper or watch one broadcast channel etc. The results in this section are similar to Anderson and Gabszewicz (2006), Anderson and Coate (2005), and Armstrong (2006). Assume that the demand has the following form: $q_1(\mathbf{z}, \mathbf{p}) = A(z_1, z_2) + (p_2 - p_1)B(z_1, z_2)$, $q_2(\mathbf{z}, \mathbf{p}) = D(z_1, z_2) + (p_1 - p_2)B(z_1, z_2)$ where $A(z_1, z_2)$, $B(z_1, z_2)$, and $D(z_1, z_2)$ are some differentiable functions. Here $q_1(\mathbf{z}, \mathbf{p})$ and $q_2(\mathbf{z}, \mathbf{p})$ depend only on the price difference because we assumed that neither consumer abstains from consumption of a media product (otherwise, $A(z_1, z_2)$ or $D(z_1, z_2)$ could also be functions of p_j). At the first stage, media outlets choose z_1 and z_2; at the last stage, each media outlet chooses the price from their respective problems. The first order conditions imply that optimal qs depend only on the price difference that is a function of zs chosen at the first stage. [23] As a result, neither $\overline{q}_j(\mathbf{z}) = q_j(\mathbf{z}, \mathbf{p}(\mathbf{z}))$ nor $\pi_j(\mathbf{z}, \mathbf{p}) = (p_j(\mathbf{z}) + a - d)\overline{q}_j(\mathbf{z}, \mathbf{p})$ depend on d or a. This is a revenue neutrality result.[24] It happens because media outlets fully transfer the costs of production of a media product to media consumers.

With revenue neutrality, the equilibrium choice of z does not depend on d or a, as these parameters do not affect neither the size of the audience of a media outlet nor its forgone profit when it chooses the news coverage desired by a special interest group. So, theoretically, if there is competition between media outlets, and the markets are fully covered, and there should not be an effect of falling marginal costs or

[23] At the last stage, media outlets solve $(p_1 + a - d)[A(z_1, z_2) + (p_2 - p_1)B(z_1, z_2)] \to \max_{p_1}$, $(p_2 + a - d)[D(z_1, z_2) + (p_1 - p_2)B(z_1, z_2)] \to \max_{p_2}$. From the first order conditions, it follows that $A(z_1, z_2) * \frac{1}{B(z_1, z_2)} + p_2 - a + d = 2p_1$, $D(z_1, z_2) * \frac{1}{B(z_1, z_2)} + p_1 - a + d = 2p_2$. Then $\overline{p}_1(\mathbf{z}) = A(z_1, z_2) * \frac{2}{3B(z_1, z_2)} + D(z_1, z_2) * \frac{1}{3B(z_1, z_2)} - a + d$, $\overline{p}_2(\mathbf{z}) = A(z_1, z_2) * \frac{1}{3B(z_1, z_2)} + D(z_1, z_2) * \frac{2}{3B(z_1, z_2)} - a + d$, and $p_2(\mathbf{z}) - p_1(\mathbf{z}) = A(z_1, z_2) * \frac{1}{3B(z_1, z_2)} - D(z_1, z_2) * \frac{1}{3B(z_1, z_2)}$.

[24] Anderson and Gabszewicz (2006) show this result under more general assumptions for N media outlets.

increasing profitability of advertising.

Not fully covered markets

In this section, we look at the case in which the aggregate demand for media outlets depends on the price, i.e. if prices of both media outlets go up, it may prevent media consumers from paying for either media product. From the basic setup, we keep the assumption that $W(z, q(\overline{\mathbf{p}}(\mathbf{z}), \mathbf{z}))$ is a concave function of each z with SIG's ideal $z > 0$. As before, we consider a general case of a demand function given by $q_j(\mathbf{z}, \mathbf{p})$. To proceed, we need to make some reasonable assumptions about the function $q_j(\mathbf{z}, \mathbf{p})$ and its derivatives. Assume that $\frac{\partial q_j(\mathbf{z}, \mathbf{p})}{\partial p_j} \leq 0$ (higher price deters consumption), $\frac{\partial q_j(\mathbf{z}, \mathbf{p})}{\partial p_{-j}} \geq 0$ (higher competitor's price increase consumption), and $\frac{\partial [q_j(\mathbf{z}, \mathbf{p}) + q_{-j}(\mathbf{z}, \mathbf{p})]}{\partial p_j} < 0$ (markets are not fully covered, and the increase in price of one media outlet decreases the aggregate media consumption). Also, $\frac{\partial^2 q_j(\mathbf{z}, \mathbf{p})}{\partial p_j^2} = \frac{\partial^2 q_j(\mathbf{z}, \mathbf{p})}{\partial p_j \partial p_{-j}} 0$ (demand function is linear in prices), $\left| \frac{\partial q_j}{\partial p_j} \right| \geq \left| \frac{\partial q_j}{\partial p_{-j}} \right|$ (own price is not less important than the competitor's price), and $\frac{\partial^2 qj(\mathbf{z}, \overline{\mathbf{p}}(\mathbf{z}))}{\partial z_j \partial p_j} = \frac{\partial^2 q_j(\mathbf{z}, \overline{\mathbf{p}}(\mathbf{z}))}{\partial z_{-j} \partial p_j} = 0$ (separability). We consider a symmetric equilibrium in which $\frac{\partial q_i(\mathbf{z}, \mathbf{p})}{\partial z_i} \leq 0$ for $z_i = z_{-i} \geq 0$, $\frac{\partial q_i(\mathbf{z}, \mathbf{p})}{\partial z_{-i}} \geq 0$ for $z_i = z_{-i} \geq 0$ (there is lower demand for a product located further from 0), and $\frac{\partial [q_i(\mathbf{z}, \mathbf{p}) + q_{-i}(\mathbf{z}, \mathbf{p})]}{\partial z_i} = 0$ (the aggregate demand remains the same if one of two media outlets with the same coverage changes its position a little bit).

For example, such a demand function could be derived from the utility function like $u_i = y - \tau(|z^j - z_i|) - p_i$ with reservation utility u_0. Then consumer j prefers media product i if $y - \tau(|z^j - z_i|) - p_i \geq \max\{u_0, y - \tau(|z^j - z_{-i}|) - p_{-i}\}$, media product $-i$ if $y - \tau(|z^j - z_{-i}|) - p_{-i} \geq \max\{u_0, y - \tau(|z^j - z_i|) - p_i\}$, and no media product at all if $u_0 \geq \max\{y - \tau(|z^j - z_i|) - p_i, y - \tau(|z^j - z_{-i}|) - p_{-i}\}$.

Under this set of assumptions, the propositions analogous to Proposition 1 and Proposition 2 could be proven. The presence of one interest group distorts equilibrium choices made by media outlets and makes media outlets biased in the direction desired by the special interest group. The presence of two interest groups with opposing preferences stretches equilibrium positions of media outlets in two directions so that media outlets become more polarized. In both cases, marginal costs ensure that media equilibrium is either less or more distorted by the presence of special interest groups, depending on the preferences of interest groups and consumers' tolerance for bias.

Formally, denote $\widetilde{\mathbf{z}}$ the vector of equilibrium choices of news coverage in the presence of interest groups.

Proposition 4 *If there are two media outlets and there is one or two special interest groups,*

1. *If assumptions (6) are satisfied, then:*
   - *Bias* $|\widetilde{z}_j|$ *is an increasing function of the marginal costs (d),* $\dfrac{\partial |\widetilde{z}_j|}{\partial d} > 0$*;*
   - *Bias* $|\widetilde{z}_j|$ *is a decreasing function of the advertising revenue per reader (a),* $\dfrac{\partial |\widetilde{z}_j|}{\partial a} < 0$*;*
2. *If assumptions (7) and (8) are satisfied, then:*
   - *Bias* $|\widetilde{z}_j|$ *is a decreasing function of the marginal costs (d),* $\dfrac{\partial |\widetilde{z}_j|}{\partial d} > 0$*;*
   - *Bias* $|\widetilde{z}_j|$ *is an increasing function of the advertising revenue per reader (a),* $\dfrac{\partial |\widetilde{z}_j|}{\partial a} < 0$*.*

Proof. In Appendix B. ■

Note that the "paradox result" of Ellman and Germano (2009) is consistent with the second part of this Proposition. In Ellman and Germano (2009), $W = zq$ (in our notation), which satisfies (7). If a media outlet relies more on the profit from a special interest group (advertiser in their case), it corresponds to higher d or smaller a (explicit cost of advertising, in contrast to subsidies paid in addition to this explicit cost).

Budget constrained special interest groups

If every special interest group faces a binding budget constraint, then the relationship between the extent of distortion in news coverage, marginal costs of production, and advertising revenues per reader becomes unambiguous. We can prove the following proposition:

Proposition 5 *If there are two media outlets and there is one or two special interest groups, and special interest groups face binding budget constraints, then*

- *Bias* $|\widetilde{z}_j|$ *is an increasing function of the marginal costs* (d), $\dfrac{\partial\,|\widetilde{z}_j|}{\partial d} > 0$;
- *Bias* $|\widetilde{z}_j|$ *is a decreasing function of the advertising revenue per reader* (a), $\dfrac{\partial\,|\widetilde{z}_j|}{\partial a} < 0$.

Proof. In Appendix B. ∎

The intuition behind this Proposition is straightforward. A decrease in the marginal costs of production or an increase in unit advertising revenues makes subsidizing media more costly, as it increases the forgone profit which a special interest group has to reimburse in order to distort media behavior. If a budget constraint is binding, the interest group can afford subsidizing a smaller bias as the marginal costs go up.

3.4 Several special interest groups

In this section, we consider what happens if the number of budget constrained special interest groups goes up, while their aggregate budget constraint is remained unchanged. In particular, assume that all special interest groups have the aggregate budget given by $\overline{C}$, the budget constraint of each of a special interest group is $\dfrac{\overline{C}}{N}$, and all the interest groups have aligned preferences.

Under this set of assumptions, we can prove the following result:

Proposition 6 *If the total amount of money, which can be spent on subsidizing media,* $\overline{C}$ *is fixed, special interest groups have aligned preferences, and the number of special interest groups* N *with budget constraints* $C_j(\mathbf{z}, q) \leq \dfrac{\overline{C}}{N}$ *goes up, the resulting media equilibrium is less distorted in favor of interest groups: for any* i $\left|\widetilde{z}_i - \widetilde{z}_i^0\right|$ *is a decreasing function of* N.

Proof. In Appendix B. ∎

This result follows from the fact that higher number of special interest groups tightens budget constraint of each particular group, and, therefore, it becomes more difficult for them compensate a media outlet for a marginal change in news coverage.[25]

This proposition can be interpreted in the following way. If advertising markets are more concentrated (i.e. the number of advertisers in this market is smaller, while the total amount of money in the market stays the same) then the media bias is expected to be larger. Therefore, empirically higher concentration of special interest groups in the economy leads to more distorted news coverage, controlling for the size of advertising market. This result arises because media outlets compete for such a scarce resource as advertising revenues. Similar prediction is discussed, although not modeled, by Dyck et al. (2008).

The importance of a number of advertisers was known to media outlets long ago. Adolph S. Ochs, one of early publishers of the *New York Times*, in 1916 said: "It may seem like a contradiction (yet it is true) to assert: the greater the number of advertisers, the less influence they are individually able to exercise with the publisher."[26] Starr (2004) also notices that advertising revenues in the print media typically came from different sources, in contrast to far more concentrated of radio programs, and this was the reason why radio programs become much more dependent on advertisers and, as a result, exhibit higher bias in favor of advertisers.

A corollary from Proposition 6 is the following: even if there is an infinite number of media outlets in the market, this does not necessarily lead to the absence of a media bias.[27] However, if there is an infinite number of special interest groups in the economy, with ideal points distributed along $(-\infty; +\infty)$, then it is enough to guarantee the absence of aggregate bias, according to Proposition 3 extended for the case of many special interest groups and many media outlets).

[25] A driving condition for this result is the convexity of indifference curve of the media outlet j in the plane (z, c).

[26] From an address by Mr. Adolph S. Ochs, publisher of The New York Times, at the Philadelphia Convention of the Associated Advertising Clubs of The Associated Advertising Club of the World. 07.26.1916. Cited in Elmer Davis, "History of the New York Times, 1851-1921", pp. 397-398

[27] This result parallels findings of Mullainathan and Shleifer (2005).

4 Implications

The model described above suggests that we can predict the relationship between economic growth, technological change, and the distortions in news coverage. Depending on the circumstances, we can observe different effects. We expect falling marginal costs and growing advertising revenues to have a positive effect if people do not tolerate bias, if special interest groups do not pay too much attention to the size of the audience, if those groups face binding budget constraint, and if there are multiple SIGs and media outlets in the economy. For example, in the 19th century United States, political parties played the role of special interest groups in the framework of our model. Because people disliked bias, interest groups had opposing preferences and faced budget constraints, and thus the model predicts a positive effect of economic variables on newspaper independence. The empirical results in Gentzkow et al. (2006) and Petrova (2010) are consistent with these predictions. We would expect similar effects in countries with similar economic and institutional environment, such as Mexico in the 1990s.

Second, we would expect a negative effect of falling marginal costs, or the growth of advertising profitability, if people do not care too much about bias, if SIGs have aligned preferences, or if there is a single SIG or no competition between media outlets. Thus, we doubt that the media in African countries would become less biased as a result of economic development.

Third, we expect no effect of the economic environment on media independence if markets are fully covered. For example, if the majority of the population receives information from free broadcast channels (e.g. in Russia or other CIS countries), neither falling marginal costs nor the growth of advertising can substantially change the aggregate media audience. Correspondingly, our model predicts no effect of marginal costs or advertising profitability per se, even though the incentives of interest groups may change.[28]

[28] For example, rising prices for natural resources may increase the rents available for dictatorial governments and, at the same time, the profitability of advertising. As a result, these governments, acting as special interest groups, are ready to pay more to stay in power and to silence independent media (as discussed in Egorov et al. (ming)). So, empirically, an

Proposition 1 implies that media consumers can be fooled by biased media only if they are ready to accept this bias. If people stop consuming the media product when its bias becomes too high, or if they can easily switch to a less biased media product, then influencing public opinion becomes much more difficult. Therefore, as in the de Maitre quote that says "every country has the government it deserves," we can say "every country has the media it deserves." This proposition highlights the importance of the audience for the news coverage.

Our model also allows us to differentiate the effect of economic development on the political versus commercial media bias. Assume that conditions (6) are satisfied. Then if the media rely more on advertising revenues, there should be fewer political distortions in news coverage and more distortions in the coverage of advertisers.

In the framework in our model, the effect of competition is ambiguous. If special interest groups are budget constrained, as in Proposition 6, then the competition between media outlets is indeed beneficial. If budget constraints are not an important issue, then competition does not help, and the results in Proposition 4 are not very different from the results in Propositions 1 and 2.

5 Conclusions

Many scholars (e.g. Downs (1957), Olson (1965), Olson (1982), Grossman and Helpman (1994), Grossman and Helpman (2001)) note that special interest groups have a comparative advantage in information awareness: they possess much better knowledge about related issues and policies than either policymakers or society as a whole. Grossman and Helpman (1999) and Grossman and Helpman (2001) point out that under certain circumstances interest groups will reveal a portion of their information to the general public, and therefore are engaged in the process of "educating voters." Or, they will use endorsements to help their members learn their own preferences. Media outlets are important because their product is not only

increase in marginal revenues from advertising may be associated with a decrease in media independence (Gehlbach and Sonin (2008)).

commercial, but also a public good that provides people with the information necessary to sustain the political system of representative democracy (Lazarsfeld et al. (1948)). A number of authors (Gentzkow et al. (2006), Dyck et al. (2008), Dyck and Zingales (2002)) argue that free and independent mass media can constrain the behavior of special interest groups and restrict their influence on policy outcomes by revealing information those special interest groups want to conceal. In contrast, in this paper we analyze the case of media bias that is induced by special interest groups, which is more in line with Sobbrio (2010), Besley and Prat (2006), and Gabszewicz et al. (2001).

Our model describes the interaction between special interest groups and media outlets under an audience constraint. Media outlets face a trade-off between a larger audience and less biased content (and thus lower contributions) and a smaller audience and more biased content. As a result, a number of factors become important for news coverage: the technology (such as the marginal costs of media production; potential sales and advertising revenues at the status quo point), the properties of the consumer demand function (elasticity of demand for the media product with respect to the extent of media bias); and the characteristics of special interest groups trying to affect news coverage (their number, the alignment of their preferences, and their marginal valuation of particular news coverage). Therefore, our model combines supply-side and demand-side explanations of media bias.

We identify three different effects of economic development on media coverage. Petrova (2010) shows that in the United States in the 19th century, growing advertising revenues stimulated the development of an independent press, consistent with Propositions 1 and 4 of the model. Empirically testing the model's propositions in other countries and times is a potentially fruitful avenue of future research.

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APPENDIX A

Proof of Proposition 1. Subgame perfect equilibrium in this game is found by backward induction. In the last stage, a media outlet chooses coverage z and accepts a contribution c from a special interest group if for this z $\max_p \pi(p,z) + c(z) \geq \pi^*$, where π^* is the profit which can be earned without the special interest group. As before, $\overline{\pi}(z) = \max_p \pi(p,z) = \max_p (p+a-d)q(p,z)$, $\overline{p}(z) = \arg\max_p \pi(p,z)$, and $\overline{q}(z) = q(\overline{p}(z), z)$. The problem of the special interest group can be rewritten as

$$\max_{z,c} W(z, q(\overline{p}(z), z)) - c \tag{9}$$
$$s.t.\ \overline{\pi}(z) + c \geq \pi^*$$

Note that a profit maximizing special interest group will never pay the media outlet more than necessary to get the desired bias, which implies that the inequality in (9) is satisfied with an equality. Therefore, the problem (9) can be rewritten as

$$\max_z W(z, \overline{q}(z)) - \pi^* + \overline{\pi}(z) \tag{10}$$

The first order condition for this problem is

$$\frac{\partial W(z, q(\overline{p}, z))}{\partial z} + \frac{\partial W(z, q(\overline{p}, z))}{\partial q} \frac{dq(\overline{p}, z)}{dz} + \frac{d\overline{\pi}(z)}{dz} = 0 \tag{11}$$

First, we want to show that the optimal news coverage satisfies $0 < z < \widehat{z}$. From (11), it follows that the optimal $\widetilde{z}$ which solves (10) lies within the range $[0, \widehat{z}]$ Suppose that it is not the case, and $\widetilde{z} < 0$ or $\widetilde{z} > \widehat{z}$. Then the utility of the special interest group would be higher it would choose policy 0 instead of $\widetilde{z} < 0$, or policy $\widehat{z}$ instead of $\widetilde{z} > \widehat{z}$. So, the choice of z such that $\widetilde{z} < 0$ or $\widetilde{z} > \widehat{z}$ is not consistent with optimal behavior. Denote the left-hand side of (11) by $F(z)$. Neither 0 nor $\widehat{z}$ solves (11). $F(0)$ is positive, as $\dfrac{\partial \overline{\pi}(0)}{\partial z} = 0$, by definition, and $\dfrac{dW}{dz}(0, q)$ is positive. Also, $F(\widehat{z}) < 0$, because $\dfrac{dW}{dz}|_{z=\widehat{z}} = 0$, and $\widehat{z}$ solves (5). Note also that $\dfrac{\partial \overline{\pi}(z)}{\partial z} < 0$, as $\widehat{z}$ is not optimal for the media outlet (optimal point for an outlet is normalized to 0). As a result, we show that equilibrium media policy $\widetilde{z}$ satisfies $0 < \widetilde{z} < \widehat{z}$.

Now, assume that (6) is satisfied. Then, in order to show that $\widetilde{z}$ is an increasing function of d, we can use the results of monotone comparative statics (see e.g. theorem 4.1 in Athey et al. (1998)). Denote $G(z, q(\overline{p}(z), z)) = \dfrac{\partial W(z, q(\overline{p}(z), z))}{\partial z} + \dfrac{\partial W(z, q(\overline{p}, z))}{\partial q}\dfrac{dq(\overline{p}(z), z)}{dz}$. The mixed derivative of the objective function in (10) with respect to z and d is then equal to $\dfrac{\partial G(z,q)}{\partial q}\dfrac{\partial q(\overline{p}(z), z)}{\partial p}\dfrac{\partial \overline{p}(z)}{\partial d} - \dfrac{dq(\overline{p}(z), z)}{dz}$.Note that by the envelope theorem $\dfrac{\partial \overline{\pi}(z, a, d)}{\partial d} = \dfrac{\partial}{\partial d}(\overline{p} + a - d)q(\overline{p}(z), z) = -q(\overline{p}(z), z)$, hence $\dfrac{\partial^2 \overline{\pi}(z, a, d)}{\partial d \partial z} = -\dfrac{dq(\overline{p}(z), z)}{dz}$, $\dfrac{\partial q(\overline{p}(z), z)}{\partial p} = -g'(\overline{p}(z)) < 0$ and $\dfrac{dq(\overline{p}(z), z)}{dz} = h'(z) - g'(\overline{p}(z))\dfrac{\partial \overline{p}(z)}{\partial z}$.Let $R(p, z, a, d) = \dfrac{\partial}{\partial p}\pi(p, z) = \dfrac{\partial}{\partial p}(p + a - d)q(p, z) = q(p, z) - (p + a - d)g'(p)$. Now by the implicit function theorem $\dfrac{\partial \overline{p}(z)}{\partial z} = -\dfrac{\frac{\partial R}{\partial z}}{\frac{\partial R}{\partial p}} = \dfrac{h'(z)}{(\overline{p} + a - d)g''(\overline{p}) + 2g'(\overline{p})} \leq 0$. $\dfrac{\partial \overline{p}}{\partial d} = -\dfrac{\frac{\partial R}{\partial d}}{\frac{\partial R}{\partial p}} = \dfrac{g'(\overline{p})}{(\overline{p} + a - d)g''(\overline{p}) + 2g'(\overline{p})} \geq 0$, $\dfrac{\partial \overline{p}}{\partial a} = -\dfrac{\frac{\partial R}{\partial a}}{\frac{\partial R}{\partial p}} = -\dfrac{g'(\overline{p})}{(\overline{p} + a - d)g''(\overline{p}) + 2g'(\overline{p})} \leq 0$. Hence, we have $\dfrac{\partial \overline{p}(z)}{\partial z} \leq 0$, $\dfrac{\partial \overline{p}}{\partial d} \geq 0$, $\dfrac{\partial \overline{p}}{\partial a} \leq 0$.Note also that $\dfrac{dq(\overline{p}(z), z)}{dz} \leq 0$.[29]

The mixed derivative of the objective function in (10) with respect to z and d is greater or equal to 0 if $\dfrac{\partial G(z,q)}{\partial q} \leq 0$ and $z > 0$. But $\dfrac{\partial G(z,q)}{\partial q} = \dfrac{\partial^2 W(z, q(\overline{p}(z), z))}{\partial z \partial q} + \dfrac{\partial^2 W(z, q(\overline{p}(z), z))}{\partial q^2}\dfrac{dq(\overline{p}(z), z)}{dz}$, which is less than 0 by assumption (6) (note that $\dfrac{\partial^2 W(z, q(\overline{p}(z), z))}{\partial q^2} = 0$). As a result, $\dfrac{\partial F}{\partial d} \geq 0$, function $W(z, \overline{q}(z)) - \pi^* + \overline{\pi}(z)$ is supermodular, and $\widetilde{z}$ is an increasing function of d. Similarly, the mixed derivative of the objective function in (10) with respect to z and a is then equal to $\dfrac{\partial G(z,q)}{\partial q}\dfrac{\partial q(\overline{p}(z), z)}{\partial p}\dfrac{\partial \overline{p}}{\partial a} + \dfrac{dq(\overline{p}(z), z)}{dz}$,

[29] The comparison $\dfrac{dq(\overline{p}(z), z)}{dz}$ vs 0 is equivalent to $h'(z) - g'(\overline{p})\dfrac{\partial \overline{p}(z)}{\partial z}$ vs 0, i.e. $\dfrac{h'(z)}{g'(\overline{p})}$ vs $\dfrac{h'(z)}{(\overline{p} + a - d)g''(\overline{p}) + 2g'(\overline{p})}$, i.e. $\dfrac{h'(z)}{g'(\overline{p})}$ vs $\dfrac{h'(z)}{(\overline{p} + a - d)g''(\overline{p}) + 2g'(\overline{p})}$, i.e. $h'(z)((\overline{p} + a - d)g''(\overline{p}) + 2g'(\overline{p}))$ vs $h'(z)g'(\overline{p})$, i.e. $g'(\overline{p})$ vs $(\overline{p} + a - d)g''(\overline{p}) + 2g'(\overline{p})$, i.e. $g'(\overline{p}) \leq (\overline{p} + a - d)g''(\overline{p}) + 2g'(\overline{p})$.

which is less or equal to 0 if $\frac{\partial G(z,q)}{\partial q} \leq 0$ and $z > 0$. As a result, $\frac{\partial F}{\partial a} \leq 0$, and by the implicit function theorem, $\frac{\partial \widetilde{z}}{\partial a} = -\frac{\frac{\partial F}{\partial a}}{\frac{\partial F}{\partial \widetilde{z}}} < 0$, and $\widetilde{z}$ is a decreasing function of a.

Now, consider the transformation of demand function so that the elasticity of demand with respect to bias goes up for any z, as a function. Then $\left|\frac{\partial q(\overline{p}(z),z)}{\partial z}\frac{z}{q}\right| = \left|\frac{dh}{dz}\frac{z}{h(z)-g(p)}\right|$ goes up for any z. So, for any given z, if $\left|\frac{dh}{dz}\frac{z}{h-g}\right|$ goes up, it implies that $\frac{\partial W(z,q(\overline{p},z))}{\partial z}$ stays the same, $\frac{\partial W(z,q(\overline{p},z))}{\partial q}$ $\frac{\partial W(z,q(\overline{p},z))}{\partial q}\frac{dq(\overline{p}(z),z)}{dz}$ goes down, and $\frac{d\overline{\pi}(z)}{dz} = (\overline{p}+a-d)\frac{dh}{dz}$ also goes down. To restore the equilibrium, z should go down. Then $\frac{\partial W(z,q(\overline{p},z))}{\partial z}$ goes down, $\frac{\partial W(z,q(\overline{p},z))}{\partial q}$ goes up, $\frac{dq(\overline{p}(z),z)}{dz}$ goes up (as its derivative $\frac{\partial^2 h}{\partial z^2} > 0$) For z such that $0 < z < \widehat{z}$, $\frac{dW}{dz}|_z$ is positive, so the overall effect of a marginal decrease in z on the perturbed left-hand side of equation (11) is positive. As a result, equilibrium, described by (11), could be restored only by decreasing z.

Now consider the effect of a change in $\frac{\partial W(z,q(\overline{p},z))}{\partial z}$, a marginal valuation of bias by the special interest group, such that $\frac{\partial W(z,q(\overline{p},z))}{\partial z}$ goes up for any z. After this change, the first term in the left-hand side of (11) goes up, and all other terms remain constant. So, in order to restore the equilibrium and satisfy (11), we need to increase z, so that $\frac{dW}{dz}|_z$ goes down, and $\frac{d\overline{\pi}(z)}{dz} = (\overline{p}(z)+a-d)\frac{dh}{dz}$ goes down. So, if $\frac{\partial W(z,q(\overline{p},z))}{\partial z}$ goes up for every z, it implies that the optimal bias z goes up too.

Now consider the case of a budget constraint, i.e. that the special interest group can spend on subsidizing media not more than $\overline{C}$. If the budget constraint is binding, it implies that the problem of the special interest group can be rewritten as

$$\max_{z,c} W(z,q(\overline{p}(z),z)) - \overline{C} \tag{12}$$
$$s.t.\ \overline{\pi}(z) = \pi^* - \overline{C} \ = (p^*+a-d)q^* - \overline{C}$$

In other words, z is found as the solution of the equation $\overline{\pi}(z) = \max_p (p+a-d)\left[h(z)-g(p)\right] = (p^* + a-d)q^* - \overline{C}$, or $\overline{C} = (p^*+a-d)q^* - (\overline{p}(z)+a-d)\overline{q}(z)$. The derivative of the right-hand side of this equation with respect to z is $\frac{\partial}{\partial z}((p^* + a - d)q^* - (\overline{p}(z) + a - d)\overline{q}(z)) = -\frac{d\overline{\pi}(z)}{dz} = -(\overline{p} + a - d)h'(z) > 0$. The corresponding derivative with respect to d is $-q^* + \overline{q}(z) < 0$, as q^* maximizes $q(z)$ by definition. So, by the implicit function theorem, optimal z which solves $\overline{C} = (p^* + a - d)q^* - (\overline{p}(z) + a - d)\overline{q}(z)$ is an increasing function of d. Similarly, the derivative of $(p^* + a - d)q^* - (\overline{p}(z) + a - d)\overline{q}(z)$ with respect to a is $q^* - \overline{q}(z) > 0$, as q^* maximizes $q(z)$ by definition. Therefore, by the implicit function theorem, optimal z which solves $\overline{C} = (p^* + a - d)q^* - (\overline{p}(z) + a - d)\overline{q}(z)$ is an increasing function of a. ■

Proof of Proposition 2. The first part of the proof of Proposition 2 repeats the corresponding part of the proof of Proposition 1.

Now, as in the proof of Proposition 1, the first order condition for the special interest group's problem is

$$\frac{\partial W(z, q(\overline{p}, z))}{\partial z} + \frac{\partial W(z, q(\overline{p}, z))}{\partial q}\frac{dq(\overline{p}, z)}{dz} + \frac{d\overline{\pi}(z)}{dz} = 0$$

As before, denote the left-hand side of (11) by $F(\cdot)$ and

$$G(z, q(\overline{p}(z), z)) = \frac{\partial W(z, q(\overline{p}, z))}{\partial z} + \frac{\partial W(z, q(\overline{p}(z), z))}{\partial q}\frac{dq(\overline{p}(z), z)}{dz}.$$

The derivative of F with respect to d is equal to $\frac{\partial G(z, q(\overline{p}(z), z))}{\partial q}\frac{\partial q(\overline{p}(z), z)}{\partial p}\frac{\partial \overline{p}}{\partial d} - \frac{dq(\overline{p}(z), z)}{dz}$, which is equal to $\frac{\partial^2 W(z, q(\overline{p}, z))}{\partial z \partial q}\frac{\partial q(\overline{p}(z), z)}{\partial p}\frac{\partial \overline{p}}{\partial d} + \frac{\partial^2 W(z, q(\overline{p}(z), z))}{\partial q^2}\frac{dq(\overline{p}(z), z)}{dz}\frac{\partial q(\overline{p}(z), z)}{\partial p}\frac{\partial \overline{p}}{\partial d} - \frac{dq(\overline{p}, z)}{dz}$. Note that $\frac{\partial \overline{p}}{\partial d} = -\frac{\partial \overline{p}}{\partial a} = \frac{g'(\overline{p})}{(\overline{p} + a - d)g''(\overline{p}) + 2g'(\overline{p})}$. We can easily see that $\frac{\partial^2 W(z, q(\overline{p}(z), z))}{\partial q^2}\frac{dq(\overline{p}(z), z)}{dz}\frac{\partial q(\overline{p}(z), z)}{\partial p}\frac{\partial \overline{p}}{\partial d} \leq 0$. Hence, we need to show only that $\frac{\partial^2 W(z, q(\overline{p}, z))}{\partial z \partial q}\frac{\partial q(\overline{p}(z), z)}{\partial p}\frac{\partial \overline{p}}{\partial d} - \frac{dq(\overline{p}, z)}{dz} \leq 0$ or that $g'(\overline{p})\frac{\partial \overline{p}}{\partial z} - h'(z) - \frac{\partial^2 W(z, q(\overline{p}, z))}{\partial z \partial q}g'(\overline{p})\frac{\partial \overline{p}}{\partial d} \leq 0$. As $g'(\overline{p})\frac{\partial \overline{p}}{\partial z} \leq 0$ and by assumption (8) $\frac{\partial^2 W(z, q(\overline{p}, z))}{\partial z \partial q} \geq \frac{|h'(z)|}{g'(\overline{p})\frac{\partial \overline{p}}{\partial d}}$, by implicit function theorem $\frac{\partial \tilde{z}}{\partial d} = -\frac{\frac{\partial F}{\partial d}}{\frac{\partial F}{\partial \tilde{z}}} < 0$, and $\tilde{z}$ is a decreasing function of d.

Similarly, the derivative of F with respect to a is equal to $\frac{\partial G(z,q)}{\partial q}\frac{\partial q(\overline{p}(z),z)}{\partial p}\frac{\partial \overline{p}}{\partial a}+\frac{dq(\overline{p}(z),z)}{dz}$, which is equal to $\frac{\partial^2 W(z,\overline{q})}{\partial z\partial q}\frac{\partial \overline{q}}{\partial p}\frac{\partial \overline{p}}{\partial a}+\frac{\partial^2 W(z,\overline{q})}{\partial q^2}\frac{d\overline{q}}{dz}\frac{\partial \overline{q}}{\partial p}\frac{\partial \overline{p}}{\partial a}+\frac{d\overline{q}}{dz}$.

$\frac{\partial^2 W(z,q(\overline{p}(z),z))}{\partial q^2}\frac{dq(\overline{p}(z),z)}{dz}\frac{\partial q(\overline{p}(z),z)}{\partial p}\frac{\partial \overline{p}}{\partial a}\geq 0$ and $-g'(\overline{p})\frac{\partial \overline{p}}{\partial z}\geq 0$

Because of $\frac{\partial^2 W(z,q(\overline{p}(z),z))}{\partial q^2}\leq 0$, $\frac{dq(\overline{p}(z),z)}{dz}<0$, $\frac{\partial q(\overline{p}(z),z)}{\partial p}<0$, $\frac{\partial \overline{p}}{\partial a}\leq 0$, $\frac{\partial \overline{p}}{\partial z}\leq 0$. Also, $\frac{\partial^2 W(z,q(\overline{p},z))}{\partial z\partial q}(-g'(\overline{p}))\frac{\partial \overline{p}}{\partial a}+h'(z)\geq 0$ by assumption (8) $\frac{\partial^2 W(z,q(\overline{p},z))}{\partial z\partial q}\geq\frac{h'(z)}{g'(\overline{p})\frac{\partial \overline{p}}{\partial a}}$, hence, $\frac{\partial F}{\partial a}\geq 0$, and by implicit function theorem $\frac{\partial \widetilde{z}}{\partial a}=-\frac{\frac{\partial F}{\partial a}}{\frac{\partial F}{\partial \widetilde{z}}}<0$, and $\widetilde{z}$ is a decreasing function of d.

Similarly, the derivative of F with respect to a is equal to $\frac{\partial G(z,q)}{\partial q}\frac{\partial q(\overline{p}(z),z)}{\partial p}\frac{\partial \overline{p}}{\partial a}+\frac{dq(\overline{p}(z),z)}{dz}$, which is equal to $\frac{\partial^2 W(z,q(\overline{p},z))}{\partial z\partial q}\frac{\partial q(\overline{p}(z),z)}{\partial p}\frac{\partial \overline{p}}{\partial a}+\frac{\partial^2 W(z,q(\overline{p}(z),z))}{\partial q^2}\frac{dq(\overline{p}(z),z)}{dz}\frac{\partial q(\overline{p}(z),z)}{\partial p}\frac{\partial \overline{p}}{\partial a}+\frac{dq(\overline{p}(z),z)}{dz}$.

By assumption (8), $\left|\frac{dq(\overline{p},z)}{dz}\right|\leq\frac{\partial^2 W(z,q(\overline{p},z))}{\partial z\partial q}\left|\frac{\partial q(\overline{p}(z),z)}{\partial p}\frac{\partial \overline{p}}{\partial a}\right|$, and, therefore,

$$\left|\frac{dq(\overline{p},z)}{dz}\right|\leq\frac{\frac{\partial^2 W(z,q(\overline{p},z))}{\partial z\partial q}\frac{\partial q(\overline{p},z)}{\partial p}\frac{\partial \overline{p}}{\partial a}}{1+\frac{\partial^2 W(z,q(\overline{p},z))}{\partial q^2}\frac{\partial q(\overline{p},z)}{\partial p}\frac{\partial \overline{p}}{\partial a}}.$$

As a result, $\frac{\partial^2 W(z,q(\overline{p}(z),z))}{\partial z\partial q}\frac{\partial q(\overline{p}(z),z)}{\partial p}\frac{\partial \overline{p}}{\partial a}+\frac{\partial^2 W(z,q(\overline{p}(z),z))}{\partial q^2}\frac{dq(\overline{p}(z),z)}{dz}\frac{\partial q(\overline{p}(z),z)}{\partial p}\frac{\partial \overline{p}}{\partial a}+\frac{dq(\overline{p}(z),z)}{dz}\geq 0$, and by implicit function theorem $\frac{\partial \widetilde{z}}{\partial a}=-\frac{\frac{\partial F}{\partial a}}{\frac{\partial F}{\partial \widetilde{z}}}>0$, and $\widetilde{z}$ is an increasing function of a. ■

Proof of proposition 3. In this case a problem of special interest group i can be written as

$$\max_z W_i(z,q(\overline{p}_{12}(z),z))-C_i,\ i\in\{1,2\} \tag{13}$$
$$s.t.\ \pi(\overline{p}_{12}(z),z,C_i(z)),C_{-i}(z)))\geq\pi(\overline{p}_{-i}(\widetilde{z}_{-i}),\widetilde{z}_{-i},0,C_{-i}(\widetilde{z}_{-i}))$$

where $C_{-i}(z)$ is a contribution schedule of the other special interest group, z is news coverage of a single media outlet, $\widetilde{z}_i$ is the media coverage chosen by the media outlet with special interest group

i, $\overline{p}_{12}(z)$ solves $\max\limits_{p}\pi(p,z)$, $)\overline{p}_{-i}(\widetilde{z}_{-i})$ solves $\max\limits_{p}\pi(p,\widetilde{z}_{-i})$. At the optimal point, the special interest group does not pay more than necessary to the media outlet, so the constraint in the problem (13) is binding, and $\pi(\overline{p}_{12}(z), z, C_i(z)), C_{-i}(z)) = \pi(\overline{p}_{-i}(\widetilde{z}_{-i}), \widetilde{z}_{-i}, 0, C_{-i}(\widetilde{z}_{-i}))$. As a result, $C_i(z) = \pi(\overline{p}_{-i}(\widetilde{z}_{-i}), \widetilde{z}_{-i}, 0, C_{-i}(\widetilde{z}_{-i})) - (\overline{p}_{12}(z) + a - d)q_{12}(\overline{p}_{12}(z), z) - C_{-i}(z)$. Therefore, the problem (13) of the special interest group i can be rewritten as

$$\max_{z} W_i(z, \overline{q}(z)) - \pi(\overline{p}_{-i}(\widetilde{z}_{-i}), \widetilde{z}_{-i}, 0, C_{-i}(\widetilde{z}_{-i})) + (\overline{p}_{12}(z) + a - d)q_{12}(\overline{p}_{12}(z), z) + C_{-i}(z)$$

As $-\pi(\overline{p}_{-i}(\widetilde{z}_{-i}), \widetilde{z}_{-i}, 0, C_{-i}(\widetilde{z}_{-i}))$ does not depend on z, this problem is equivalent to

$$\max_{z} W_i(z, \overline{q}_{12}(z)) + (\overline{p}_{12}(z) + a - d)q_{12}(\overline{p}_{12}(z), z) + C_{-i}(z) \tag{14}$$

Let's denote $\overline{q}_{12}(z) = q_{12}(\overline{p}_{12}(z), z)$. First order condition for the problem (14) (using the envelope theorem for the profit of a media outlet) is

$$\frac{\partial W_i(z, \overline{q}_{12}(z))}{\partial z} + \frac{\partial W_i(z, \overline{q}_{12}(z))}{\partial q}\frac{d\overline{q}_{12}(z)}{dz} + (\overline{p}_{12}(z) + a - d)\frac{\partial \overline{q}_{12}(z)}{\partial z} + \frac{dC_{-i}(z)}{dz} = 0 \tag{15}$$

In the equilibrium, $\widetilde{z}_{12}$ which solves (15) is the same for both $i \in \{1, 2\}$. Also this $\widetilde{z}_{12}$ solves the problem of the media outlet

$$\max_{z}(\overline{p}_{12}(z) + a - d)\overline{q}_{12}(z) + \sum_{i=1,2} C_i(z)$$

First order condition for this problem is

$$(\overline{p}_{12}(z) + a - d)\frac{\partial \overline{q}_{12}(z)}{\partial z} + \frac{dC_1(z)}{dz} + \frac{dC_2(z)}{dz} = 0 \tag{16}$$

Combined (15) for both i and (16) yield that equilibrium $\widetilde{z}_{12}$ is also a solution of the following equation:[30]

[30] In fact, it is a Grossman-Helpman efficiency result (Grossman and Helpman 2001).

$$(\overline{p}_{12}(z)+a-d)\frac{\partial \overline{q}_{12}(z)}{\partial z}+\frac{dW_1(z,\overline{q}_{12}(z))}{dz}+\frac{dW_2(z,\overline{q}_{12}(z))}{dz}=0 \tag{17}$$

In other words, optimal $\widetilde{z}_{12}$ solves the following problem:

$$\max_z \sum_{i=1,2} W_i(z,\overline{q}_{12}(z))+(\overline{p}_{12}(z)+a-d)\overline{q}_{12}(z)$$

Suppose both $\widehat{z}_i>0$, $i=1,2$. Assume, without loss of generality, that $\widehat{z}_1<\widehat{z}_2$. Then the left-hand side of (17) at the point $\widehat{z}_1$is equal to $(\overline{p}_{12}(z)+a-d)\frac{\partial \overline{q}_{12}(z)}{\partial z}+\frac{\partial W_2(z,\overline{q}_{12}(z))}{\partial z}+\frac{\partial W_2(z,\overline{q}_{12}(z))}{\partial q}\frac{d\overline{q}_{12}(z)}{dz})\,|_{z=\widehat{z}_1}>0$ as $\widehat{z}_1<\widehat{z}_2$. Similarly, the left-hand side of (17) at the point $\widehat{z}_2$ is less than 0. As a result, continuity of all functions implies that a solution of (17) lies between $\widehat{z}_1$ and $\widehat{z}_2$. Similar argument holds for the case $\widehat{z}_1>0$, $\widehat{z}_2<0$. ■

APPENDIX B

Proof of Proposition 4. Each SIG solves

$$\max_{\mathbf{z}} \sum_{j=1,2} W_i(z_j, q_j(\overline{\mathbf{p}}(\mathbf{z}), \mathbf{z})) - c_{ij},\ \ i \in \{1,2\}$$
$$s.t.\ \pi_j(\overline{\mathbf{p}}(\mathbf{z}), \mathbf{z}, C_{ij}(\mathbf{z})), C_{-ij}(\mathbf{z}))) \geq \pi(\overline{\mathbf{p}}_{-i}(\widetilde{\mathbf{z}}_{-i}), \widetilde{\mathbf{z}}_{-i}, 0, C_{-i,j}(\widetilde{\mathbf{z}}_{-i})),\ \ j \in \{1,2\}$$

We consider separately the case of one interest group and the case of two interest groups.

One special interest group, two media outlets

The special interest group solves the following problem:

$$\max_{\mathbf{z}} \sum_{j=1,2} W(z_j, q_j(\overline{\mathbf{p}}(\mathbf{z}), \mathbf{z})) + C_1(\mathbf{z}) + C_2(\mathbf{z})$$
$$s.t.\ \pi_1(\overline{\mathbf{p}}(\mathbf{z}), \mathbf{z}, C_1(\mathbf{z})) \geq \overline{\pi}_1(\mathbf{z})$$
$$\pi_2(\overline{\mathbf{p}}(\mathbf{z}), \mathbf{z}, C_2(\mathbf{z})) \geq \overline{\pi}_2(\mathbf{z})$$

where $\overline{\pi}_i(\mathbf{z})$ is the profit of media outlet i without subsidies from the special interest group if news coverage of both outlets is given by (z_1, z_2). As the special interest group does not want to pay a media outlet more than it is necessary, this problem is equivalent to

$$\max_{\mathbf{z}} \sum_{j=1,2} W(z_j, q_j(\overline{\mathbf{p}}(\mathbf{z}), \mathbf{z})) + \overline{\pi}_1(\mathbf{z}) + \overline{\pi}_2(\mathbf{z}) \tag{18}$$

First, we want to derive the comparative statics for the solution of (18) with respect to key parameters. In particular, we are going to use the results of robust comparative statics (Athey et al. (1998)). Denote the objective function in (18) as F.

Note that $\overline{\mathbf{p}}(\mathbf{z})$ is computed from the problem of an individual media outlet at the first stage, i.e. as a solution of $\max_{p_j}(p_j+a-d)q_j(\mathbf{p}, \mathbf{z})$. The first order condition for this problem is $q_j+(p_j+a-d)\dfrac{\partial q_j(\mathbf{p}, \mathbf{z})}{\partial p_j} = 0$.

Using the implicit function theorem, we can derive the comparative statics of $\overline{\mathbf{p}}$ with respect to z_j, z_{-j}, or d. In particular, $\frac{\partial \overline{p}_j}{\partial z_j} = -\frac{\frac{\partial q_j(\mathbf{p},\mathbf{z})}{\partial z_j} + (p_j+a-d)\frac{\partial^2 q_j(\mathbf{p},\mathbf{z})}{\partial p_j \partial z_j}}{2\frac{\partial q_j(\mathbf{p},\mathbf{z})}{\partial p_j} + (p_j+a-d)\frac{\partial^2 q_j(\mathbf{p},\mathbf{z})}{\partial p_j^2}} = -\frac{\frac{\partial q_j(\mathbf{p},\mathbf{z})}{\partial z_j}}{2\frac{\partial q_j(\mathbf{p},\mathbf{z})}{\partial p_j}} \leq 0$ for $z_j \geq 0$, $\frac{\partial \overline{p}_j}{\partial z_{-j}} = -\frac{\frac{\partial q_j(\mathbf{p},\mathbf{z})}{\partial z_{-j}}}{2\frac{\partial q_j(\mathbf{p},\mathbf{z})}{\partial p_j}} \geq 0$ for $z_j \geq 0$, and $\frac{\partial \overline{p}_j}{\partial d} = -\frac{-\frac{\partial q_j(\mathbf{p},\mathbf{z})}{\partial p_j}}{2\frac{\partial q_j(\mathbf{p},\mathbf{z})}{\partial p_j}} = 1/2 \geq 0$.

We want to show that F is supermodular. First, we compute $\frac{\partial^2 F}{\partial z_1 \partial z_2} = \frac{d^2 W(z_1, q_1(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{dz_1 dz_2} + \frac{d^2 W(z_2, q_2(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{dz_1 dz_2} + \frac{d^2 \overline{\pi}_1(\mathbf{z})}{dz_1 dz_2} + \frac{d^2 \overline{\pi}_2(\mathbf{z})}{dz_1 dz_2}$. This expression is equal to $\frac{\partial^2 W(z_1, q_1(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial z_1 \partial z_2} + \frac{\partial^2 W(z_1, q_1(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial q \partial z_1}\frac{dq_1}{dz_2} + \frac{\partial^2 W(z_2, q_2(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial q \partial z_2}\frac{dq_2}{dz_1} + \frac{\partial^2 W(z_1, q_1(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial q^2}\frac{dq_1}{dz_1}\frac{dq_1}{dz_2} + \frac{\partial^2 W(z_2, q_2(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial q^2}\frac{dq_2}{dz_1}\frac{dq_2}{dz_2} + \frac{\partial W(z_1, q_1(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial q}\frac{dq_2}{dz_1 dz_2} + \frac{\partial W(z_2, q_2(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial q}\frac{dq_2}{dz_1 dz_2} + \frac{d^2 \overline{\pi}_1(\mathbf{z})}{dz_1 dz_2} + \frac{d^2 \overline{\pi}_2(\mathbf{z})}{dz_1 dz_2}$. Note that $\frac{\partial^2 W(z_1, q_1(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial z_1 \partial z_2} = 0$ and $\frac{dq_2}{dz_1 dz_2} = 0$. Note also that $\frac{\partial^2 W(z_1, q_1(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial q^2}\frac{dq_1}{dz_1}\frac{dq_1}{dz_2} + \frac{\partial^2 W(z_2, q_2(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial q^2}\frac{dq_2}{dz_1}\frac{dq_2}{dz_2} \geq 0$ in a symmetric equilibrium, as $\frac{dq_i}{dz_i} \geq 0$, $\frac{dq_i}{dz_{-i}} \leq 0$,.and $\frac{\partial^2 W(z_1, q_1(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial q^2} \leq 0$ by assumption. We can also simplify $\frac{d^2 \overline{\pi}_1(\mathbf{z})}{dz_1 dz_2} = \frac{d}{dz_1}\left[(\overline{p}_1 + a - d)\frac{\partial q_1(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z})}{\partial z_2}\right] = (\overline{p}_1 + a - d)\left(\frac{\partial^2 q_1(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial z_1 \partial z_2} + \frac{\partial^2 q_1(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial z_2 \partial p_1}\frac{d\overline{p}_1}{dz_1} + \frac{\partial^2 q_1(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial z_2 \partial p_2}\frac{d\overline{p}_2}{dz_1}\right) + \frac{d\overline{p}_1}{dz_1}\frac{\partial q_1(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial z_2}$. Note that $\frac{\partial^2 q_1(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial z_1 \partial z_2} = 0$, and by the assumption about separability $\frac{\partial^2 q_1(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial z_2 \partial p_1}\frac{\partial \overline{p}_1}{\partial z_1} + \frac{\partial^2 q_1(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial z_2 \partial p_2}\frac{\partial \overline{p}_2}{\partial z_1} = 0$. As a result, $\frac{\partial^2 F}{\partial z_1 \partial z_2} = \frac{\partial^2 W(z_1, q_1(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial q \partial z_1}\frac{dq_1}{dz_2} + \frac{\partial^2 W(z_2, q_2(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial q \partial z_2}\frac{dq_2}{dz_1} + \frac{d\overline{p}_1}{dz_1}\frac{\partial q_1(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial z_2} + \frac{d\overline{p}_2}{dz_2}\frac{\partial q_2(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial z_1}$. In a symmetric equilibrium $\frac{\partial q_j}{\partial z_{-j}} > 0$, and $\frac{\partial q_j}{\partial p_i}\frac{\partial \overline{p}_j}{\partial z_j} + \frac{\partial q_j}{\partial p_{-j}}\frac{\partial \overline{p}_{-j}}{\partial z_j} \leq 0$. Note that $\frac{\partial^2 F}{\partial z_1 \partial z_2}$ can be written as $\frac{\partial q_1}{\partial z_2}\left(\frac{\partial^2 W(z_1, q_1(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial q \partial z_1} + \frac{d\overline{p}_1}{dz_1}\right) + \frac{\partial q_2}{\partial z_1}\left(\frac{\partial^2 W(z_2, q_2(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial q \partial z_2} + \frac{d\overline{p}_2}{dz_2}\right) + \sum_{j=1}^{2}\frac{\partial^2 W(z_j, q_j(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial q \partial z_j}\left(\frac{\partial q_j}{\partial p_j}\frac{\partial \overline{p}_j}{\partial z_j} + \frac{\partial q_j}{\partial p_{-j}}\frac{\partial \overline{p}_{-j}}{\partial z_j}\right)$. Under assumptions (6) or (7) and (8), all terms in the last expression are non-negative, and F has increasing differences in (z_1, z_2).

Now, we want to show that F has increasing (decreasing) differences in (z_1, d). Mixed derivative $\frac{\partial^2 F}{\partial z_1 \partial d}$ is equal to $\frac{d^2 W(z_1, q_1(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{dz_1 dd} + \frac{d^2 W(z_2, q_2(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{dz_1 dd} + \frac{d^2 \overline{\pi}_1(\mathbf{z})}{dz_1 dd} + \frac{d^2 \overline{\pi}_2(\mathbf{z})}{dz_1 dd}$. This expression can be written as $\frac{\partial^2 W(z_1, q_1(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial z_1 \partial q}\frac{dq_1}{dd} + \frac{\partial^2 W(z_1, q_1(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial q^2}\frac{dq_1}{dz_1}\frac{dq_1}{dd} + \frac{\partial^2 W(z_2, q_2(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial q^2}\frac{dq_2}{dz_1}\frac{dq_2}{dd} - \frac{dq_1}{dz_1} - \frac{dq_2}{dz_1}$ which is equal to $\frac{\partial^2 W(z_1, q_1(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial z_1 \partial q}\frac{dq_1}{dd}$ in a symmetric equilibrium. Note also that $\frac{dq_1}{dd} =$

$\frac{\partial q_1}{\partial p_1}\frac{\partial \overline{p}_1}{\partial d}+\frac{\partial q_1}{\partial p_2}\frac{\partial \overline{p}_2}{\partial d}\leq 0$, as $\left|\frac{\partial q_1}{\partial p_1}\right|\geq\left|\frac{\partial q_1}{\partial p_2}\right|$. As a result, $\frac{\partial^2 F}{\partial z_1 \partial d}$ is non-negative if $\frac{\partial^2 W(z_1,q_1(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial z_1 \partial q}\leq 0$, and vice versa. So, F has increasing (decreasing) differences in (z_1,d) if $\frac{\partial^2 W(z_1,q_1(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial z_1 \partial q}\leq 0$ ($\frac{\partial^2 W(z_1,q_1(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}))}{\partial z_1 \partial q}\geq 0$). The supermodularity of F implies that each $\widetilde{z}_j$ is increasing (decreasing) function of d if (6) is satisfied ((7) and (8) are satisfied). Similarly, each $\widetilde{z}_j$ is decreasing (increasing) function of a if (6) is satisfied ((7) and (8) are satisfied). .

Two special interest groups, two media outlets

$$\max_{\mathbf{z}}\sum_{j=1,2}W_i(z_j,q_j(\overline{p}_j(\mathbf{z}),\mathbf{z}))-c_{ij},\ i\in\{1,2\} \tag{19}$$
$$s.t.\ \pi_j(\overline{p}_j(\mathbf{z}),\mathbf{z},C_{ij}(\mathbf{z})),C_{-i,j}(\mathbf{z})))\geq\pi(\overline{p}_{-i,j}(\widetilde{\mathbf{z}}_{-i}),\widetilde{\mathbf{z}}_{-i},0,C_{-i,j}(\widetilde{\mathbf{z}}_{-i})),\ j\in\{1,2\}$$

Note first that at the optimal point, a special interest group does not pay more than necessary to the media outlet, so the constraint in the problem (19) is binding, and $\pi_j(\overline{p}_j(\mathbf{z}),\mathbf{z},C_{ij}(\mathbf{z})),C_{-i,j}(\mathbf{z})))=\pi_j(\overline{p}_{-i,j}(\widetilde{\mathbf{z}}_{-i}),\widetilde{\mathbf{z}}_{-i},0,C_{-i,j}(\widetilde{\mathbf{z}}_{-i}))$. As a result, $C_{ij}(\mathbf{z})=\pi_j(\overline{p}_{-i,j}(\widetilde{\mathbf{z}}_{-i}),\widetilde{\mathbf{z}}_{-i},0,C_{-i,j}(\widetilde{\mathbf{z}}_{-i}))-(\overline{p}_j(\mathbf{z})+a-d)q_j(\overline{p}_j(\mathbf{z}),\mathbf{z})-C_{-i,j}(\mathbf{z})$. Therefore, the problem (19) of special interest group i can be rewritten as

$$\max_{\mathbf{z}}\sum_{j=1,2}\left[W_i(z_j,q_j(\overline{p}_j(\mathbf{z}),\mathbf{z}))-\pi_j(\overline{p}_{-i,j}(\widetilde{\mathbf{z}}_{-i}),\widetilde{\mathbf{z}}_{-i},0,C_{-i,j}(\widetilde{\mathbf{z}}_{-i}))+(\overline{p}_j(\mathbf{z})+a-d)q_j(\overline{p}_j(\mathbf{z}),\mathbf{z})+C_{-i,j}(\mathbf{z})\right]$$

As $-\pi_j(\overline{p}_{-i,j}(\widetilde{\mathbf{z}}_{-i}),\widetilde{\mathbf{z}}_{-i},0,C_{-i,j}(\widetilde{\mathbf{z}}_{-i}))$ does not depend on z, this problem is equivalent to

$$\max_{\mathbf{z}}\sum_{j=1,2}\left[W_i(z_j,q_j(\overline{p}_j(\mathbf{z}),\mathbf{z}))+(\overline{p}_j(\mathbf{z})+a-d)q_j(\overline{p}_j(\mathbf{z}),\mathbf{z})+C_{-i,j}(\mathbf{z})\right]$$

The first order conditions for this problem is

$$\frac{\partial W_i(z_j,q_j(\overline{p}_j(\mathbf{z}),\mathbf{z}))}{\partial z_j}+\frac{\partial W_i(z_j,q_j(\overline{p}_j(\mathbf{z}),\mathbf{z}))}{\partial q}\frac{dq_j(\overline{p}_j(\mathbf{z}),\mathbf{z})}{dz_j}+(\overline{p}_j(\mathbf{z})+a-d)\frac{dq_j(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z})}{\partial z_j}+\frac{\partial p_j(\mathbf{z})}{\partial z_j}q_j(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z}) \tag{20}$$
$$+\frac{\partial p_{-j}(\mathbf{z})}{\partial z_j}q_j(\overline{\mathbf{p}}(\mathbf{z}),\mathbf{z})+\frac{\partial C_{-i,j}(\mathbf{z})}{\partial z_j}=0,\ j\in\{1,2\}$$

The system of equations (20) for $i=1,2$ gives the solution for the problem (19) if Hessian matrix for each pair of conditions is positively semi-definite.

Also, $\widetilde{\mathbf{z}}$, the solution of (20), solves the profit maximization problem of each media outlet:

$$\max_{z_j}(\overline{p}_j(\mathbf{z}) + a - d)q_j(\overline{p}_j(\mathbf{z}), \mathbf{z}) + \sum_{i=1,2} C_{ij}(\mathbf{z})$$

First order condition for this problem is

$$(\overline{p}_j(\mathbf{z}) + a - d)\frac{dq_j(\overline{p}_j(\mathbf{z}), \mathbf{z})}{\partial z_j} + \frac{\partial p_j(\mathbf{z})}{\partial z_j} q_j(\overline{p}_j(\mathbf{z}), \mathbf{z}) + \frac{\partial C_{1j}(\mathbf{z})}{\partial z_j} + \frac{\partial C_{2j}(\mathbf{z})}{\partial z_j} = 0 \tag{21}$$

If we combine (21) and (20), we obtain that $\widetilde{\mathbf{z}}$, the solution of (19), also solves the following problem

$$\max_{\mathbf{z}} \sum_{i=1,2} \sum_{j=1,2} \left[W_i(z_j, q_j(\overline{p}_j(\mathbf{z}), \mathbf{z})) + (\overline{p}_j(\mathbf{z}) + a - d)q_j(\overline{p}_j(\mathbf{z}), \mathbf{z})\right]$$

This result is similar to Grossman and Helpman (1994) efficiency result, extended for the case of several interest groups.

First order conditions are

$$\frac{\partial W_i(z_j, q_j(\overline{p}_j(\mathbf{z}), \mathbf{z}))}{\partial z_j} + \frac{\partial W_i(z_j, q_j(\overline{p}_j(\mathbf{z}), \mathbf{z}))}{\partial q} \frac{dq_j(\overline{p}_j(\mathbf{z}), \mathbf{z})}{dz_j} + \frac{\partial W_i(z_j, q_j(\overline{p}_j(\mathbf{z}), \mathbf{z}))}{\partial z_j} + \frac{\partial W_i(z_j, q_j(\overline{p}_j(\mathbf{z}), \mathbf{z}))}{\partial q} \frac{dq_j(\overline{p}_j(\mathbf{z}), \mathbf{z})}{dz_j} +$$
$$(\overline{p}_j(\mathbf{z}) + a - d)\frac{dq_j(\overline{\mathbf{p}}_j(\mathbf{z}), \mathbf{z})}{\partial z_j} + \frac{\partial p_j(\mathbf{z})}{\partial z_j} q_j(\overline{\mathbf{p}}(\mathbf{z}), \mathbf{z}) + \frac{\partial p_{-j}(\mathbf{z})}{\partial z_j} q_j(\overline{\mathbf{p}}(\mathbf{z}), \mathbf{z}) +$$
$$(\overline{p}_{-j}(\mathbf{z}) + a - d)\frac{dq_{-j}(\overline{\mathbf{p}}(\mathbf{z}), \mathbf{z})}{\partial z_j} + \frac{\partial p_{-j}(\mathbf{z})}{\partial z_j} q_{-j}(\overline{\mathbf{p}}(\mathbf{z}), \mathbf{z}) + \frac{\partial p_j(\mathbf{z})}{\partial z_j} q_{-j}(\overline{\mathbf{p}}(\mathbf{z}), \mathbf{z}) = 0, \ j \in \{1, 2\}$$

Now, we can find the derivatives of $\widetilde{\mathbf{z}}$ with respect to parameters using an implicit function theorem. For the case of aligned interests (preferred points of both interest groups are to positive), the proof is the same as for the case of a single special interest group. For the case of misaligned interests, note that subsidies to media outlets from the other side of coverage are not permitted, so the problem of each interest group could be simplified to $\max_{\mathbf{z}} W_i(z_i, q_i(\overline{\mathbf{p}}(\mathbf{z}), \mathbf{z})) + (\overline{p}_j(\mathbf{z}) + a - d)q_j(\overline{\mathbf{p}}(\mathbf{z}), \mathbf{z}) + C_{-i,i}(\mathbf{z})$, which is reduced to the problem in the previous subsection. ■

Proof of proposition 6. The problem of special interest group i is

$$\begin{aligned}
&\sum_{j=1}^{M}\left[W_{ij}(z_j, q(z_j, \mathbf{z}_{-j})) - c_j\right] \to \max_{z_1,\dots z M} \\
&s.t. \qquad\qquad (22)\\
&c_j \geq \max_{z_j} \pi(z_j, \mathbf{z}_{-j}, \mathbf{C}_{-i}(\cdot)) - \pi(z_j, \mathbf{z}_{-j}) = \pi(z_j^*, \mathbf{z}_{-j}, \mathbf{C}_{-i}(\cdot)) - \pi(z_j, \mathbf{z}_{-j}, \mathbf{C}_{-i}(\cdot)),\ j = 1, .., M \\
&\sum_{j=1}^{M} c_j \leq \frac{\overline{C}}{N}
\end{aligned}$$

Note that it is not profitable for a special interest group to pay media outlet more than it is necessary to get desired coverage z_j. So, this problem is equivalent to

$$\begin{aligned}
&\sum_{j=1}^{M}\left[W_{ij}(z_j, q(z_j, \mathbf{z}_{-j})) - c_j\right] \to \max_{z_1,\dots z M} \\
&s.t. \qquad\qquad (23)\\
&\sum_{j=1}^{M}\left[\pi(z_j^*, \mathbf{z}_{-j}, \mathbf{C}_{-i}(\cdot)) - \pi(z_j, \mathbf{z}_{-j}, \mathbf{C}_{-i}(\cdot))\right] \leq \frac{\overline{C}}{N}
\end{aligned}$$

The solution of this problem is described by Kuhn-Tucker conditions:

$$\frac{\partial W_{ij}(z_j, q(z_j, \mathbf{z}_{-j}))}{\partial z_j} + \sum_{k \neq j} \frac{\partial W_{ik}(z_k, q(z_k, \mathbf{z}_{-k}))}{\partial q}\frac{\partial q_k}{\partial z_j} + \lambda \sum_{j \neq i} \frac{\partial \pi(z_k^*, \mathbf{z}_{-k}, \mathbf{C}_{-i}(\cdot))}{\partial z_j} - \lambda \sum_{j=1}^{M} \frac{\partial \pi(z_k, \mathbf{z}_{-k}, \mathbf{C}_{-i}(\cdot))}{\partial z_j} = 0,\ j = 1, .., M$$

$$\lambda\left(\sum_{j=1}^{M}\left[\pi(z_j^*, \mathbf{z}_{-j}, \mathbf{C}_{-i}(\cdot)) - \pi(z_j, \mathbf{z}_{-j}, \mathbf{C}_{-i}(\cdot))\right] - \frac{\overline{C}}{N}\right) = 0$$

The solution of this problem is the best response of special interest group i to strategies chosen by the others $\mathbf{C}_{-i}(\cdot)$, here $i = 1, ..., N$. Note that for a given set of functions $\pi(z_j^*, \mathbf{z}_{-j}, \mathbf{C}_{-i}(\cdot))$, when best response functions are taken as given and the presence of a new special interest group does not change optimal solution, the following statement is true. If N goes up, all equilibrium z go down if special interest group i prefers positive bias (and go up if special interest group i prefers negative bias). Now, what happens if $\pi(z_j^*, \mathbf{z}_{-j}, \mathbf{C}_{-i}(\cdot))$ is not fixed? If N increases by 1, this implies that new interest group might be willing to offer contribution to some media outlets. As the preferred point of this special interest group is more extreme than the preferred

To derive comparative statics with respect to N, note that mixed derivative of Lagrangian with respect to z and N is equal to 0. ■