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The Impact of Media on Voting Behaviour:

A Game-Theoretic Approach

Master Thesis International Economics

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SUMMARY

In this paper, I develop a game-theoretic model to examine the effect of information provided by media on voting behaviour. Empirical research suggests the impact of media on election outcomes to be quite significant. The aim of this paper is to see whether these empirical findings are supported by theoretical evidence. To this end, I extend the model of social image theory developed by Swank (2019), which explains voting behaviour by means of social image concerns, by allowing for a public figure sharing his opinion with the public. Under the assumption that citizens attach significant value to the information provided by the public figure, the model shows that public information can change voting behaviour by hindering communication between citizens. In addition to supporting the empirical results obtained in previous research, the model therefore sheds light on a possible mechanism underlying the influence of media on election outcomes.

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1. Introduction

The election of Donald Trump as president of the United States on November 8th 2016, soon after the Brexit vote in June earlier that year, marked the beginning of a turbulent period in world politics. Apart from serving as a wake-up call for the establishment, it reignited the debate on the impact of media on election outcomes. Although recent developments on the political scene are likely to be related to a multitude of challenges that characterises the Western world since the economic crisis of 2008, including the arduous recovery of the economy, the economic inequalities intensified by globalisation, and the floods of refugees, the role of media should not be neglected. Trump's election underscores the significant influence of mass media, such as Fox News, on election outcomes.

Previous empirical research has examined the impact of different media types on voting behaviour. Radio (Hall and Capella, 2002), newspapers (Gerber et al., 2009 and Snyder and Strömberg, 2010), and television (Gentzkow, 2006 and DellaVigna and Kaplan, 2006) are all found to play a significant role in determining election outcomes. The influence of media results mainly from the essential information they provide to citizens on political developments. This information allows citizens to form stronger opinions on the state of the world and thereby on politics (Chiang and Knight, 2011 and Dilliplane, 2014). Ultimately, in line with the game-theoretic voting model of social image theory (Swank, 2019) stronger opinions increase the probability that citizens go out to vote (Mutz, 2002). Altogether, the existing empirical research suggests that media influence voting behaviour by affecting citizens' opinions.

The aim of this paper is to see whether these empirical findings are supported by theoretical evidence. I develop a game-theoretic model that examines the impact of the media on voting behaviour. To this end, I build further on the model of social image theory developed by Swank (2019). This game-theoretic model argues that voting behaviour is not driven by a citizen's belief to be able to influence the election outcome. Instead, it explains voting by means of citizens' social image concerns, in line with the findings of Gerber et al. (2008). The concerns included in the model are reputation, pride, and shame. The interplay of these three social concerns ultimately determine a citizen's voting behaviour. Voting behaviour in this model consists of communication with neighbours, opinion forming, and the turnout decision. By affecting the relative importance of each social concern, opinions play a central role in this model. Therefore, the model of social image theory provides the necessary fundamentals for a model that addresses the impact of information provided by media on voting behaviour. After all, this information affects voting behaviour by influencing opinions. To include media in the model, I add a public figure that conveys his view of the world to the public. This public figure represents the media. By determining which equilibria exist in the presence of information provided by this public figure, we can derive how media affect voting behaviour through opinion forming in a game-theoretical setting.

The paper is structured as follows. Section 2 gives an overview of relevant literature. The model is described in section 3 and analysed in section 4. Section 5 discusses and concludes.

2. Related Literature

Politically relevant information is typically conveyed to the electorate through the media. Overall, there is broad agreement among researchers that media influence voting behaviour and have a positive impact on voter turnout. Gerber et al. (2009) studied the difference in voting behaviour between people who received a daily newspaper and people who did not. They find that exposure to media, in their case a newspaper, increases voter turnout. This is in line with the finding of Gentzkow (2006) that the drop in American voter turnout from 1950 onwards is related to a significant decrease in the consumption of newspapers. The most important mechanism underlying the positive effect of media on voter turnout is the information they provide to the voter (Chiang & Knight, 2011 and Baek, 2009). Information on political issues helps citizens form an opinion. Mondak (1995) shows that actual knowledge on politics does not increase so much as a result of newspapers, but that it predominantly increases the self-perceived knowledge of voters, which is most relevant when explaining voting behaviour.

Especially politically slanted media is likely to affect citizens' opinions on political issues (Hall and Capella, 2002). DellaVigna and Kaplan (2006), who examine the impact of the introduction of Fox News in several American states on voter turnout, find the politically slanted Fox News to have a positive influence on the extensive margin of voting. The extensive margin in this case is the change in the number of people that vote for the party favoured by Fox News. The effect on the intensive margin, i.e. the change in opinion strength of people who already planned to vote for this party, is not measured. Similarly, Dilliplane (2014) shows that partisan news exposure positively influences the vote share obtained by the party supported. He finds that such exposure increases the likelihood that citizens with a weak opinion are reactivated to vote for their own party. The opposite is true as well. When citizens are consistently exposed to news channels that favour the opposing party, they are less likely to vote for their own party and more likely to vote for the opposing party (Dilliplane, 2014). Thus, politically biased media can both reinforce and converse voters' preferences.

We now discuss what, according to previous research, determines the magnitude of this influence.

2.1. The Role of the Medium

In general, all media increase voting turnout simply by providing information. Mondak (1995) argues that the medium through which people receive their information, whether this is television, newspaper, or radio, does not matter. Nevertheless, there has been some ambiguity about the role of television, as its correlation to voter turnout has often been found to be negative. However, it is important to be careful when interpreting this finding. It is a misconception that exposure to political information provided by television reduces, by itself, voter turnout. Instead, two side effects that are inherent to television must be taken into account. The explanation for the finding that higher television exposure results in a lower turnout is therefore twofold.

Firstly, television is often more focused on a mass, rather than a local, public due to the high fixed production costs (Oberholzer-Gee and Waldfogel, 2009). In addition, it crowds out local broadcasting (George and Waldfogel, 2006), which is essential for civic engagement in local elections. As national television results in less information provision on local politics, an increase in national television consumption leads to a decline in voter turnout in local elections. George and Waldfogel (2006) and Snyder and Strömberg (2010) find a similar effect for the rise of national newspapers.

Secondly, television provides more leisure relative to political coverage in comparison to more traditional news sources such as radio and newspaper. As a result, people will automatically spend less time consuming political information when watching television. Gentzkow (2006) argues that the decreased voter turnout which is linked to increased television exposure can largely be explained by the simultaneous drop in the consumption of media characterised by relatively more political coverage.

Thus, as long as the information reaches the citizens, the medium through which politically relevant information is transmitted to the public does not matter for its influence on voting behaviour. Therefore, we assume in the model that there exists only one way in which the public figure can convey his opinion to the people, which is through a message.

2.2. The Importance of Credibility

Furthermore, the literature suggests that perceived credibility of the news source is important for the magnitude of its influence. Leeson (2008) shows that when the media are mainly controlled by the government, political engagement in a country is found to be lower. Overall, citizens trust the media less under such circumstances. He discusses the possibility that this low level of trust would have a negative effect on the extent to which citizens base their opinions on the information provided by this type of media. Consequently, voter turnout is lower as citizens experience a lack of (trustworthy) information concerning the upcoming election. In line with Leeson (2008), Chiang and Knight (2011) stress the importance of credibility of political endorsements published in newspapers. The more reliable an endorsement is perceived by the voters, the bigger its influence.

Overall, the literature suggests that credibility is important for media to be influential. The model will assume that the information provided by the public figure is considered trustworthy. This results from the premises that this person has an ability which is higher than any citizen, and that he will always send his true message to the public.

2.3. The Impact of Prior Knowledge

Generally, media influence on voter behaviour is found to be stronger for undecided voters, who do not hold strong opinions concerning the upcoming election (Kahn and Kenney, 1999 and Chiang and Knight, 2011). These are people who generally have less interest in, and less knowledge of, politics. Baum (2005) shows that politically aware citizens are not easily influenced by media when it comes to their opinions or voting behaviour. In contrast, apolitical audiences are easily persuadable. Since this share of the population is quite large and often overlooked, the impact of politically biased media on voting behaviour can be substantial (Baum, 2005).

Furthermore, Enikilopov et al. (2011) demonstrate that in the case of Russia, where most media are state-owned and the political landscape consists mostly of short-lived opposition parties, the impact of independent media on voting behaviour is considerable. The unstable political landscape causes most citizens to be poorly informed on political parties. Therefore, citizens are relatively strongly influenced by information provided by independent television. Enikilopov et al. (2011) show that exposure to (the scarce) independent television that favours opposition parties in Russia significantly increased the success of the opposition while it decreased the vote share obtained by the pro-government party.

Thus, generally speaking, media influence is strongest for poorly informed citizens, as media constitute their main source of information. In our model, we assume that citizens are sufficiently undecided to take the information provided by the public figure into account in their opinion forming process.

3. Model

The model is largely based on the model of social image theory developed by Swank (2019). The main difference lies in the existence of a public figure communicating his opinion to the public.

- In this model we consider an election in which citizens can vote for a policy $x \in \{0, 1\}$. The payoff citizens get from the outcome of the election is wx, in which w is the state of the world, with $w \in \{-1, 1\}$. The probability that $w = 1$ equals z, which is assumed to be $\frac{1}{2}$. Clearly, if $w = -1$ ($w = 1$) citizens' utility is highest when $x = 0$ ($x = 1$).
- An infinite amount of neighbourhoods makes up the constituency of the election. Each neighbourhood consists of two citizens, citizen i and $-i$. Citizens within a neighbourhood are assumed to be homogenous. However, neighbourhoods are heterogeneous, differing in the probability that their citizens have a high ability. The neighbourhood is considered the playing field of the game, in which the communication and turnout strategy are determined. The model will be described from the viewpoint of citizen i. Since citizens within a neighbourhood are homogenous, the same description applies to both citizens.
- A public figure, representing the media, which we will call agent A, receives a signal $s_A \in \{-1, 1\}$ about the state of the world w. The probability that his signal is correct, $\Pr(w = s_A)$, equals α, which can be considered the ability of agent A. It is assumed that agent A's ability is common knowledge. As discussed in the literature review, we assume that the public figure is considered credible by the citizens. Therefore we assume that $\alpha > \frac{1}{2}$. In addition, after receiving signal s_A, we assume that agent A reveals his true signal to both citizens i and $-i$ through message m_A. Thus, $m_A = s_A$.
- Citizen i receives a private signal $s_i \in \{-1, 1\}$ about the state of the world w. The probability that this signal is correct depends on citizen i's ability a_i. A

citizen's ability is either high, $a_i = H$, or low, $a_i = L$, with $\Pr(a_i = H) = \pi$. The citizen's perceived ability determines his reputation, which is high (low) when his fellow citizen considers him as highly (less) able. Citizen i does not know whether his ability is high or low. For citizens with a high ability, the probability that their signal is correct, $\Pr(w = s_i)$, equals h, whereas for citizens with a low ability Pr $(w = s_i)$ equals l. In this model it is assumed that $\alpha > h > l \geq \frac{1}{2}$. This is known by both the agent and the citizens.

- In addition to the private signal, citizen i receives a message m_A from agent A.
- After receiving both signals, citizen i sends a cheap-talk message $m_i \in \{-1, 1\}$ to his neighbour about his private sigal s_i. He can either choose to reveal his true signal, $m_i = s_i$, or to reveal the opposite signal, $m_i = -s_i$. Citizen i receives a similar message from citizen $-i$. After the communication stage, citizen i forms an opinion $\widehat{z_i}(s_i, m_{-i}, m_A)$ about w. This opinion represents what citizen i believes is the probability that $w = 1$ and is based on Bayes' rule, $\widehat{z_i}(s_i, m_{-i}, m_A) = \Pr(w = 1 | s_i, m_{-i}, m_A)$. We define $\widehat{|z_i(s_i, m_{-i}, m_A) - \frac{1}{2}|}$ as a measure for the strength of citizen i's opinion. It follows that his opinion is weak if $\widehat{z_i}(s_i, m_{-i}, m_A)$ is close to $\frac{1}{2}$ and strong if it is close to 0 or 1. Furthermore, citizen i's opinion as perceived by citizen $-i$ is defined as $\widehat{z_i^p}(s_{-i}, m_i, m_A)$, and citizen i's expectation about $-i$'s belief about i's opinion as $E_i[\widehat{z_i^p}(s_{-i}, m_i, m_A)]$
$= \Pr(s_{-i} = 1 | s_i, m_A)\widehat{z_i^p}(1, m_i, m_A) + \Pr(s_{-i} = -1 | s_i, m_A)\widehat{z_i^p}(-1, m_i, m_A)$.
- Based on this information, citizen i makes his turnout decision $t \in \{0, 1\}$, where $t = 0$ means that he does not vote and $t = 1$ that he does. If citizen i decides to vote, he will make a policy decision based on his opinion. More specifically, he will vote $x = 1$ if $\widehat{z}(s_i, m_{-i}, m_A) > \frac{1}{2}$, $x = 0$ if $\widehat{z}(s_i, m_{-i}, m_A) < \frac{1}{2}$, and be indifferent between $x = 1$ and $x = 0$ if $\widehat{z}(s_i, m_{-i}, m_A) = \frac{1}{2}$ in order to maximize utility received from wx. However, in this model it is assumed that this utility is negligible compared to the (dis)utility received from social concerns.
- The voting decision partly depends on citizen i's sensitivity to pride θ_1 and sensitivity to shame θ_2. A citizen experiences feelings of pride when his neighbour thinks or knows that the former has voted. Shame occurs in the opposite case, which is when a citizen expects that his neighbour thinks or knows that he did not vote. These feelings of pride and shame can be explained by the fact that voting is considered a civic duty, that should be performed by each citizen. Not fulfilling its

civic duty provokes feelings of shame, which depend positively on the strength of a citizen's opinion. This is because it is assumed that a stronger perceived opinion increases the expected likelihood to vote.

- To model whether citizen i's turnout decision is observed or not, which is important for how much pride and shame citizen i expects to experience, we introduce $k_i^p \in \{0,1\}$, where $k_i^p = 1$ denotes that citizen $-i$ does observe i's turnout decision and $k_i^p = 0$ denotes that he does not. We define κ as the probability that $k_i^p = 1$ and $\widehat{t_i^p}\left(k_i^p,\ s_{-i},\ m_i,\ m_A\right)$ as $-i$'s perception about whether i voted or not, which, if $k_i^p = 1$, equals either 0 or 1.
- We define c_i^v as the cost of voting, which is evenly distributed on the interval $[0, \overline{c}]$. It follows that $\overline{c}$ is the highest expected cost of voting. Furthermore, it is assumed that c_i^v and c_{-i}^v are not correlated.
- Finally, the utility function of citizen i is given by

$$U_i = wx + \eta E_i\left[\widehat{\pi_i^p}\ (s_{-i},\ m_i,\ m_A)\right] + \theta_1 E_i\left[\widehat{t_i^p}\left(k_i^p,\ s_{-i},\ m_i,\ m_A\right)\right]$$

$$-\theta_2 E_i\left|\widehat{z_i^p}(s_{-i},\ m_i,\ m_A) - \tfrac{1}{2}\right| \cdot \left[1 - E_i\left[\widehat{t_i^p}(k_i^p,\ s_{-i},\ m_i,\ m_A)\right]\right] - t_i c_i^v \qquad (1)$$

where wx represents the utility citizen i gets from the policy outcome. The second element captures how reputation contributes to citizen i's utility, with η indicating how sensitive citizen is to his perceived ability and $E_i\left[\widehat{\pi_i^p}\ (s_{-i},\ m_i,\ m_A)\right]$ representing i's expectation about $-i$'s perception about i's ability, given s_{-i}, m_i and m_A. In other words, this is the expected reputation that results from sending cheap-talk message m_i to his neighbour citizen $-i$. The third element captures how pride of being perceived as having voted affects utility, with θ_1 measuring citizen i's sensitivity to pride and $E_i\left[\widehat{t_i^p}\left(k_i^p,\ s_{-i},\ m_i,\ m_A\right)\right]$ representing i's expectation about $-i$'s perception about the probability that i votes, given s_{-i}, m_i and m_A. The fourth element of the equation serves as a measure for the impact of shame on expected utility. θ_2 represents citizen i's sensitivity to shame and $E_i\left|\widehat{z_i^p}(s_{-i},\ m_i,\ m_A) - \tfrac{1}{2}\right|$ represents i's expectation about $-i$'s perception about the strength of i's opinion, given s_{-i}, m_i and m_A. Finally, $t_i c_i^v$ represents citizen i's direct cost of voting.

- The game is solved using Symmetric Sequential Equilibria.

4. Analysis

There are two strategies in the model: the communication strategy, $m_i \in \{s_i, -s_i\}$, and the turnout strategy, $t_i \in \{0, 1\}$. In this section we analyse how information provided by a public figure affects these strategies.

4.1. The Turnout Decision

To identify the conditions that determine the turnout decision, we compare the payoffs for citizen i in both the case of voting, $t_i = 1$, and not voting, $t_i = 0$. Note that $1 - \kappa$ represents the probability that citizen $-i$ does not observe citizen i's voting decision, thus that $k_i^p = 0$. It follows that $E_i\left[\widehat{t_i^p}\left(k_i^p,\, s_{-i},\, m_i,\, m_A\right)\right]$ becomes $E_i\left[\widehat{t_i^p}\,(0,\, s_{-i},\, m_i,\, m_A)\right]$.

The payoff for citizen i when $t_i = 1$ equals

$$\begin{aligned}&\kappa\theta_1 + (1-\kappa)\theta_1 E_i\left[\widehat{t_i^p}(0,\, s_{-i},\, m_i,\, m_A)\right] \\ &- (1-\kappa)\theta_2 E_i\left|\widehat{z_i^p}(s_{-i},\, m_i,\, m_A) - \tfrac{1}{2}\right|\left\{1 - E_i\left[\widehat{t_i^p}(0,\, s_{-i},\, m_i,\, m_A)\right]\right\} - c_i^v.\end{aligned}$$

The payoff for citizen i when $t_i = 0$ equals

$$\begin{aligned}&(1-\kappa)\theta_1 E_i\left[\widehat{t_i^p}(0,\, s_{-i},\, m_i,\, m_A)\right] - \kappa\theta_2 E_i\left|\widehat{z_{-i}^p}(s_{-i},\, m_i,\, m_A) - \tfrac{1}{2}\right| \\ &- (1-\kappa)\theta_2 E_i\left|\widehat{z_i^p}(s_{-i},\, m_i,\, m_A) - \tfrac{1}{2}\right|\left\{1 - E_i\left[\widehat{t_i^p}(0,\, s_{-i},\, m_i,\, m_A)\right]\right\}.\end{aligned}$$

In order to find the threshold cost of voting we equate both equations. This will give us the cost of voting for which citizen i is indifferent between $t_i = 1$ and $t_i = 0$. Equating both equations (see appendix) results in

$$\kappa\left[\theta_1 + \theta_2 E_i\left|\widehat{z_{-i}^p}(s_{-i},\, m_i,\, m_A) - \tfrac{1}{2}\right|\right] = c_i^v = c^*(m_i,\, m_{-i},\, m_A) \tag{2}$$

where $c^*(m_i,\ m_{-i},\ m_A)$ represents the threshold cost that determines the turnout decision. More specifically, if $c_i^v < c^*(m_i,\ m_{-i},\ m_A)$ citizen i will decide to vote, $t_i = 1$, whereas if $c_i^v > c^*(m_i,\ m_{-i},\ m_A)$ citizen i will decide not to vote, $t_i = 0$. Finally, citizen i is indifferent between voting and not voting if $c_i^v = c^*(m_i,\ m_{-i},\ m_A)$. As a result, the higher the threshold cost of voting, $c^*(m_i,\ m_{-i},\ m_A)$, the higher the probability that $c_i^v < c^*(m_i,\ m_{-i},\ m_A)$ and therefore the likelihood that citizen i will vote. As can be seen from equation (2), the threshold cost depends positively on κ, θ_1 and θ_2, and $E_i\left|\widehat{z^p_{-i}}(s_{-i},\ m_i,\ m_A) - \frac{1}{2}\right|$. Note that $1 - \kappa$, which represents the scenario in which citizen $-i$ does not observe whether citizen i votes or not, does not matter for the turnout decision. Since citizen $-i$ does not observe the voting decision of citizen i in this case, citizen i receives the same payoff from pride and shame regardless of whether he chooses $t_i = 1$ or $t_i = 0$.

The analysis of the turnout decision shows that adding a public figure to the model does not change the turnout strategy as compared to the original model by Swank (2019). However, the equilibrium voter turnout does change. This is due to the fact that $\widehat{z^p_{-i}}(s_{-i},\ m_i,\ m_A)$ consists of three signals as opposed to two in the model without a public figure. Each citizen now knows a third signal s_A, which has a higher probability of being correct than either of the citizens signals. Remember that this is because of the assumption that $\alpha > h > l \geq \frac{1}{2}$. The implication is that perceived opinions are stronger in this model than in the original model. The agent's signal, s_A, now drives the citizen's opinion further to either 0 or 1. For example, when i and $-i$ have opposing signals, the opinion will no longer equal $\frac{1}{2}$. Instead, it will take on the value of signal s_A. Therefore, on average,

$$E_i\left|\widehat{z^p_{-i}}(s_{-i},\ m_i,\ m_A) - \tfrac{1}{2}\right| > E_i\left|\widehat{z^p_{-i}}(s_{-i},\ m_i) - \tfrac{1}{2}\right|.$$

This implies that

$$\begin{aligned} c^*(m_i,\ m_{-i},\ m_A) &= \kappa\left[\theta_1 + \theta_2 E_i\left|\widehat{z^p_{-i}}(s_{-i},\ m_i,\ m_A) - \tfrac{1}{2}\right|\right] \\ > c^*(m_i,\ m_{-i}) &= \kappa\left[\theta_1 + \theta_2 E_i\left|\widehat{z^p_{-i}}(s_{-i},\ m_i) - \tfrac{1}{2}\right|\right] . \end{aligned}$$

Since citizens vote as long as $c_i^v < c^*(m_i,\ m_{-i},\ m_A)$, it follows that equilibrium voter turnout is higher in the extended model with public information than in the original model. It is important to note that a higher probability of voting has consequences for the expected payoff of both pride and shame. This will further be discussed when determining the conditions under which information is shared.

4.2. Information Sharing and Opinion Forming

In this section we will see that the communication strategy, in contrast to the turnout strategy, does change when adding a public figure to the model. This is because the information available to citizen i in the stage before communication with his neighbour takes place, has changed. He now knows the signal of agent A, s_A, through m_A. Knowing that $\alpha > h > l \geq \frac{1}{2}$, citizen i has therefore more information on the probability that his own signal, s_i, is correct than in the model without a public figure. This impacts his incentive to share information with his neighbour.
As described in the original model by Swank (2019), the information shared by citizens determines both their reputation and their perceived opinion strength. In line with the original model, it is assumed that congruence of signals increases opinion strength while dissonance decreases opinion strength. Depending on the weight of each of the social concerns and the likelihood of voting, citizens will have an incentive to send a signal that will either increase or decrease congruence to maximise expected utility.

I will now analyse how a public signal affects information sharing and opinion forming. Assume an equilibrium in which citizens reveal their true signal, $m_i = s_i$ and $m_{-i} = s_{-i}$. In this case, both citizens possess the same information after the communication stage. This information contains their own signal, their neighbour's signal and the agent's signal. It follows that $\widehat{\pi_i^p}(s_{-i}, m_i, m_A) = \widehat{\pi_{-i}^p}(s_i, m_{-i}, m_A)$ and $\widehat{z_i}(s_i, m_{-i}, m_A) = \widehat{z_i^p}(s_{-i}, m_i, m_A)$ $= E_i\left[\widehat{z_i^p}(s_{-i}, m_i, m_A)\right]$. Lemma 1 shows how the posterior beliefs concerning abilities, opinions, and probability of voting are defined in an equilibrium where citizens reveal their true signal to each other, $m_i = s_i$ and $m_{-i} = s_{-i}$. Proofs can be found in the appendix.

Lemma 1

1. Citizens' beliefs about each other abilities

$$\widehat{\pi_i^p}(s_{-i}, s_{-i}, s_{-i}) > \widehat{\pi_i^p}(s_{-i}, -s_{-i}, -s_{-i}) > \widehat{\pi_i^p}(s_{-i}, s_{-i}, -s_{-i}) > \widehat{\pi_i^p}(s_{-i}, -s_{-i}, s_{-i}) \quad (3)$$

Remember that citizen $-i$'s belief about citizen i's ability is defined as $\widehat{\pi}_i^p(s_{-i}, m_i, m_A)$. As in the original model, signal congruence as compared to signal dissonance leads to a higher perceived reputation for being able. Furthermore, given that agent A has a higher probability of having received a correct signal than each of the citizens ($\alpha > h > l \geq \frac{1}{2}$), having the same signal as the agent positively affects a citizen's reputation for being able. This explains why

$$\widehat{\pi}_i^p(s_{-i}, -s_{-i}, -s_{-i}) > \widehat{\pi}_i^p(s_{-i}, s_{-i}, -s_{-i}).$$

2. Citizens' beliefs about their opinions

$$\begin{aligned}\widehat{z}_i(1,1,1) > \widehat{z}_i(1,-1,1) = \widehat{z}_i(-1,1,1) > \widehat{z}_i(-1,-1,1) > \widehat{z}_i(1,1,-1)\\ > \widehat{z}_i(1,-1,-1) = \widehat{z}_i(-1,1,-1) > \widehat{z}_i(-1,-1,-1) \qquad (4)\end{aligned}$$

Remember that $\widehat{z}_i(s_i, m_{-i}, m_A)$ represents what citizen i thinks is the probability that $w = 1$, given the information available. The more signals are equal to 1, the higher the probability that $w = 1$. Again, knowing that $\alpha > h > l \geq \frac{1}{2}$, agent A's opinion weighs more heavily in the opinion forming process than citizens' signals. This explains the assumption that

$$\widehat{z}_i(-1,-1,1) > \widehat{z}_i(1,1,-1).$$

3. Perceived probability that citizen i voted if $m_i = s_i$

Remember that $-i$'s perception about i's turnout decision is given by $\widehat{t}_i^p(k_i^p, s_{-i}, m_i, m_A)$ and is calculated as

$$\widehat{t}_i^p(k_i^p, s_{-i}, m_i, m_A) = \frac{c^*(m_i, m_{-i}, m_A)}{\bar{c}} = \frac{\kappa\theta_1 + \kappa\theta_2\left|\widehat{z}_i^p(s_{-i}, m_i, m_A) - \frac{1}{2}\right|}{\bar{c}}.$$

Note that if $k_i^p = 1$, the perceived probability of voting is either 0 or 1. Therefore, we only have to define the perceived probability when $k_i^p = 0$. There are four scenarios:

1) $s_A = s_{-i}$ and $s_i = s_{-i}$:

$$\widehat{t_p^i}(0,\ s_{-i},\ s_{-i},\ s_{-i}) \ = \ \frac{\kappa\theta_1 + \kappa\theta_2\left|\widehat{z_i^p}(s_{-i}, s_{-i}, s_{-i}) - \frac{1}{2}\right|}{c} \tag{5}$$

2) $s_A = s_{-i}$ and $s_i = \ -s_{-i}$:

$$\widehat{t_p^i}(0,\ s_{-i},\ -s_{-i},\ s_{-i}) \ = \ \frac{\kappa\theta_1 + \kappa\theta_2\left|\widehat{z_i^p}(s_{-i}, -s_{-i}, s_{-i}) - \frac{1}{2}\right|}{c} \tag{6}$$

3) $s_A \neq s_{-i}$ and $s_i = s_{-i}$:

$$\widehat{t_p^i}(0,\ s_{-i},\ s_{-i},\ -s_{-i}) \ = \ \frac{\kappa\theta_1 + \kappa\theta_2\left|\widehat{z_i^p}(s_{-i}, s_{-i}, -s_{-i}) - \frac{1}{2}\right|}{c} \tag{7}$$

4) $s_A \neq s_{-i}$ and $s_i = \ -s_{-i}$:

$$\widehat{t_p^i}(0,\ s_{-i},\ -s_{-i},\ -s_{-i}) \ = \ \frac{\kappa\theta_1 + \kappa\theta_2\left|\widehat{z_i^p}(s_{-i}, -s_{-i}, -s_{-i}) - \frac{1}{2}\right|}{c} \tag{8}$$

Now that the posterior beliefs are defined, we identify the conditions under which citizen i prefers $m_i = s_i$ and thereby the conditions under which he has an incentive to deviate by choosing $m_i = \ -s_i$. Citizen i has an incentive to deviate from $m_i = s_i$ if he can benefit from sending the opposite signal by either strengthening or weakening his perceived opinion. A weaker perceived opinion affects citizen i's expected utility by decreasing disutility from shame. At the same time, a weaker opinion decreases the threshold cost of voting, as can be seen from equation (2). A lower threshold cost narrows the circumstances under which citizen i would vote. Since citizens only experience feelings of shame when they do not vote, a lower threshold cost increases the likelihood of shame. In contrast, a stronger perceived opinion increases the expected likelihood of voting, and thus reduces the likelihood of shame, by increasing the threshold cost of voting. At the same time, it increases the disutility from shame when citizen i abstains from voting.

To identify the conditions under which citizen i will deviate, we compare the expected payoff from sending $m_i = s_i$ with the expected payoff from sending $m_i = \ -s_{-i}$ for each element of the utility function. Let's suppose $s_i = 1$. Knowing that $s_i = 1$, deviating means sending $m_i = \ -1$. In calculating the payoff from each element, we make a distinction between a scenario in which $s_A = 1$ and one in which $s_A = \ -1$. Furthermore, since citizen $-i$'s signal is not known by citizen i, the payoff citizen i expects to receive depends on the probability that $s_{-i} = 1$ plus the probability that $s_{-i} = \ -1$.

4.2.1. Reputation

We first look at the effect of sending $m_i = 1$ rather than $m_i = -1$ on citizen i's payoff received from reputation for being able.

If $s_A = 1$:

$$\Pr(s_{-i} = 1 | s_i = 1,\ s_A = 1)\ \eta \left[\widehat{\pi_i^p}(1, 1, 1) - \widehat{\pi_i^p}(1, -1, 1)\right]$$

$$+ \quad \Pr(s_{-i} = -1 | s_i = 1,\ s_A = 1)\ \eta \left[\widehat{\pi_i^p}(-1, 1, 1) - \widehat{\pi_i^p}(-1, -1, 1)\right] > 0 \tag{9}$$

If $s_A = -1$:

$$\Pr(s_{-i} = 1 | s_i = 1,\ s_A = -1)\ \eta \left[\widehat{\pi_i^p}(1, 1, -1) - \widehat{\pi_i^p}(1, -1, -1)\right]$$

$$+ \quad \Pr(s_{-i} = -1 | s_i = 1,\ s_A = -1)\ \eta \left[\widehat{\pi_i^p}(-1, 1, -1) - \widehat{\pi_i^p}(-1, -1, -1)\right] < 0 \tag{10}$$

Clearly, if $s_A = 1$, citizen i has no incentive to deviate. Based on the posterior beliefs as defined in lemma 1, sending $m_i = 1$ yields a strictly higher payoff than $m_i = -1$. However, when $s_A = -1$, citizen i gets a strictly higher payoff from deviating. Since $\alpha > h > l \geq \frac{1}{2}$, sending the same signal as the public figure's signal increases citizen i's reputation for being able by increasing signal congruence.

4.2.2. Pride

Secondly, we consider when citizen i will deviate seeking to increase payoff received from pride. The payoff from sending $m_i = 1$ rather than $m_i = -1$ is defined as $\theta_1\left(\frac{c^*(1,\ m_{-i},\ m_A) - c^*(-1,\ m_{-i},\ m_A)}{\bar{c}}\right)$ with threshold cost $c^*(m_i,\ m_{-i},\ m_A) = \kappa\left[\theta_1 + \theta_2 E_i \left|\widehat{z_i^p}(s_{-i},\ m_i,\ m_A) - \frac{1}{2}\right|\right]$.

Remember that the importance of pride for total utility depends on whether citizen i's turnout decision is observed or not. Therefore we make a distinction between a situation in which $k_i^p = 1$, with probability κ, and one in which $k_i^p = 0$, with probability $1 - \kappa$. However, since in both situations citizen i experiences pride, the total payoff received is calculated as $\kappa * (\textit{payoff when } k_i^p = 1) + (1 - \kappa) * (\textit{payoff when } k_i^p = 0)$.

If $s_A = 1$:

- when $k_i^p = 1$ (voting is observed):

$$\Pr(s_{-i} = 1 | s_i = 1,\ s_A = 1)\ \theta_1 \kappa\left(\frac{c^*(1,1,1) - c^*(-1,1,1)}{\bar{c}}\right)$$

$$+\Pr(s_{-i}=-1|\,s_i=1,\ s_A=1)\ \theta_1\kappa\left(\frac{c^*(1,-1,1)-c^*(-1,-1,1)}{\bar{c}}\right)$$

- when $k_i^p=0$ (voting is not observed):

$$\Pr(s_{-i}=1|\,s_i=1,\ s_A=1)\ \theta_1(1-\kappa)\left(\frac{c^*(1,1,1)-c^*(-1,1,1)}{\bar{c}}\right)$$

$$+\Pr(s_{-i}=-1|\,s_i=1,\ s_A=1)\ \theta_1(1-\kappa)\left(\frac{c^*(1,-1,1)-c^*(-1,-1,1)}{\bar{c}}\right)$$

In total the payoff from sending $m_i=1$ instead of $m_i=-1$ equals

$$\Pr(s_{-i}=1|\,s_i=1,\ s_A=1)\ \theta_1\left(\frac{c^*(1,1,1)-c^*(-1,1,1)}{\bar{c}}\right)$$

$$+\Pr(s_{-i}=-1|\,s_i=1,\ s_A=1)\ \theta_1\left(\frac{c^*(1,-1,1)-c^*(-1,-1,1)}{\bar{c}}\right)>0 \qquad (11)$$

If $s_A=-1$:

- when $k_i^p=1$ (voting is observed):

$$\Pr(s_{-i}=1|\,s_i=1,\ s_A=-1)\ \theta_1\kappa\left(\frac{c^*(1,1,-1)-c^*(-1,1,-1)}{\bar{c}}\right)$$

$$+\Pr(s_{-i}=-1|\,s_i=1,\ s_A=-1)\ \theta_1\kappa\left(\frac{c^*(1,-1,-1)-c^*(-1,-1,-1)}{\bar{c}}\right)$$

- when $k_i^p=0$ (voting is not observed):

$$\Pr(s_{-i}=1|\,s_i=1,\ s_A=-1)\ \theta_1(1-\kappa)\left(\frac{c^*(1,1,-1)-c^*(-1,1,-1)}{\bar{c}}\right)$$

$$+\Pr(s_{-i}=-1|\,s_i=1,\ s_A=-1)\ \theta_1(1-\kappa)\left(\frac{c^*(1,-1,-1)-c^*(-1,-1,-1)}{\bar{c}}\right)$$

In total the payoff from sending $m_i=1$ instead of $m_i=-1$ equals

$$\Pr(s_{-i}=1|\,s_i=1,\ s_A=-1)\ \theta_1\left(\frac{c^*(1,1,-1)-c^*(-1,1,-1)}{\bar{c}}\right)$$

$$+\Pr(s_{-i}=-1|\,s_i=1,\ s_A=-1)\ \theta_1\left(\frac{c^*(1,-1,-1)-c^*(-1,-1,-1)}{\bar{c}}\right)<0 \qquad (12)$$

Since the expected utility from pride depends positively on the likelihood of voting as perceived by citizen $-i$ given by $\widehat{t}_i^p(k_i^p,\ s_{-i},\ m_i,\ m_A)=\frac{c^*(m_i,m_{-i},m_A)}{\bar{c}}=\frac{\kappa\theta_1+\kappa\theta_2\left|\widehat{z}_i^p(s_{-i},m_i,m_A)-\frac{1}{2}\right|}{\bar{c}}$, citizen i has an incentive to increase congruence of signals. Note that, contrary to the original model, citizen i can now directly increase congruence of signals and not only probability of signal congruence. This is because citizen i now knows s_A, whereas in the original model citizen i only knows his own signal s_i. Citizen i profits from signal congruence as it increases perceived opinion strength, which in turn increases the threshold cost and thereby the perceived likelihood of voting. To maximise the expected utility from pride, citizen i will therefore send $m_i=1$ if $s_A=1$ and $m_i=-1$ if $s_A=-1$.

4.2.3. Shame

Thirdly, we look at the payoff from shame when sending $m_i=1$ instead of $m_i=-1$, which is defined as

$\theta_2\left[(1-\frac{c^*(1,\,m_{-i},\,m_A)}{c})\left|\widehat{z_i^p}(s_{-i},\ 1,\ m_A)-\frac{1}{2}\right|-(1-\frac{c^*(-1,\,m_{-i},\,m_A)}{c})\left|\widehat{z_i^p}(s_{-i},\ -1,\ m_A)-\frac{1}{2}\right|\right]$ with threshold cost $c^*(m_i,\ m_{-i},\ m_A)\ =\kappa\left[\theta_1+\theta_2 E_i\left|\widehat{z_i^p}(s_{-i},\ m_i,\ m_A)-\frac{1}{2}\right|\right]$.

As with pride, the importance of shame for total utility depends on whether citizen i's turnout decision is observed or not and total payoff is calculated as $\kappa * (payoff\ when\ k_i^p=1)\ +(1-\kappa)*(payoff\ when\ k_i^p=0)$.

If $s_A=1$:

- when $k_i^p=1$ (voting is observed):

$-\Pr(s_{-i}=1|\,s_i=1,\ s_A=1)$

$\theta_2\kappa\left[(1-\frac{c^*(1,1,1)}{c})\left|\widehat{z_i^p}(1,1,1)-\frac{1}{2}\right|-(1-\frac{c^*(-1,1,1)}{c})\left|\widehat{z_i^p}(1,-1,1)-\frac{1}{2}\right|\right]$

$-\Pr((s_{-i}=\ -1|\,s_i=1,\ s_A=1)$

$\theta_2\kappa\left[(1-\frac{c^*(1,-1,1)}{c})\left|\widehat{z_i^p}(-1,1,1)-\frac{1}{2}\right|-(1-\frac{c^*(-1,-1,1)}{c})\left|\widehat{z_i^p}(-1,-1,1)-\frac{1}{2}\right|\right]$

- when $k_i^p=0$ (voting is not observed):

$-\Pr(s_{-i}=1|\,s_i=1,\ s_A=1)$

$\theta_2(1-\kappa)\left[(1-\frac{c^*(1,1,1)}{c})\left|\widehat{z_i^p}(1,1,1)-\frac{1}{2}\right|-(1-\frac{c^*(-1,1,1)}{c})\left|\widehat{z_i^p}(1,-1,1)-\frac{1}{2}\right|\right]$

$-\Pr((s_{-i}=\ -1|\,s_i=1,\ s_A=1)$

$\theta_2(1-\kappa)\left[(1-\frac{c^*(1,-1,1)}{c})\left|\widehat{z_i^p}(-1,1,1)-\frac{1}{2}\right|-(1-\frac{c^*(-1,-1,1)}{c})\left|\widehat{z_i^p}(-1,-1,1)-\frac{1}{2}\right|\right]$

In total the payoff from sending $m_i=1$ instead of $m_i=\ -1$ equals

$-\Pr(s_{-i}=1|\,s_i=1,\ s_A=1)$

$\theta_2\left[(1-\frac{c^*(1,1,1)}{c})\left|\widehat{z_i^p}(1,1,1)-\frac{1}{2}\right|-(1-\frac{c^*(-1,1,1)}{c})\left|\widehat{z_i^p}(1,-1,1)-\frac{1}{2}\right|\right]$

$-\ \Pr((s_{-i}=\ -1|\,s_i=1,\ s_A=1)$

$$\theta_2\left[(1-\frac{c^*(1,-1,1)}{c})\left|\widehat{z_i^p}(-1,1,1)-\frac{1}{2}\right|-(1-\frac{c^*(-1,-1,1)}{c})\left|\widehat{z_i^p}(-1,-1,1)-\frac{1}{2}\right|\right] \qquad (13)$$

If $s_A=\ -1$:

- when $k_i^p=1$ (voting is observed):

$-\Pr(s_{-i}=1|\,s_i=1,\ s_A=\ -1)$

$\theta_2\kappa\left[(1-\frac{c^*(1,1,-1)}{c})\left|\widehat{z_i^p}(1,1,-1)-\frac{1}{2}\right|-(1-\frac{c^*(-1,1,-1)}{c})\left|\widehat{z_i^p}(1,-1,-1)-\frac{1}{2}\right|\right]$

$-\Pr((s_{-i}=\ -1|\,s_i=1,\ s_A=\ -1)$

$$\theta_2\kappa\left[(1-\tfrac{c^*(1,-1,-1)}{\bar{c}})\left|\widehat{z_i^p}(-1,1,-1)-\tfrac{1}{2}\right|-(1-\tfrac{c^*(-1,-1,-1)}{\bar{c}})\left|\widehat{z_i^p}(-1,-1,-1)-\tfrac{1}{2}\right|\right]$$

- when $k_i^p = 0$ (voting is not observed):

$$-\Pr(s_{-i}=1|\,s_i=1,\ s_A=-1)$$
$$\theta_2(1-\kappa)\left[(1-\tfrac{c^*(1,1,-1)}{\bar{c}})\left|\widehat{z_i^p}(1,1,-1)-\tfrac{1}{2}\right|-(1-\tfrac{c^*(-1,1,-1)}{\bar{c}})\left|\widehat{z_i^p}(1,-1,-1)-\tfrac{1}{2}\right|\right]$$
$$-\Pr((s_{-i}=-1|\,s_i=1,\ s_A=-1)$$
$$\theta_2(1-\kappa)\left[(1-\tfrac{c^*(1,-1,-1)}{\bar{c}})\left|\widehat{z_i^p}(-1,1,-1)-\tfrac{1}{2}\right|-(1-\tfrac{c^*(-1,-1,-1)}{\bar{c}})\left|\widehat{z_i^p}(-1,-1,-1)-\tfrac{1}{2}\right|\right]$$

In total the payoff from sending $m_i = 1$ instead of $m_i = -1$ equals

$$-\Pr(s_{-i}=1|\,s_i=1,\ s_A=-1)$$
$$\theta_2\left[(1-\tfrac{c^*(1,1,-1)}{\bar{c}})\left|\widehat{z_i^p}(1,1,-1)-\tfrac{1}{2}\right|-(1-\tfrac{c^*(-1,1,-1)}{\bar{c}})\left|\widehat{z_i^p}(1,-1,-1)-\tfrac{1}{2}\right|\right]$$
$$-\Pr((s_{-i}=-1|\,s_i=1,\ s_A=-1)$$
$$\theta_2\left[(1-\tfrac{c^*(1,-1,-1)}{\bar{c}})\left|\widehat{z_i^p}(-1,1,-1)-\tfrac{1}{2}\right|-(1-\tfrac{c^*(-1,-1,-1)}{\bar{c}})\left|\widehat{z_i^p}(-1,-1,-1)-\tfrac{1}{2}\right|\right]$$

(14)

As can be seen from equation (13) and (14), there are two contrasting forces determining the payoff from shame when voting. Whether sending $m_i = 1$ instead of $m_i = -1$ results in a higher payoff depends on which force dominates. On the one hand, strengthening citizen i's perceived opinion by sending $m_i = s_A$ results in a higher threshold voting cost. This implies that citizen i is more likely to vote, which would eliminate shame altogether. On the other hand, strengthening his perceived opinion also implies more shame when citizen i does not vote. Therefore, he also has an incentive to weaken his opinion by sending $m_i = -s_A$.

4.2.4. Cost of voting

Finally, we discuss how sending $m_i = 1$ rather than $m_i = -1$ affects the expected cost of voting for citizen i, which is defined as $\tfrac{1}{2}(\tfrac{[c^*(1,\,m_{-i},\,m_A)]^2}{\bar{c}}-\tfrac{[c^*(-1,\,m_{-i},\,m_A)]^2}{\bar{c}})$ with threshold cost $c^*(m_i,\ m_{-i},\ m_A)=\kappa\left[\theta_1+\theta_2 E_I\left|\widehat{z_i^p}(s_{-i},\ m_i,\ m_A)-\tfrac{1}{2}\right|\right]$.

If $s_A = 1$:

$$-\Pr(s_{-i}=1|\,s_i=1,\ s_A=1)\ \tfrac{1}{2}(\tfrac{[c^*(1,1,1)]^2}{\bar{c}}-\tfrac{[c^*(-1,1,1)]^2}{\bar{c}})$$

$$-\Pr(s_{-i} = -1 \mid s_i = 1,\ s_A = 1)\ \tfrac{1}{2}\left(\frac{[c^*(1,-1,1)]^2}{\bar{c}} - \frac{[c^*(-1,-1,1)]^2}{\bar{c}}\right) < 0 \qquad (15)$$

If $s_A = -1$:

$$-\Pr(s_{-i} = 1 \mid s_i = 1,\ s_A = -1)\ \tfrac{1}{2}\left(\frac{[c^*(1,1,-1)]^2}{\bar{c}} - \frac{[c^*(-1,1,-1)]^2}{\bar{c}}\right)$$
$$-\Pr(s_{-i} = -1 \mid s_i = 1,\ s_A = -1)\ \tfrac{1}{2}\left(\frac{[c^*(1,-1,-1)]^2}{\bar{c}} - \frac{[c^*(-1,-1,-1)]^2}{\bar{c}}\right) > 0 \qquad (16)$$

Equation (15) shows that citizen i profits from deviating if his signal equals the agent's signal. This is because deviating in this case decreases his perceived opinion strength and thereby the likelihood of voting. A lower probability of voting reduces the expected direct cost of voting, which is beneficial for citizen i's total expected payoff. In reverse, as shown by equation (16), citizen i does not profit from deviating when his signal does not equal the agent's signal. In this situation he cannot decrease the expected direct cost of voting by deviating as he cannot further weaken his perceived opinion.

4.2.5. Total expected utility

Based on the above calculations, what are the conditions under which citizen i will share information? Remember that we have assumed that $\alpha > h > l \geq \frac{1}{2}$. This assumption has important implications for information sharing. We know that citizen i can influence the level of congruence between signals depending on the message he sends to his neighbour. Whether he will want to increase or decrease this level depends on how much value he attaches to each of the social concerns, thus on η, θ_1, and θ_2.

Case 1: The weight of the social concerns is such that citizen i's expected utility depends positively on stronger opinions.

In this case, citizen i will want to increase congruence. To this end, he will send the signal that has the highest probability of being correct. I will now show how this leads to an equilibrium in which no information is shared. Consider the following scenarios.

- **Scenario 1:** $s_A = 1$

  The private signal of citizen i can either be $s_i = 1$ or $s_i = -1$.

  What message will he send to his neighbour when his own signal is equal to the agent's signal, or $s_i = s_A = 1$? We keep in mind that citizen i profits most from sending the signal that has the highest probability of being correct as he wants to increase congruence of signals. Now, citizen i knows that s_A is very likely to be correct since $\alpha > h > l \geq \frac{1}{2}$. Given that $s_i = s_A$, the probability that both signals are correct is even greater. This is because $\alpha > \frac{1}{2}$ and $h > l \geq \frac{1}{2}$, implying that $\alpha * h > (1-\alpha) * (1-h)$ and $\alpha * l > (1-\alpha) * (1-l)$. As a result, citizen i has no incentive to deviate and will thus send $m_i = 1 = s_A = s_i$.

Now what happens when $s_i = -s_A = -1$? Citizen i knows that s_A is more likely to be correct than his own signal s_i again because $\alpha > h > l \geq \frac{1}{2}$. In this case $\alpha * (1-h) > (1-\alpha) * h$ and $\alpha * (1-l) > (1-\alpha) * l$. Given that he wants to increase congruence, which is more likely when signals are correct, he will send the signal he thinks has the highest probability of being correct. Thus, he will deviate and send $m_i = 1 = s_A = -s_i$, even though his own signal is $s_i = -1$.

So in this scenario, in which citizen i wants congruence of signals, he will send $m_i = s_A$, irrespective of his own signal. Therefore, we say that his message contains no information. This can be considered as a pooling equilibrium, meaning that a citizen's actions do not reveal any information about his private signal.

- **Scenario 2:** $s_A = -1$

  A similar logic applies. Intending to increase congruence of signals and knowing that $\alpha > h > l \geq \frac{1}{2}$, citizen i will always send $m_i = s_A = -1$, irrespective of his own signal. This is because the agent's signal has the highest probability of being correct. Again, no equilibrium exists in which information is shared.

Case 2: The weight of the social concerns is such that citizen i's expected utility depends negatively on stronger opinions.

In this case we assume that citizen i profits from creating dissonance, which weakens perceived opinion strength, instead of congruence. What happens in that case? Since $\alpha > h > l \geq \frac{1}{2}$, the agent's signal s_A is always more likely to be correct than his own signal s_i. Given that citizen i wants to send the signal that has the highest probability of being incorrect in order to create signal dissonance, he will choose to send the opposite signal of the most 'correct' signal, which is s_A. This opposite signal will have a probability of being correct of only $(1-\alpha) < \frac{1}{2}$. This implies that, irrespective of s_i, citizen i will always send message $m_i = -s_A$. Again, messages contain no information.

Proposition 1

In a game where the turnout strategy is given by equation (2) and $\alpha > h > l \geq \frac{1}{2}$*, no SSE equilibrium exists in which citizens share information.*

5. Concluding Remarks

In this paper I developed a game-theoretic model to examine the impact of media on voting behaviour. Building further on the model of social image theory (Swank, 2019) that explains voting behaviour by means of social concerns, the model shows that the influence of information provided by a public figure is quite significant. The main finding of the model is that public information hinders communication between citizens as a result of social concerns. This has a few implications.

First, it implies that reputational concerns disappear in the presence of media. Since messages no longer contain information, citizens cannot deduct their neighbours' ability from it. Consequently, no reputations can be allocated in an equilibrium without information sharing. As shown in the model of Swank (2019), citizens' reputations play an important role in stimulating citizens to inform themselves about the upcoming election. In other words, they encourage citizens to become rationally knowledgeable. If reputations disappear, the probability that citizens stay rationally ignorant increases. Second, it implies that people hold relatively stronger opinions. As citizens consider the information provided by the public figure trustworthy, they attach significant value to it. Additionally, since communication between citizens is hindered in the presence of public information, the relative influence of media on citizens' opinions is larger. Third, it implies that voter turnout is higher. This is a direct result of the stronger opinions citizens hold. Analysing the exact consequences of hindered communication between citizens would be interesting for further research.

Altogether, the findings obtained in this game-theoretic model support the results of empirical research that suggest media affect voting behaviour and increase voter turnout. The main insight of this paper is that, if voting behaviour is based on social concerns, the presence of media has the capacity to hinder communication between citizens. This finding is especially interesting in light of the increasing polarisation that currently characterises the American and European electorates. Social media have allowed for more specific targeting by politicians and news sources. The result is that citizens are increasingly exposed to only one part of the available information. Since the information they receive is based on their personal characteristics, social class, or internet search history, it is plausible that citizens are mainly exposed to the information that is best aligned with their opinions. In combination with disencouraging communication, media might therefore be a contributor to the rising levels of polarisation.

Although the insights of this model are plausible, it is important to remember that this is a theoretical model. Apart from being a huge simplification of reality, the model relies on several assumptions. This is important to keep in mind when interpreting the results of this model. For example, the main finding is entirely dependent on the assumption that the public figure has a higher (perceived) ability than any citizen. In addition, the model assumes that social concerns are the main determinant of voting behaviour. If this assumption would be wrong and social concerns only play a minor role or no role at all, there is not directly an obvious reason why citizens would stop sharing information in response to media exposure. Despite these limitations, the model offers an interesting insight in how media might contribute to the recent political developments by hindering communication. Further research could focus on finding empirical evidence for the claim that media hinder communication.

APPENDIX

Proof equation (2):

$$\begin{aligned}
&\kappa\theta_1 + (1-\kappa)\theta_1 E_i\left[\widehat{t}_i^p(0,\ s_{-i},\ m_i,\ m_A)\right] \\
&-(1-\kappa)\theta_2 E_i\left|\widehat{z}_i^p(s_{-i},\ m_i,\ m_A) - \tfrac{1}{2}\right|\left\{1 - E_i\left[\widehat{t}_i^p(0,\ s_{-i},\ m_i,\ m_A)\right]\right\} - c_i^v \\
&= (1-\kappa)\theta_1 E_i\left[\widehat{t}_i^p(0,\ s_{-i},\ m_i,\ m_A)\right] - \kappa\theta_2 E_i\left|\widehat{z}_{-i}^p(s_{-i},\ m_i,\ m_A) - \tfrac{1}{2}\right| \\
&-(1-\kappa)\theta_2 E_i\left|\widehat{z}_i^p(s_{-i},\ m_i,\ m_A) - \tfrac{1}{2}\right|\left\{1 - E_i\left[\widehat{t}_i^p(0,\ s_{-i},\ m_i,\ m_A)\right]\right\} \\
&\kappa\theta_1 - c_i^v = -\kappa\theta_2 E_i\left|\widehat{z}_{-i}^p(s_{-i},\ m_i,\ m_A) - \tfrac{1}{2}\right| \\
&\kappa\theta_1 + \kappa\theta_2 E_i\left|\widehat{z}_{-i}^p(s_{-i},\ m_i,\ m_A) - \tfrac{1}{2}\right| = c_i^v \\
&\kappa\left[\theta_1 + \theta_2 E_i\left|\widehat{z}_{-i}^p(s_{-i},\ m_i,\ m_A) - \tfrac{1}{2}\right|\right] = c_i^v = c*(m_i,\ m_{-i},\ m_A)
\end{aligned}$$

Proof of equation (3):

$$\widehat{\pi}_i^p(s_{-i},\ s_{-i},s_{-i}) = \frac{\pi^2(h^2\alpha + (1-h)^2(1-\alpha)) + \pi\,(1-\pi)\,l\,h\,\alpha + \pi\,(1-\pi)(1-l)(1-h)(1-\alpha)}{\pi^2(h^2\alpha + (1-h)^2(1-\alpha)) + 2\pi\,(1-\pi)\,l\,h\,\alpha + 2\pi\,(1-\pi)(1-l)(1-h)(1-\alpha) + (1-\pi)^2(l^2\alpha + (1-l)^2(1-\alpha))}$$

$$\widehat{\pi}_i^p(s_{-i},\ -s_{-i},s_{-i}) \\ = \frac{\pi^2(h\,(1-h)\,\alpha + (1-h)\,h\,(1-\alpha)) + \pi\,(1-\pi)\,l\,(1-h)\,\alpha + \pi\,(1-\pi)(1-l)\,h\,(1-\alpha)}{\pi^2(h\,(1-h)\,\alpha + (1-h)\,h\,(1-\alpha)) + 2\pi(1-\pi)\,l\,(1-h)\,\alpha + 2\pi(1-\pi)(1-l)\,h\,(1-\alpha) + (1-\pi)^2(l\,(1-l)\,\alpha + (1-l)\,l\,(1-\alpha))}$$

$$\widehat{\pi}_i^p(s_{-i},\ s_{-i},-s_{-i}) = \frac{\pi^2(h^2(1-\alpha) + (1-h)^2\alpha) + \pi\,(1-\pi)\,l\,h\,(1-\alpha) + \pi\,(1-\pi)(1-l)(1-h)\,\alpha}{\pi^2(h^2(1-\alpha) + (1-h)^2\alpha) + 2\pi\,(1-\pi)\,l\,h\,(1-\alpha) + 2\pi\,(1-\pi)(1-l)(1-h)\,\alpha + (1-\pi)^2(l^2(1-\alpha) + (1-l)^2\alpha)}$$

$$\widehat{\pi_i^p}(s_{-i}, -s_{-i}, -s_{-i}) = \frac{\pi^2(h(1-h)(1-\alpha) + (1-h)h\alpha) + \pi(1-\pi)\,l\,(1-h)(1-\alpha) + \pi(1-\pi)(1-l)\,h\,\alpha}{\pi^2(h(1-h)(1-\alpha) + (1-h)h\alpha) + 2\pi(1-\pi)\,l\,(1-h)(1-\alpha) + 2\pi(1-\pi)(1-l)\,h\,\alpha + (1-\pi)^2(l(1-l)(1-\alpha) + (1-l)\,l\,\alpha)}$$

We can show that $\widehat{\pi_i^p}(s_{-i}, s_{-i}, s_{-i}) > \widehat{\pi_i^p}(s_{-i}, -s_{-i}, -s_{-i}) > \widehat{\pi_i^p}(s_{-i}, s_{-i}, -s_{-i}) > \widehat{\pi_i^p}(s_{-i}, -s_{-i}, s_{-i})$

Proof of equation (4):

$$\widehat{z_i}(1,1,1) = \frac{(\pi h + (1-\pi)l)^2\alpha}{(\pi h + (1-\pi)l)^2\alpha + (1-(\pi h + (1-\pi)l))^2(1-\alpha)}$$

$$\widehat{z_i}(1,-1,1) = \frac{(\pi h + (1-\pi)l)(1-(\pi h + (1-\pi)l))\alpha}{(\pi h + (1-\pi)l)(1-(\pi h + (1-\pi)l))\alpha + (1-(\pi h + (1-\pi)l))(\pi h + (1-\pi)l)(1-\alpha)}$$

$$\widehat{z_i}(1,1,-1) = \frac{(\pi h + (1-\pi)l)^2(1-\alpha)}{(\pi h + (1-\pi)l)^2(1-\alpha) + (1-(\pi h + (1-\pi)l))^2\alpha}$$

$$\widehat{z_i}(1,-1,-1) = \frac{(\pi h + (1-\pi)l)(1-(\pi h + (1-\pi)l))(1-\alpha)}{(\pi h + (1-\pi)l)(1-(\pi h + (1-\pi)l))(1-\alpha) + (1-(\pi h + (1-\pi)l))(\pi h + (1-\pi)l)\alpha}$$

$$\widehat{z_i}(-1,-1,-1) = \frac{(1-(\pi h + (1-\pi)l))^2(1-\alpha)}{(1-(\pi h + (1-\pi)l))^2(1-\alpha) + (\pi h + (1-\pi)l)^2\alpha}$$

$$\widehat{z_i}(-1,1,-1) = \frac{(1-(\pi h + (1-\pi)l))(\pi h + (1-\pi)l)(1-\alpha)}{(1-(\pi h + (1-\pi)l))(\pi h + (1-\pi)l)(1-\alpha) + (\pi h + (1-\pi)l)(1-(\pi h + (1-\pi)l))\alpha}$$

$$\widehat{z_i}(-1,-1,1) = \frac{(1-(\pi h + (1-\pi)l))^2\alpha}{(1-(\pi h + (1-\pi)l))^2\alpha + (\pi h + (1-\pi)l)^2(1-\alpha)}$$

$$\widehat{z_i}(-1,1,1) = \frac{(1-(\pi h + (1-\pi)l))(\pi h + (1-\pi)l)\alpha}{(1-(\pi h + (1-\pi)l))(\pi h + (1-\pi)l)\alpha + (\pi h + (1-\pi)l)(1-(\pi h + (1-\pi)l))(1-\alpha)}$$

We can show that

$$\widehat{z_i}(1,1,1) > \widehat{z_i}(1,-1,1) = \widehat{z_i}(-1,1,1) > \widehat{z_i}(-1,-1,1) > \widehat{z_i}(1,1,-1)$$
$$> \widehat{z_i}(1,-1,-1) = \widehat{z_i}(-1,1,-1) > \widehat{z_i}(-1,-1,-1)$$

The expected payoff from pride, avoiding shame, and voting cost, when choosing $m_i = 1$ equals

If $s_A = 1$

$$\begin{aligned}
&Pr(s_{-i} = 1|s_i = 1)\,\tfrac{c*(1,1,1)}{c}\,(\kappa\theta_1 + (1-\kappa)\theta_1\widehat{t_i^p}(0,1,1,1) - (1-\kappa)\theta_2|\widehat{z_i^p}(1,1,1) - \tfrac{1}{2}|[1-\widehat{t_i^p}(0,1,1,1)] - \tfrac{1}{2}c*(1,1,1))\\
&+ Pr(s_{-i} = 1|s_i = 1)\,(1 - \tfrac{c*(1,1,1)}{c})((1-\kappa)\theta_1\widehat{t_i^p}(0,1,1,1) - \kappa\theta_2|\widehat{z_i^p}(1,1,1) - \tfrac{1}{2}| - (1-\kappa)\theta_2|\widehat{z_i^p}(1,1,1) - \tfrac{1}{2}|[1-\widehat{t_i^p}(0,1,1,1)])\\
&+ Pr(s_{-i} = -1|s_i = 1)\,\tfrac{c*(1,-1,1)}{c}\,(\kappa\theta_1 + (1-\kappa)\theta_1\widehat{t_i^p}(0,-1,1,1) - (1-\kappa)\theta_2|\widehat{z_i^p}(-1,1,1) - \tfrac{1}{2}|[1-\widehat{t_i^p}(0,-1,1,1)] - \tfrac{1}{2}c*(1,-1,1))\\
&+ Pr(s_{-i} = -1|s_i = 1)\,(1 - \tfrac{c*(1,-1,1)}{c})((1-\kappa)\theta_1\widehat{t_i^p}(0,-1,1,1)) - \kappa\theta_2|\widehat{z_i^p}(-1,1,1) - \tfrac{1}{2}| - (1-\kappa)\theta_2|\widehat{z_i^p}(-1,1,1) - \tfrac{1}{2}|[1-\widehat{t_i^p}(0,-1,1,1)])
\end{aligned}$$

If $s_A = -1$

$$\begin{aligned}
&Pr(s_{-i} = 1|s_i = 1)\,\tfrac{c*(1,1,-1)}{c}\,(\kappa\theta_1 + (1-\kappa)\theta_1\widehat{t_i^p}(0,1,1,-1) - (1-\kappa)\theta_2|\widehat{z_i^p}(1,1,-1) - \tfrac{1}{2}|[1-\widehat{t_i^p}(0,1,1,-1)] - \tfrac{1}{2}c*(1,1,-1))\\
&+ Pr(s_{-i} = 1|s_i = 1)\,(1 - \tfrac{c*(1,1,-1)}{c})((1-\kappa)\theta_1\widehat{t_i^p}(0,1,1,-1) - \kappa\theta_2|\widehat{z_i^p}(1,1,-1) - \tfrac{1}{2}| - (1-\kappa)\theta_2|\widehat{z_i^p}(1,1,-1) - \tfrac{1}{2}|[1-\widehat{t_i^p}(0,1,1,-1)])\\
&+ Pr(s_{-i} = -1|s_i = 1)\,\tfrac{c*(1,-1,-1)}{c}\,(\kappa\theta_1 + (1-\kappa)\theta_1\widehat{t_i^p}(0,-1,1,-1) - (1-\kappa)\theta_2|\widehat{z_i^p}(-1,1,-1) - \tfrac{1}{2}|[1-\widehat{t_i^p}(0,-1,1,-1)] - \tfrac{1}{2}c*(1,-1,-1))
\end{aligned}$$

$$+Pr(s_{-i} = -1|s_i = 1)\ (1 - \tfrac{c*(1,-1,-1)}{c})((1-\kappa)\theta_1 \widehat{t_i^p}(0,-1,1,-1)) - \kappa\theta_2|\widehat{z_i^p}(-1,1,-1) - \tfrac{1}{2}| - (1-\kappa)\theta_2|\widehat{z_i^p}(-1,1,-1) - \tfrac{1}{2}|[1 - \widehat{t_i^p}(0,-1,1,-1)])$$

The expected payoff from pride, avoiding shame, and voting cost, when choosing $m_i = -1$ equals

If $s_A = 1$

$$Pr(s_{-i} = 1|s_i = 1)\ \tfrac{c*(-1,1,1)}{c}\ (\kappa\theta_1 + (1-\kappa)\theta_1 \widehat{t_i^p}(0,1,-1,1) - (1-\kappa)\theta_2|\widehat{z_i^p}(1,-1,1) - \tfrac{1}{2}|[1 - \widehat{t_i^p}(0,1,-1,1)] - \tfrac{1}{2}c*(-1,1,1))$$

$$+Pr(s_{-i} = 1|s_i = 1)\ (1 - \tfrac{c*(-1,1,1)}{c})((1-\kappa)\theta_1 \widehat{t_i^p}(0,1,-1,1) - \kappa\theta_2|\widehat{z_i^p}(1,-1,1) - \tfrac{1}{2}| - (1-\kappa)\theta_2|\widehat{z_i^p}(1,-1,1) - \tfrac{1}{2}|[1 - \widehat{t_i^p}(0,1,-1,1)])$$

$$+Pr(s_{-i} = -1|s_i = 1)\ \tfrac{c*(-1,-1,1)}{c}\ (\kappa\theta_1 + (1-\kappa)\theta_1 \widehat{t_i^p}(0,-1,-1,1) - (1-\kappa)\theta_2|\widehat{z_i^p}(-1,-1,1) - \tfrac{1}{2}|[1 - \widehat{t_i^p}(0,-1,-1,1)] - \tfrac{1}{2}c*(-1,-1,1))$$

$$+Pr(s_{-i} = -1|s_i = 1)\ (1 - \tfrac{c*(-1,-1,1)}{c})((1-\kappa)\theta_1 \widehat{t_i^p}(0,-1,-1,1)) - \kappa\theta_2|\widehat{z_i^p}(-1,-1,1) - \tfrac{1}{2}| - (1-\kappa)\theta_2|\widehat{z_i^p}(-1,-1,1) - \tfrac{1}{2}|[1 - \widehat{t_i^p}(0,-1,-1,1)])$$

If $s_A = -1$

$$Pr(s_{-i} = 1|s_i = 1)\ \tfrac{c*(-1,1,-1)}{c}\ (\kappa\theta_1 + (1-\kappa)\theta_1 \widehat{t_i^p}(0,1,-1,-1) - (1-\kappa)\theta_2|\widehat{z_i^p}(1,-1,-1) - \tfrac{1}{2}|[1 - \widehat{t_i^p}(0,1,-1,-1)] - \tfrac{1}{2}c*(-1,1,-1))$$

$$+Pr(s_{-i} = 1|s_i = 1)\ (1 - \tfrac{c*(-1,1,-1)}{c})((1-\kappa)\theta_1 \widehat{t_i^p}(0,1,-1,-1) - \kappa\theta_2|\widehat{z_i^p}(1,-1,-1) - \tfrac{1}{2}| - (1-\kappa)\theta_2|\widehat{z_i^p}(1,-1,-1) - \tfrac{1}{2}|[1 - \widehat{t_i^p}(0,1,-1,-1)])$$

$$+Pr(s_{-i} = -1|s_i = 1)\ \tfrac{c*(-1,-1,-1)}{c}\ (\kappa\theta_1 + (1-\kappa)\theta_1 \widehat{t_i^p}(0,-1,-1,-1) - (1-\kappa)\theta_2|\widehat{z_i^p}(-1,-1,-1) - \tfrac{1}{2}|[1 - \widehat{t_i^p}(0,-1,-1,-1)] - \tfrac{1}{2}c*(-1,-1,-1))$$

$$+Pr(s_{-i} = -1|s_i = 1)\ (1 - \tfrac{c*(-1,-1,-1)}{c})((1-\kappa)\theta_1 \widehat{t_i^p}(0,-1,-1,-1)) - \kappa\theta_2|\widehat{z_i^p}(-1,-1,-1) - \tfrac{1}{2}| - (1-\kappa)\theta_2|\widehat{z_i^p}(-1,-1,-1) - \tfrac{1}{2}|[1 - \widehat{t_i^p}(0,-1,-1,-1)])$$

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