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Advertisement, media bias, political polarisation

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When consumers value cognitive consistency between the news they read and policies they support, politicians are induced to make policies that conform to a polarized media landscape which not only depends on user subscription for revenue but also advertisement receipts. Following Guo et. al. (2018), I develop a model to study how the dependency on advertisement revenue affects media bias, political polarisation, and voter preferences. I show that though the equilibrium prices of the two newspapers fall when they depend on advertising receipts, the difference between the equilibrium prices and thus ideological position of a marginal voter remains unchanged, compared to Guo et. Al. (2018). Moreover, the extents of political and media polarisation do not depend on newspapers' dependence on advertisement receipts. I also find that when political parties are not ideologically driven and newspapers have a stronger preference for editorial neutrality, then increase in the public's trust on the newspapers for news consumption leads to increased media and political polarisation.

1 Introduction

Media, especially news channels, play a substantial role in shaping people's opinion about the society in which they live in. News channels also play a crucial role in democracies by holding the state accountable for its actions and raising the concerns of the citizens to the state. Consequently, media is also known as the fourth pillar of a democracy.

In that case, it is the paramount responsibility of news outlets to do unbiased reporting of news and facts. However, there is ample evidence in the literature to evince that media, in most countries, are highly biased. For instance, Groseclose and Milyo (2005) found evidence suggesting that US news channels are biased towards left of the centre. There is, however, no consensus on the direction of the media bias. Goldberg (2002) and Coulter (2003) argue that the bias is in favour of the left, while Alterman (2003) and Franken (2003) argue that the bias is in favour of the right. Apart from the direction of bias, the origin of media bias is also not unanimously accepted in the current literature. In principle, media bias can originate from the supply side, and reflect the preferences of journalists (Baron, 2004), editors, and owners (Besley and Prat, 2004; Djankov et al., 2003). It can also originate from the demand side, and reflect the news providers' profit-maximising motive to cater to the demand of the consumers (Mullainathan and Shleifer, 2005). Nevertheless, media bias has far reaching consequences, especially in democracies. A biased media landscape may even influence policies designed by the political parties. A party's policies can be influenced by media firms whose ideological orientation is closer to it (Chan and Suen, 2008). Therefore, in this research project I attempt to explore the different factors that lead to media bias and political polarisation.

Mullainathan and Shleifer (2005) studied the decision to slant news contents when consumers value cognitive consistency. Guo et.al. (2018) further expanded Mullainathan and Shleifer (2005)'s work by combining Downs (1957)'s and d'Aspremont et.al.(1979)'s models. Their model captures the behaviour of political parties, media firms, voters, but ignores the influence of dependence of media firms on advertisement revenue. Chan and Suen (2008) and Gab-

szewicz et.al. (2001) take into account advertisement revenue but they leave out how such polarisation affects voter preferences. Therefore, I would examine how news channels' dependency on advertisement revenue affects media bias, political polarisation, and voter preferences.

The main focus of this study is to examine the effects of dependency on advertisement revenue on media bias, political polarisation, and voter preferences. I would add advertisement revenue to the model of Guo et.al. (2018) to see if this addition makes any modifications in the equilibrium values of their model. I am choosing the model of Guo et.al. (2018) as I find it the most comprehensive model that explains the interaction among media bias, political polarisation, and voter preferences. The authors make the duopoly assumption in the spirit of Hotelling (1929). Adding another player (advertisers) to their model would help make the model more comprehensive and would result in a 4-Stage game. At Stage 1, political parties and newspapers simultaneously choose their ideological position on a left-right political spectrum. At Stage 2, newspapers simultaneously set the prices they would charge to their customers. At Stage 3, newspapers simultaneously set the tariffs they would charge to the advertisers. Finally, at Stage 4, voters consume news and make their voting decisions.

Analysing the role advertisement receipts play on media bias and political polarisation is crucial. It could help us rethink about the extent to which commercialisation has affected the news channels and politics, especially in large democracies. Such analysis can also help in designing policies regarding whether advertisements should be the prime revenue source of newspapers. If yes, then are there ways to reduce media bias and political polarisation

while newspapers heavily depend on advertisement receipts? Moreover, such an analysis can be further expanded to capture more real world scenarios such as inclusion of multi-party electoral systems, autocratic systems, etc.

2   Literature Review

Economists have tried to model media polarisation and political bias for past several decades. Each model identifies one or many factors that drive(s) media polarisation. For instance, Guo et.al (2018) argue that it is the consumers need for cognitive consistency between the news they read and the policies they support that induces politicians to propose polarised policies which conform to a polarised media landscape. The theoretical foundations of the present models of media bias and political polarisation largely come from model's like Hotelling (1927) and d'Aspremont et.al. (1979). Hotelling's model concludes that firms in a duopoly that are selling identical commodities and are facing linear transportation costs, inevitably converge to the centre (to maximise the number of customers) and minimal product differentiation happens. d'Aspremont et.al. (1979), however, challenged the linear transportation cost assumption of Hotelling's model. They assumed transportation costs are quadratic with respect to distance. Consequently, d'Aspremont et.al (1979) reach to the conclusion that both sellers in a duopoly have a tendency to maximise their differentiation, thus countering Hotelling's conclusion. Brenner (2005) also further expanded Hotelling's model by relaxing the duopoly assumption. He argued that with quadratic transportation costs, when the number of firms is greater than 2, firms neither maximise nor minimise differentiation. Increasing the number of firms, however, is advantageous for the firms at the corner (Brenner, 2005). Hence, hinting towards the fact that biased media may have an economic advantage over unbiased or centrist media platforms.

In a major contribution to the field of political economy, Downs (1957) argues that tendency of political parties in a two-party system to resemble each other and converge their policies to the median voter can be explained as efficient reactions to imperfect information in a large democracy. Downs (1957) argues that we live in a world where all agents (consumers and governments) have imperfect information about each other and the cost of obtaining information to be perfectly knowledgeable far outweighs the benefits from such information as the probability of one perfectly informed vote determining the election outcome is statistically zero. So, individuals have incentive to let persuaders (like news channels) to bridge the information gap. Persuaders, however, can report facts in a biased manner to suit the political group they support in exchange of policy favours. So, Downs (1957) provides key insights into the interaction between media and politics. But Downs (1957) does not explore the importance of ownership or source of revenue of these Persuaders. Guo et. al (2018) combined the approach of d'Aspremont et.al (1979) and Downs (1957) to conclude that minimal product differentiation and maximal product differentiation are only two special cases in case of media and political polarisation. When media firms are operating in a society where politics does not matter, then maximal product differentiation effectively softens competition and maximises profit (Guo et.al., 2018). When political parties are not ideologically driven and their main goal is to win elections, then political policies converge to the median voter, thus no political polarisation (Guo et.al., 2018). But in a world where political parties and media firms coexist, and political parties are not only ideologically motivated but also driven by office-motives, equilibrium ideological positions adopted by media firms and political parties are less extreme. The equilibrium ideological position of the two media

firms would be more extreme than that of the two political parties, though (Guo et.al., 2018). In their model, however, they assume that the only source of revenue the two media firms have is consumer subscription. This assumption may not necessarily be true in the real world. Media firms are heavily dependent on advertisements and derive virtually no revenue from viewers and listeners (Chan and Suen, 2008). Chan and Suen (2008) also argue that in a duopoly when media firms are commercially driven, the two media firms converge to a moderate ideological position in the equilibrium. Gabszewicz et.al. (2001) also support this conclusion of Chan and Suen (2008). They argue that as the newspaper industry depends on the possibility of financing an important fraction of its activities by advertising receipts, the editors of the newspapers moderate the political message they convey to their readers. Gabszewicz et.al. (2001) mentions that when media firms depend on advertising revenue, the editors tend to present a similar centrist image to their readers. The intuition behind this result is that the editors have to sell centrist and tasteless political messages to their readers in order to sell a larger audience to their advertisers (Gabszewicz et.al., 2001). But this is contrary to Chan and Suen (2008)'s and other previously mentioned authors' claims that media is heavily dependent on advertisement receipts and is highly polarised.

Mullainathan and Shleifer (2005) consider another major force that could guide media bias: reader diversity. They argue that when people value cognitive consistency, then a polarised political and media landscape may result in a more accurate picture being presented to the conscientious reader. They also find that competition among newspapers increases media bias. Greater competition among newspapers forces them to aggressively cater to the prejudices of their readers as competitors strive to divide the market (Mullainathan

and Shleifer, 2005). Hence, making news contents more biased.

3   Model

My model assumes that there are n $(n > 0)$ people living in the society, two political parties (indexed by $i = r,\ l$), and two newspaper firms (indexed by $j = 1,\ 2$). The assumptions related to political parties and newspapers are similar to that of Guo et.al. (2018). Each political party chooses a policy position such that $\alpha_r \in [0,\ 1]$ and $\alpha_l \in [-1,\ 0]$, and each of the newspapers advocate a policy position such that $\beta_1 \in [0,\ 1]$ and $\beta_2 \in [-1,\ 0]$. Like Guo et.al. (2018), I follow the duopoly assumption as it provides the simplest oligopoly framework which incorporates locations, prices, and strategic interactions. A fraction q of the population chooses a newspaper for news consumption and vote for a political party based on the policy positions advocated by their chosen newspaper and political party. Hence, for a citizen with ideological position x, the utility from voting for party i and getting news from media outlet j is:

$$U(i, j, x) = u - a(\alpha_i - x)^2 - b(\beta_j - x)^2 - c(\alpha_i - \beta_j)^2 - p_j$$

$i = r,\ l$ and $j = 1,\ 2$

where p_j is the price charged by newspaper j. The term $-a(\alpha_i - x)^2$ shows the dis-utility from voting for parties that have ideological position far from one's own ideological position. The term $-b(\beta_j - x)^2$ shows the dis-utility from subscribing to newspapers that advocate ideological positions that are far from one's own ideological position. The term $-c(\alpha_i - \beta_j)^2$ shows the dis-utility when there is a difference between the ideological positions of the newspaper one subscribed to and the political party one voted for. This term captures

the demand for cognitive consistency. Parameters a, b, and c are all positive real numbers and x is uniformly distributed on [-1, 1].

(1-q) of the population does not watch news and Z represents the fraction of (1-q) who will vote for part r. Z is uniformly distributed over 0 and 1. So, Party r wins if:

$$q.Pr(chooses\ party\ r) + (1-q)Z \geq 1/2.$$

So,

$$Pr(r\ wins) = 1/2 + q(Pr(chooses\ party\ r) - 1/2)/(1-q).$$

To ensure that the above probability is within 0 and 1, Guo et.al. (2018) assumes $q \leq 1/2$. Now, let δ and ρ represent the degree of how ideologically driven a party is and the degree of motivation a party has for winning the office, respectively. If Party r wins, then it obtains an office rent of $\rho - \delta(\alpha_r - 1)^2$. Note that the office rent reaches its maximum when $\alpha_r = 1$. This reflects the assumption that party r has policy preferences in addition to pure office winning motive. Party r chooses α_r to maximize

$$\Phi_r = Pr(r\ wins)(\rho - \delta(\alpha_r - 1)^2).$$

Similarly, party l chooses α_l to maximize

$$\Phi_l = Pr(l\ wins)(\rho - \delta(\alpha_r + 1)^2).$$

Newspapers have two main sources of revenue: user subscription and advertisement receipts. So, they also sell ad insets to advertising agencies at prices s_i, $i = 1, 2$. I will incorporate advertising agencies to my model according to

Gabszcewicz et.al.(2001). An advertiser is represented by a parameter θ where $\theta \in [0,1]$, which expresses the intensity of the advertisers' preferences for buying an inset in a newspaper. Gabszcewicz et.al.(2001) also assumes that the density of advertisers' population of type θ is constant and is equal to $4k$. Furthermore, according to Gabszcewicz et.al.(2001), D_i and R_i represent the demand function for advertising insets in newspaper i:

$$D_i(s_1, s_2) = 4k.(1 \ - \ s_i/(n.q.Pr(chooses\ newspaper\ i)))\ ;\ i = 1,\ 2$$

$$R_i(s_1, s_2) = 4k.(1 \ - \ s_i/(n.q.Pr(chooses\ newspaper\ i))).s_i\ ;\ i = 1,\ 2.$$

Gabszcewicz et.al.(2001) derives the equilibrium tariff charged by newspapers to the advertising agencies to be $s_i^* = (n.q.Pr(chooses\ newspaper\ i))/2$ resulting to the equilibrium receipts

$$R_i(s_1^*, s_2^*) = k(n.q.Pr(chooses\ newspaper\ i)).$$

Moreover, the newspapers have ideal policy positions equal to that of the median voter ($x = 0$): as suggested by Mullainathan and Shleifer (2005) one can interpret the ideological position of $x = 0$ as unbiased reporting. They suffer dis-utility when they drift away from the ideal position. But apart from ideology, newspapers are also profit maximising institutions. I assume that newspapers have two main sources of revenue: user subscription and advertisement receipts. Newspaper j wants to maximize:

$$\Pi_j \ = \ (n.q.Pr(chooses\ newspaper\ i)).[(p_j \ + \ k) - c'] - t.\beta_j^2\ ;\ j = 1,\ 2$$

where k refers to the unit receipt originating from advertising sales, p_j is price of newspaper j, and c' is the cost of producing newspaper j. For simplicity, I assume that both the newspaper firms experience the same costs of production.

4 Benchmarks

- **Politics-only case :** Guo et. al. (2018) discusses a 'politics-only' case in which b = c = 0. An indifferent citizen's ideological position is represented by $x^P = (\alpha_r + \alpha_l)/2$. Since, x is uniformly distributed over [-1,1], Pr[Chooses Party r] = $(1 - x^p)/2$. This results in the following objective function for party r:

$$\Phi_r^P = (\frac{1}{2} - \frac{q}{(1-q)} \frac{(\alpha_r + \alpha_l)}{4})(\rho - \delta(\alpha_r - 1)^2).$$

  In a symmetric equilibrium $\alpha_r = -\alpha_l \equiv \alpha^P$, so the first-order condition reduces to:

$$\frac{\partial \Phi_r^P}{\partial \alpha_r} = \frac{-q}{4(1-q)}[(\rho - \alpha^p)^2] + \delta(1 - \alpha^P) \leq 0.$$

  Solving for α^P, Guo et.al.(2018), states that there exists a δ^* such that if $\delta \leq \delta^*$ then $\alpha^P = 0$, otherwise $\alpha^P \in (0,1)$. An important takeaway from this result is that if there are no commercial media and the political parties are not ideologically driven ($\delta \leq \delta^*$), then they tend to make less extreme policies. Hence, political polarisation is reduced.

- **Media-only case :** Guo et. al. (2018) discusses another special case in which $a = c = 0$. An indifferent citizen's ideological position is represented by $x^M = \frac{b(\beta_1^2 - \beta_2^2) + (p_1 - p_2)}{2b(\beta_1 - \beta_2)}$. Guo et. al. (2018) assumes full

price coverage which results in newspaper 1's readership fraction to be $q(1 - x^M)/2$. In this case, Guo et. al. (2018) obtains $\beta^M = 1$ for a symmetric equilibrium, where $\beta_1 = -\beta_2 \equiv \beta^M$.

5 Equilibrium Locations for Newspapers and Political Parties

In this model I have assumed that a voter who supports Party r will get news from right leaning newspaper 1, and a voter who supports Party l will get news from left leaning newspaper 2. Let $\hat{x}$ represent the voter who is indifferent between (r,1) and (l,2) at stage 4 of the game. Solving for $U(r, 1, \hat{x}) = U(l, 2, \hat{x})$ gives:

$$\hat{x}(p_1, p_2) = \frac{(a + c)(\alpha_r^2 - \alpha_l^2) + (b + c)(\beta_1^2 - \beta_2^2) - 2c(\alpha_r \beta_1 - \alpha_l \beta_2) + (p_1 - p_2)}{2(a(\alpha_r - \alpha_l) + b(\beta_1 - \beta_2))}. \tag{1}$$

Since x is uniformly distributed on [-1, 1], the probability that a voter chooses to get news from newspaper 1 is equal to $(1 - \hat{x})/2$. Given this demand function, newspaper 1 chooses p_1, to maximize π_1 in stage 2:

$$\pi_1(p_1, p_2) = \frac{n.q.(1 - \hat{x})}{2}[p_1 + k - c'] - t\beta_1^2. \tag{2}$$

Similarly, newspaper 2 chooses p_2 to maximize π_2:

$$\pi_2(p_1, p_2) = \frac{n.q.(1 + \hat{x})}{2}[p_2 + k - c'] - t\beta_2^2. \tag{3}$$

At Nash equilibrium, we want

$$\frac{\partial \pi_1}{\partial p_1} = \frac{\partial \pi_2}{\partial p_2} = 0.$$

This implies:

$$p_1 = [a(\alpha_r - \alpha_l) + b(\beta_1 - \beta_2) - \frac{(a+c)(\alpha_r^2 - \alpha_l^2)}{2}$$
$$+ \frac{(b+c)(\beta_1^2 - \beta_2^2)}{2} - c(\alpha_r \beta_1 - \alpha_l \beta_2) + \frac{p_2 - k + c'}{2} \quad (4)$$

and

$$p_2 = [a(\alpha_r - \alpha_l) + b(\beta_1 - \beta_2) + \frac{(a+c)(\alpha_r^2 - \alpha_l^2)}{2}$$
$$+ \frac{(b+c)(\beta_1^2 - \beta_2^2)}{2} - c(\alpha_r \beta_1 - \alpha_l \beta_2) + \frac{p_1 - k + c'}{2}. \quad (5)$$

Solving for p_1 and p_2 in (3) and (4) I get:

$$\hat{p_2} = 2[a(\alpha_r - \alpha_l) + b(\beta_1 - \beta_2)] + \frac{(a+c)(\alpha_r^2 - \alpha_l^2)}{3} + \frac{(b+c)(\beta_1^2 - \beta_2^2)}{3}$$
$$- \frac{2c(\alpha_r \beta_1 - \alpha_l \beta_2)}{3} + c' - k \quad (6)$$

and

$$\hat{p_1} = 2[a(\alpha_r - \alpha_l) + b(\beta_1 - \beta_2)] - \frac{(a+c)(\alpha_r^2 - \alpha_l^2)}{3} + \frac{(b+c)(\beta_1^2 - \beta_2^2)}{3}$$
$$- \frac{2c(\alpha_r \beta_1 - \alpha_l \beta_2)}{3} + c' - k. \quad (7)$$

Note that the equilibrium $\hat{p}_s$ of my model are equal to the equilibrium $\hat{p}_s + k - c'$ of Guo et.al. (2018)'s model. Also, if we assume that k is greater than c', then the equilibrium prices are lower than that of Guo et.al. (2018)'s model. This implies that when newspapers' sources of revenue are advertisement receipts along with user subscription, then the equilibrium prices of the newspa-

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[0] Derivations of equations (6),(7), and (8) are included in the Appendix

pers should be lower than otherwise. This makes intuitive sense because when newspapers derive revenue from selling ad insets, they can afford to charge lower prices to their readers and still make profit.

From equations (6) and (7), we can calculate the equilibrium price differential as such:

$$\hat{p_1} - \hat{p_2} = \frac{-2(a+c)(\alpha_r^2 - \alpha_l^2) + (b+c)(\beta_1^2 - \beta_2^2) - 2c(\alpha_r\beta_1 - \alpha_l\beta_2)}{3}. \quad (8)$$

From equations (1) and (8), we know that $\hat{x}$ increases over $(p_1 - p_2)$ which remains unchanged when advertisement receipts are added to Guo et.al. (2018)'s model. This shows that newspapers' dependency on advertisement receipts do not affect the equilibrium ideological position of the voters. Substituting the values of $(\hat{p_1} - \hat{p_2})$ into equation (2), we have:

$$\tilde{x} = \hat{x}(\hat{p_1}, \hat{p_2}) = \frac{(a+c)(\alpha_r^2 - \alpha_l^2) + (b+c)(\beta_1^2 - \beta_2^2) - 2c(\alpha_r\beta_1 - \alpha_l\beta_2)}{6[a(\alpha_r - \alpha_l) + b(\beta_1 - \beta_2)]}.$$

Now, we can express the reduced form of newspaper 1's payoff function as:

$$\Pi_1 = \frac{2[a(\alpha_r - \alpha_l) + b(\beta_1 - \beta_2)].n.q.(1 - \tilde{x})^2}{2} - t\beta_1^2$$

which is equivalent to that of Guo et.al. (2018)'s model. So, the numerical calculation for the derivation of β^* would be identical to that of Guo et.al.(2018) and

$$\beta^* = min\left\{ \frac{q(3b + 2c\alpha^*)}{2q(b+c) + 6t}, 1 \right\} \quad (9)$$

where $\beta^* = \beta_1 = -\beta_2$ and $\alpha^* = \alpha_r = -\alpha_l$.

So, the addition of revenue from advertisement receipts to the model does not

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affect the equilibrium ideological positions of the newspaper firms. Now consider Party r's decision of α_r, that is facing the following objective function:

$$\Phi_r = \left(\frac{1}{2} - \frac{q}{(1-q)} \frac{\tilde{x}}{2} \right)(\rho - \delta(\alpha_r - 1)^2) .$$

In a symmetric solution, the first-order condition for Party r is given by:

$$\frac{\partial \Phi_r}{\partial \alpha_r} = \delta(1 - \alpha^*) - \frac{q}{2(1-q)}((\rho - \alpha^*)^2)\frac{(a+c)\alpha^* - c\beta^*}{6(a\alpha^* + b\beta^*)} = 0. \qquad (10)$$

Guo et.al (2018) shows the existence of a solution for equations (9) and (10). Moreover, as I mentioned earlier the value for β^* in my model and in Guo et.al (2018)'s model are the same. As the value of α^* is a function of β^* among other parameters, it will be identical as well. So, my model extends Guo et.al (2018)'s model by showing that even when newspaper firms are dependent on advertisement revenues along with user subscription, the degree of political polarisation is the same as it is when user subscription is the only source of revenue for newspaper firms.

Proposition 1 of Guo et.al (2018) states that a unique solution to equations (13) and (14) exist. Moreover, in a symmetric solution,

$$0 \leq \alpha^P < \alpha^* < \beta^* \leq \beta^M = 1.$$

$\alpha^* > \alpha^P$ implies that the presence of commercial media tends to pull the political parties toward more extreme policy positions (Guo et.al, 2018). I have shown that even when newspapers depend on advertisement receipts the degree of media and political polarisation remains unchanged. In other words, the values of α^* and β^* remain unchanged. So proposition 1 of Guo

et.al (2018)'s model holds true for this model as well.

6   Comparative Statics

In this section I will analyze the effect of change in the degree to which newspapers value editorial neutrality (t) on the equilibrium ideological positions of the political parties and the media firms. I would also analyse the effect of change in the fraction of the population that depends on newspapers for news consumption (q) on the equilibrium ideological positions of the newspapers and the political parties. Guo et.al (2018) derive the symmetric equilibrium ideological positions for political parties when $\delta_r = \delta_l = 0$ to be:

$$\beta_1^* = \frac{3(a+c)qb}{2[q(ab+c(a+b)+3t(a+c)]}, \tag{11}$$

$$\alpha_r^* = \frac{3cqb}{2[q(ab+c(a+b)+3t(a+c)]}. \tag{12}$$

Taking the derivative of equation 11 with respect to t gives us the following equation:

$$\frac{\partial \beta_1^*}{\partial t} = -\frac{3}{2}(a+c)qb\frac{1}{[q(ab+ac+bc)+3t(a+c)]^2}3(a+c)$$

$$= \frac{-9(a+c)^2qb}{2[q(ab+c(a+b)+3t(a+c)]^2}.$$

Since $q \geq 0$, a, b, c $\in$ R$^+$, and $t \in [0, qb/6]$, therefore, for all t, $\frac{\partial \beta_1^*}{\partial t} < 0$. So, when $\delta_r = \delta_l = 0$, increase in t reduces β_1^*. In other words, when political party r is purely motivated by winning elections and is completely nonpartisan in nature, then as newspapers face more dis-utility for deviating from median voter's ideological position, its equilibrium ideological stance becomes

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more neutral. In fact, since we have a symmetric equilibrium,

$$\beta_2^* = \frac{-3(a+c)qb}{2[q(ab+c(a+b))+3t(a+c)]}$$

and

$$\frac{\partial \beta_2^*}{\partial t} = \frac{3}{2}(a+c)qb\frac{1}{[q(ab+ac+bc)+3t(a+c)]^2}3(a+c)$$

$$= \frac{9(a+c)^2qb}{2[q(ab+c(a+b))+3t(a+c)]^2} > 0.$$

Therefore, β_2 increases with t. The signs of the first order derivatives of β_1^* and β_2^* with respect to t lead to an intuitive conclusion that media polarisation is negatively related to the degree to which newspapers value editorial neutrality (t)

Now let's turn to α^*. Taking the derivative of equation (12) with respect to t gives us the following equation:

$$\frac{\partial \alpha_r^*}{\partial t} = -\frac{3}{2}cqb\frac{1}{[q(ab+ac+bc)+3t(a+c)]^2}3(a+c)$$

$$= \frac{-9(a+c)cqb}{2[q(ab+c(a+b))+3t(a+c)]^2}.$$

Therefore, for all $t \in [0, qb/6]$, $\frac{\partial \alpha_r^*}{\partial t} < 0$. So, when $\delta_r = \delta_l = 0$, α_r^* falls with t. In other words, when party r is purely motivated by winning elections, increase in preference of newspapers to adhere to neutrality makes party r support less extreme policies as well. Similar to the analysis of β_1^*, because of the

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symmetric nature of the equilibrium,

$$\alpha_l^* = \frac{-3cqb}{2[q(ab + c(a + b) + 3t(a + c)]}$$

and

$$\frac{\partial \alpha_l^*}{\partial t} = \frac{3}{2}cqb\frac{1}{[q(ab + ac + bc) + 3t(a + c)]^2}3(a + c)$$

$$= \frac{9(a + c)cqb}{2[q(ab + c(a + b) + 3t(a + c)]^2} > 0.$$

Therefore, α_l increases with t. The signs of the first order derivatives of α_r^* and α_l^* with respect to t lead me to my first proposition.

Proposition 1: Political polarisation is negatively related to the degree to which newspapers value editorial neutrality (t).

In fact, proposition 1 also implies that if newspapers adhere to neutrality so will the political parties.

Apart from media firms' adherence to neutrality, the trust that people place on newspapers can also determine the ideological positions of newspapers and political parties. I operationalize this trust factor using the variable q which represents the fraction of the population that depends on the two newspapers in my model for news consumption. Taking the derivative of equation (11) with respect to q gives us the following equation:

$$\frac{\partial \beta_1^*}{\partial q} = \frac{3(a + c)b[q(ab + c(a + b)) + 3t(a + c)] - 3(a + c)qb(ab + c(a + b))}{2[q(ab + c(a + b) + 3t(a + c)]^2}$$

Proposition 2: If $t > 0$ then $\frac{\partial \beta_1^*}{\partial q} > 0$ and if $t = 0$ then $\frac{\partial \beta_1^*}{\partial q} = 0$.

Proposition 2 implies that when political parties are not ideologically motivated (i.e. $\delta_r = \delta_l = 0$) and newspapers face dis-utility for not being neutral (i.e. $t > 0$), then increase in the fraction of the population consuming news from newspapers increases media polarisation. Whereas, if newspapers do not face dis-utility for not being neutral (i.e. $t = 0$), then increase in the fraction of the population consuming news from newspapers does not affect media polarisation.

Moreover, taking the derivative of equation 12 with respect to q gives us the following result:

$$\frac{\partial \alpha_r^*}{\partial q} = \frac{3bc[q(ab + c(a + b)) + 3t(a + c)] - 3cqb(ab + c(a + b))}{2[q(ab + c(a + b)) + 3t(a + c)]^2}$$

Proposition 3: If $t > 0$ then $\frac{\partial \alpha_r^*}{\partial q} > 0$ and if $t = 0$ then $\frac{\partial \alpha_r^*}{\partial q} = 0$.

In other words, when political when political parties are not ideologically motivated (i.e. $\delta_r = \delta_l = 0$) and newspapers face dis-utility for not being neutral (i.e. $t > 0$), then increase in the fraction of the population consuming news from newspapers increases political polarisation. Whereas, if newspapers do not face dis-utility for not being neutral (i.e. $t = 0$), then increase in the fraction of the population consuming news from newspapers does not affect political polarisation.

7   Conclusion

Following Guo et. al. (2018)'s and Gabszcewicz et.al.(2001)'s models I have shown that when newspaper firms depend on advertisement receipts political and media polarisation happen and the extent of the polarisation is the same as when the newspaper firms do not depend on advertisement revenue. The analysis also shows that the equilibrium prices of the two newspapers fall when they depend on advertising receipts. However, the difference between the equilibrium prices do not change as compared to Guo et. al. (2018)'s model. Since, the equilibrium ideological position of a marginal voter is a function of the price difference, it remains unchanged as well. So, I have shown that the conclusions made by the model of Guo et.al. (2018) are robust to newspapers depending on advertisement revenue. Moreover, my analysis also shows that when political parties are not ideologically driven and newspapers have a stronger preference for editorial neutrality, then increase in the public's trust on the newspapers for news consumption leads to increased media bias and political polarisation

8   Bibliography

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9 Appendix

Derivation of equilibrium prices ($\hat{p_1}$ and $\hat{p_2}$)

We know that

$$\hat{x}(p_1, p_2) = \frac{(a+c)(\alpha_r^2 - \alpha_l^2) + (b+c)(\beta_1^2 - \beta_2^2) - 2c(\alpha_r \beta_1 - \alpha_l \beta_2) + (p_1 - p_2)}{2(a(\alpha_r - \alpha_l) + b(\beta_1 - \beta_2))}$$

Let

$$N' = (a+c)(\alpha_r^2 - \alpha_l^2) + (b+c)(\beta_1^2 - \beta_2^2) - 2c(\alpha_r \beta_1 - \alpha_l \beta_2)$$

and

$$N = N' + p_1 - p_2$$

Let

$$D = 2(a(\alpha_r - \alpha_l) + b(\beta_1 - \beta_2))$$

From equations (3) and (4) we have:

$$\pi_1(p_1, p_2) = \frac{n.q.(1 - \hat{x})}{2}[p_1 + k - c'] - t\beta_1^2$$

and

$$\pi_2(p_1, p_2) = \frac{n.q.(1 + \hat{x})}{2}[p_2 + k - c'] - t\beta_2^2$$

So,

$$\frac{\partial \pi_1}{\partial p_1} = \frac{n.q}{2} - \frac{n.q}{2} \left[\frac{N}{D} + \frac{p_1 + k - c'}{D} \right] = 0$$

as

$$\frac{\partial \hat{x}}{\partial p_1} = 1/D$$

Now,

$$1 - \frac{N}{D} - \frac{p_1 + k - c'}{D} = 0$$

$$1 - \frac{N' + p_1 - p_2}{D} - \frac{p_1 + k - c'}{D} = 0$$

$$D - N' - p_1 + p_2 - p_1 - k - c' = 0$$

Therefore,

$$p_1 = \frac{D - N' +' p_2 - k + c'}{2} \tag{A1}$$

Moreover,

$$\frac{\partial \pi_2}{\partial p_2} = \frac{n.q}{2} + \frac{n.q}{2} \left[\frac{N}{D} - \frac{p_2 + k - c'}{D} \right] = 0$$

as

$$\frac{\partial \hat{x}}{\partial p_2} = 1/D$$

Now,

$$1 - \frac{N}{D} - \frac{p_2 + k - c'}{D} = 0$$

$$1 - \frac{N' + p_1 - p_2}{D} - \frac{p_2 + k - c'}{D} = 0$$

$$D + N' + p_1 - p_2 - p_2 - k + c' = 0$$

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Therefore,

$$p_2 = \frac{D + N' +' p_1 - k + c'}{2} \tag{A2}$$

By (A1) and (A2) we have:

$$\frac{D + N'}{2} + \frac{D - N' + p_2 - k + c'}{4} + \frac{c' - k}{2} = \hat{p_2}$$

$$\frac{2(D + N')}{4} + \frac{D - N'}{4} + \frac{c' - k}{4} + \frac{2(c' - k)}{4} = \frac{3\hat{p_2}}{4}$$

$$3D + N' + 3c' - 3k = 3\hat{p_2}$$

Therefore,

$$\hat{p_2} = D + \frac{N'}{3} + c' - k \tag{A3}$$

This implies,

$$\hat{p_2} = 2[a(\alpha_r - \alpha_l) + b(\beta_1 - \beta_2)] + \frac{(a + c)(\alpha_r^2 - \alpha_l^2)}{3} + \frac{(b + c)(\beta_1^2 - \beta_2^2)}{3}$$
$$- \frac{2c(\alpha_r\beta_1 - \alpha_l\beta_2)}{3} + c' - k$$

By (A1) and (A3) we have:

$$\frac{D - N'}{2} + \frac{D}{2} + \frac{N'}{6} + \frac{c' - k}{2} + \frac{c' - k}{2} = \hat{p_1}$$

$$D - \frac{3N'}{6} + \frac{N'}{6} + (c' - k) = \hat{p_1}$$

$$D - \frac{N'}{3} + (c' - k) = \hat{p_1}$$

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This implies,

$$\hat{p}_1 = 2[a(\alpha_r - \alpha_l) + b(\beta_1 - \beta_2)] - \frac{(a+c)(\alpha_r^2 - \alpha_l^2)}{3} + \frac{(b+c)(\beta_1^2 - \beta_2^2)}{3}$$
$$- \frac{2c(\alpha_r \beta_1 - \alpha_l \beta_2)}{3} + c' - k$$

Hence,

$$\hat{p}_1 - \hat{p}_2 = \frac{-2N'}{3} = -2\left[\frac{(a+c)(\alpha_r^2 - \alpha_l^2) + (b+c)(\beta_1^2 - \beta_2^2) - 2c(\alpha_r \beta_1 - \alpha_l \beta_2)}{3}\right]$$